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Digital Video Broadcasting (DVB);
Multimedia Home Platform (MHP) Specification 1.1.3

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DVB Digital Video Broadcasting

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Contents

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Foreword

This Technical Specification (TS) has been produced by Joint Technical Committee (JTC) Broadcast of the European Broadcasting Union (EBU), Comité Européen de Normalisation ELECtrotechnique (CENELEC) and the European Telecommunications Standards Institute (ETSI).

NOTE: The EBU/ETSI JTC Broadcast was established in 1990 to co-ordinate the drafting of standards in the specific field of broadcasting and related fields. Since 1995 the JTC Broadcast became a tripartite body by including in the Memorandum of Understanding also CENELEC, which is responsible for the standardization of radio and television receivers. The EBU is a professional association of broadcasting organizations whose work includes the co-ordination of its members' activities in the technical, legal, programme-making and programme-exchange domains. The EBU has active members in about 60 countries in the European broadcasting area; its headquarters is in Geneva.

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The Digital Video Broadcasting Project (DVB) is an industry-led consortium of broadcasters, manufacturers, network operators, software developers, regulatory bodies, content owners and others committed to designing global standards for the delivery of digital television and data services. DVB fosters market driven solutions that meet the needs and economic circumstances of broadcast industry stakeholders and consumers. DVB standards cover all aspects of digital television from transmission through interfacing, conditional access and interactivity for digital video, audio and data. The consortium came together in 1993 to provide global standardisation, interoperability and future proof specifications.

0 Introduction

0.1 Purpose

The DVB system already provides a comprehensive toolbox to enable interoperable digital video broadcasting systems based on MPEG-2 standards for various transmission media including satellite, cable, terrestrial and microwave. This toolbox also covers interactive services using different kinds of return channels and further supporting functionalities such as service information and many others.
The Multimedia Home Platform (MHP) adds a technical solution for the user terminal that enables the reception and presentation of applications in a vendor, author and broadcaster neutral framework. Here "neutral" includes scenarios that consider legacy infrastructure. Applications from various service providers will be interoperable with different MHP implementations in an horizontal market, where applications, networks, and MHP terminals can be made available by independent providers.

0.2 Application areas

At the beginning the following application areas are considered - Enhanced Broadcasting, Interactive Broadcasting and Internet Access. Enhanced Broadcasting combines digital broadcast of audio/video services with downloaded applications which can enable local interactivity. It does not need an interaction channel. The application area Interactive Broadcasting enables a range of interactive services associated or independent from broadcast services. This application area requires an interaction channel. The application area of Internet Access is intended for the provisioning of Internet services. It also includes links between those Internet services and broadcast services.

0.3 Profiles

As not all MHP implementations will be able to support all application areas and as there is a further evolution expected over time, different profiles of the MHP are considered. For this release of the MHP specification, profiles are mapped to the above mentioned application areas.

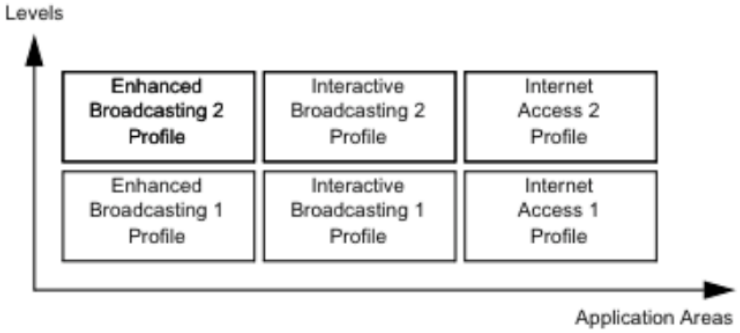

Figure 1: Application areas and levels of profiles

Figure 1 shows six example profiles, derived from two levels for each of the three application areas. The specific definition of the profiles and the particular backward and cross compatibility between profiles is provided in the detailed profile definition clause of the MHP specification. The following initial definitions apply: <profile><n+1> shall be a strict superset of <profile><n>, and Interactive Broadcasting Profile 1is defined as a strict superset of Enhanced Broadcasting Profile 1. Other dependencies are left to the detailed definition of future profiles.

0.4 Aim

The aim of the present document is to encourage implementations of:

- receivers and middleware,
- applications,
- conformance tests.

DVB welcomes feedback from implementers of these. DVB reserves the right to publish a subsequent revision of this document with (possibly significant) changes based on that feedback.

1 Scope

The present document defines the DVB solution for Multimedia Home Platforms (MHPs) that was developed to fulfil the related DVB commercial requirements MHP045. It relies on the use of appropriate DVB specifications for digital video broadcast and associated interactive services TR 101 200 [i.3]. The MHP is applicable to all DVB defined transmission media and networks such as satellite, cable, terrestrial, microwave.

The final DVB MHP solution is intended to cover the whole range of implementations including Integrated Receiver Decoders (IRDs), integrated TV sets, multimedia computers and local clusters of such devices connected via In-Home Digital Networks (IHDN). This first release focuses on single MHP terminals and does not include such local clusters. Clauses 1 to 14 specify the applicable technologies and technical definitions in a generic way. Clause 15 provides detailed profile definitions for the following initial profiles:

- Enhanced Broadcasting 2
- Interactive Broadcasting 2
- Internet Access 2

which can be extended with future additional profile definitions.

The present document is firstly intended for implementers of MHP terminals on various hardware and software platforms. Secondly it is intended for developers of applications that use the MHP functionality and APIs.

The MHP specification aims to ensure interoperability between MHP applications and different MHP implementations. Implementers should consult the publisher of the present document regarding conformance.

NOTE: This specification defines the interfaces visible to applications. Application developers should not assume that other related interfaces are available unless they are specifically listed.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the reference document (including any amendments) applies.
Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE1: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.
NOTE 2: The Java specifications which form the basis of the GEM and MHP specifications are available at http://www.jcp.org. Additional information about Java TV is available at http://java.sun.com/javame/technology/javatv/index.jsp.

Some known errata in these references are identified in annex A "(normative): External references; errata, clarifications and exemptions" on page 414. These errata take precedence over the published reference.

2.1 Normative references

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3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

Application Program Interface (API): interface between an application and a particular feature, function or resource of the MHP

application: a functional implementation realized as software running in one or spread over several interplaying hardware entities

application boundary: a concise general description of the data elements (HTML documents, code files, images etc.) used to form one application and the logical locator of the entry point, the application boundary is described by a regular expression over the URL language

NOTE: Where no such boundary is drawn, the default boundary shall be the entire set of documents that the MHP platform can access.

application instance: a unique invocation of an application, i.e. running the same application twice results in two distinct application instances

application manager: the entity in the MHP that is responsible for managing the lifecycle of the applications in the MHP

NOTE: The application manager manages both the DVB-J applications and non-DVB-J applications.

autostart applications: this term has different definitions depending on the application format:

- A DVB-J autostart application is an application that is automatically loaded and executed by the Application Manager as soon as the user selects a service on which the application is signalled as autostart.
- Auto start application a DVB-HTML application in a broadcast stream can be signalled as auto start in the same way that other DVB applications can.

NOTE: That it may not actually start providing service until it receives a start trigger.

best effort: an implementation dependent approximation which is as close as reasonable in the circumstances concerned to what has been requested

character: a specific "letter" or other identifiable symbol, e.g. "A"

character encoding: a mapping between an integer input value, and the textual character that is represented by this mapping, e.g. in ASCII value 65 (decimal) is character "A", or shift-JIS for Japanese characters

character set: see character encoding

communications network: a system of interconnected entities providing data interchange between points or from a point to multiple points

definite: a resource is considered of indefinite duration if the exact end point is not known in advance of accessing the resource (e.g. Transport Streams in MPEG-2)

NOTE: A resource is considered of definite duration if in principle the exact length is known (e.g. a file resource).

delegated application: an application encoded in a representation that is not directly consumable by an MHP terminal's standard mechanisms

domain of an application: the domain of an Xlet characterizes the "space" within which the Xlet is able to execute

NOTE 1: This includes both the "connection" where the Xlet is delivered and other "connections" where an already executing Xlet is allowed to continue executing.

NOTE 2: An application cannot run outside its domain. The maximum lifetime of an application extends from the moment the user navigates to its domain until the moment that the user navigates away from its domain.

NOTE 3: In the broadcast case a "connection" corresponds to a DVB-service. Broadcast signalling indicates which services can load an application and which services allow an already active application to continue.

DVB network: a collection of MPEG-2 Transport Stream multiplexes transmitted on a single delivery system, e.g. all digital channels on a specific cable system

DVB-HTML actor: the locus of activity or process involved in running the specific set of DVB-HTML documents for some DVB-HTML application, plus any instantiated context for that data

NOTE: The actor runs inside a user agent (native, plug-in or downloaded). The nature of the process is not defined explicitly as it depends on the nature of the user agent itself. More than one such locus of activity may be present in any given user agent.

DVB-HTML application: a set of documents selected from the DVB-HTML family of elements and content formats as defined in the present document

NOTE: The extent of the set is described by the application boundary.

DVB-HTML application states: logical states that a DVB-HTML actor can be in, (as opposed to states the user agent may be in), these states may have instance data logically associated with them (e.g. the application id and entry point)

DVB-HTML document: a complete unit of one the HTML family of elements or content formats defined in the present document

DVB-J: the Java platform defined as part of the MHP specification

DVB-J API: one of the Java APIs standardized as part of the MHP specification

DVB-J application: a set of DVB-J classes that operate together and need to be signalled as a single instance to the Application Manager so that it is aware of its existence and can control its lifetime through a lifecycle interface

events: asynchronous communication between applications and the MHP on which they are being executed, they provide communication between solution elements

font: a mechanism that allows the specific rendering of a particular character to be specified – e.g. Tiresias, 12 point

NOTE: In practice a font file format will incorporate some aspects of a character encoding

function: a process which conveys or transforms data in a predictable way, it may be effected by hardware, software of a combination of the two

hardware entity: an independent piece of hardware which forms part of a (multiple) local cluster of elements which as a whole is called MHP

NOTE: A hardware entity is for example: a Set top box, a digital VCR or a conditional access module. A hardware entity includes a number of resources. Each resource provides a number of functions.

hidden service: a DVB service that shall not be presented to the end-user by the navigator, either in a UI showing the list of available services or in response to the program up / program down keys on conventional remote controls. These are typically be used for video streams that (from the point of view of the end-user) form part of a single service, where creating multiple video streams with a common PCR is impractical. As an additional measure to prevent presentation of individual video (and audio) streams within such a service by anything other than an appropriately authored MHP application, the stream_type private_PES may be used. The mechanism or mechanisms by which a service is identified as being hidden are outside the scope of the present document.

indefinite: see definite

internet access application: an application which is resident on an MHP terminal and used for presenting content from the internet, also referred to as "internet clients" and "internet client applications"

NOTE: Applications which are downloaded to an MHP terminal when required are also covered by this definition only if this downloading process is transparent to any MHP applications. Internet access applications do not include the applications or content obtained from the internet. They are very similar conceptually to a DVB-HTML support application.

inner application: application content that forms part of a larger application and possibly of a different type, for example, an Xlet embedded within an DVB-HTML application

interoperable plug-in: a plug-in that only requires standard MHP APIs

interoperability: the reception and presentation of applications in a vendor, author and broadcaster neutral framework (From MHP45r12)

java API: a standard interface for use by platform independent application software expressed in the Java language

lifetime of an application: characterizes the time from which the application is Loaded to the time the application is Destroyed

locator: this term has different definitions depending on the application format:

- A DVB-HTML locator is a link, expressed in the syntax in RFC 2396 [41], which provides an unambiguous pointer to a DVB-HTML document accessible to the MHP in a specific transport stream. The scheme specified should resolve to one of the available transports signalled for the DVB-HTML application. For signed DVB-HTML applications the schemes http and https (ftp, others?) may use the return channel. This version of the present document does not include a scheme for transport independent locators, future versions are expected to do so.
- This term in the DVB-HTML context should not be confused with the DVB-J class of the same name.

Multimedia Home Platform (MHP): consists of an MHP viewer terminal, including all possible low to high functionality implementations, its associated peripherals and the in-home digital network

MHP connected resource: a resource used as part of the MHP which, on its own, is not conformant to the present document but which is connected to an MHP Terminal in such a way that the whole is part of the MHP

MHP service: a logical service in an MHP which can be selected through the service selection API or functional equivalents

NOTE: This includes broadcast DVB services, stored services and MHP applications executed in response to an AIT file loaded over the interaction channel.

MHP solution: encompasses the whole set of technologies necessary to implement the MHP including protocols and APIs

MHP terminal: a single piece of physical equipment conforming to the MHP specification, in particular in that it contains a Virtual Machine and an instance of the MHP API

native signalling: signalling infrastructure for a delegated application that are not part of an MHP terminal's standard mechanisms

navigator: a resident application, typically provided by the manufacturer, which the end-user can activate at any time

NOTE: The navigator can be used to select services, applications, and initiate Interoperable applications.

object carousel: a repetitively broadcast file system

OID: X.509 Object Identifier

persistent storage: non-volatile memory available in the MHP which can be read/written to by an application and which may outlive the application's own life

plug-in: a set of functionality which can be added to a generic platform in order to provide interpretation of DVB registered, but non-DVB-J, application formats; e.g. HTML3.2 or MHEG-5

profile: a description of a series of minimum configurations, defined as part of the present document, providing different capabilities of the MHP

NOTE: A profile maps a set of functions which characterize the scope of service options. The number of profiles is small. The mapping of functions into resources and subsequently into hardware entities is out of the scope of the present document and is left to manufacturers.

PSI-only service: a MPEG program listed in the PAT of a transport stream but not listed in the SDT or EIT.

regular expression: a method of capturing a large, possibly infinite set of strings in a compact representation

resident application: an application available from non-volatile storage in an MHP device which may be expressed in DVB-J but need not be so

NOTE: Its delivery route is not specified.

resource: is a well defined capability or asset of a system entity, which can be used to contribute to the realization of a service

NOTE: Examples of resources include: MPEG decoder, Graphics system.

return channel: the communications mechanism which provides connection between the MHP and a remote server

running application: an application is considered running if it is in any state other than NOT_LOADED or INVALID

runtime code extension: the ability to extend, at runtime, the executable code of an application with code not originally packaged with the application

NOTE: This facility is provided, for example, by org.dvb.lang.DVBClassLoader in DVB-J and by eval() in ECMAscript.

sandbox: unsigned applications and signed applications without a permission file have access to all the APIs for which there is no permission signalling defined, this is commonly called the sandbox

service: a sequence of programs under the control of a broadcaster which can be broadcast as part of a schedule

service component: a part of a service

NOTE: For a DVB service, service components are normally the MPEG elementary streams listed in the PMT for the service. Where multiple streams of subtitles or MPEG-2 audio representing different languages are carried in the same MPEG elementary stream these are logically service components but are not exposed through the MHP APIs as being distinct and separate.

stand-alone application: an application which is not related to a conventional DVB service

NOTE: In this version of the present document, this includes applications running as part of a stored service and applications whose signalling was carried over the interaction channel.

stream: a unidirectional continuous flow of content, for example, MPEG2 video

stored service: a set of MHP applications stored within the MHP terminal and treated as a service with regard to life cycle, service selection etc.

system software: software implementation below the API for a specific platform entirely under control of the manufacturer

trigger: an event that may cause a change in the behaviour of a DVB-HTML application that registers interest in such events

NOTE: Triggers may come from many sources e.g. the broadcast stream, or may be generated from other data (such as the system clock), or may be generated as a result of user interaction. The trigger may include a reference to time, which may be absolute (UTC), relative to some other event, relative to the NPT of a media stream. It also can carry some semantically significant payload in order to affect changes in an application based on information not available at the time an application was written.

tuning: the act of switching between two MPEG transport streams or multiplexes

NOTE: Switching between two DVB services carried in the same transport stream is not tuning.

viewer: end-user of the MHP terminal

xlet: interface used for DVB-J application life cycle control

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

AIT	Application Information Table
API	Application Programming Interface
AV	Audio Video
AWT	Abstract Windowing Toolkit
CA	Conditional Access
CI	Common Interface
CLUT	Colour LookUp Table
CSS	Cascading Style Sheets
DAVIC	Digital Audio Visual Council
DCT	Discrete Cosine Transformation
DECT	Digital Enhanced Cordless Telecommunications
DOM	Document Object Model
DSM-CC	Digital Storage Media - Command and Control
DSM-CC-OC	Digital Storage Media - Command and Control Object Carousel
DSM-CC-UU	Digital Storage Media - Command and Control User to User
DVB	Digital Video Broadcasting
ECMA	European Computer Manufacturers Association
EPG	Electronic Program Guide
ETSI	European Telecommunications Standards Institute
GIF	Graphics Interchange Format
GSM	Global System for Mobile communications
GUI	Graphical User Interface
HTML	Hyper Text Mark-up Language
HTTP	Hyper Text Transport Protocol
I/O	Input / Output
IHDN	In Home Digital Network
IP	Internet Protocol
IPR	Intellectual Property Rights
IRD	Integrated Receiver Decoder
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
ITU	International Telecommunication Union
JDK	Java Development Kit
JFIF	JPEG File Interchange Format
JMF	Java Media Framework
JPEG	Joint Picture Expert Group

LMDS	Local Multipoint Distribution System
MHEG	Multimedia Hypermedia Expert Group
MHP	Multimedia Home Platform
MMDS	Multipoint Microwave Distribution System
MPEG	Moving Picture Expert Group
OC	Object Carousel
OS	Operating System
OSD	On Screen Display
PFR	Portable Font Resource
PMT	Program Map Table
PNG	Portable Network Graphics
PSI	Program Specific Information
PSTN	Public Switched Telephone Network
RAM	Random Access Memory
ROM	Read Only Memory
SCART	The connector known as "Syndicat des Constructeurs d'Appareils Radiorecepteurs et Televiseurs" also Peritel and Euroconnector and Cenelec EN 50049-1 [i.7].
SI	Service Information
SMATV	Satellite Master-Antenna Television
TCP	Transmission Control Protocol
TS	Transport Stream
UCS	Universal Multiple-Octet Coded Character Set
UDP	User Datagram Protocol
UI	User Interface
URL	Uniform Resource Locator
UTF	UCS Transformation Coding
UU	User to User
VM	Virtual Machine
WAN	Wide Area Network
WSS	Wide Screen Signalling

4 Conventions

Unless otherwise specified, the BNF notation in the present document shall follow the definitions of section 2.1 of RFC 2616 [40].

The text "Void" in a clause title or in a reference designates a clause or reference that existed in a previous version of the present document that has been removed and replaced with "Void" to preserve the numbering of the text that remains.

5 Basic Architecture

5.1 Context

At its simplest level, the MHP is set in the following context (see figure 2). The software of the MHP has access to flows of streams and data, and may write some data to storage. The platform may be able to route streams and data outwards to a sink or store.

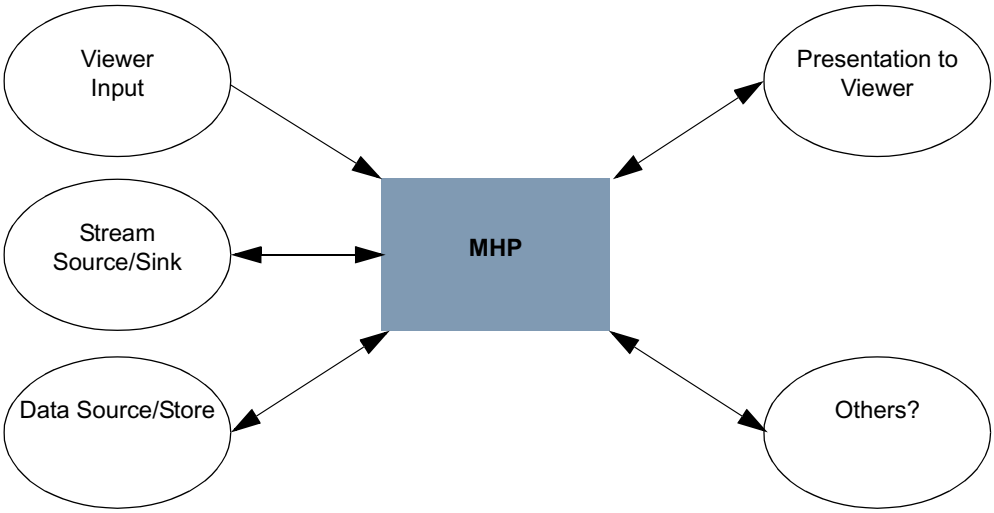


Figure 2: MHP context

The platform will receive inputs from Viewer input devices and output communications through a screen or other outputs like loudspeakers to present to the viewer. The platform may have access to communications with remote entities.

The diagram in figure 3 shows a possible set of external interfaces between an MHP and the outside world. This is one example only but it serves to illustrate a series of principles.

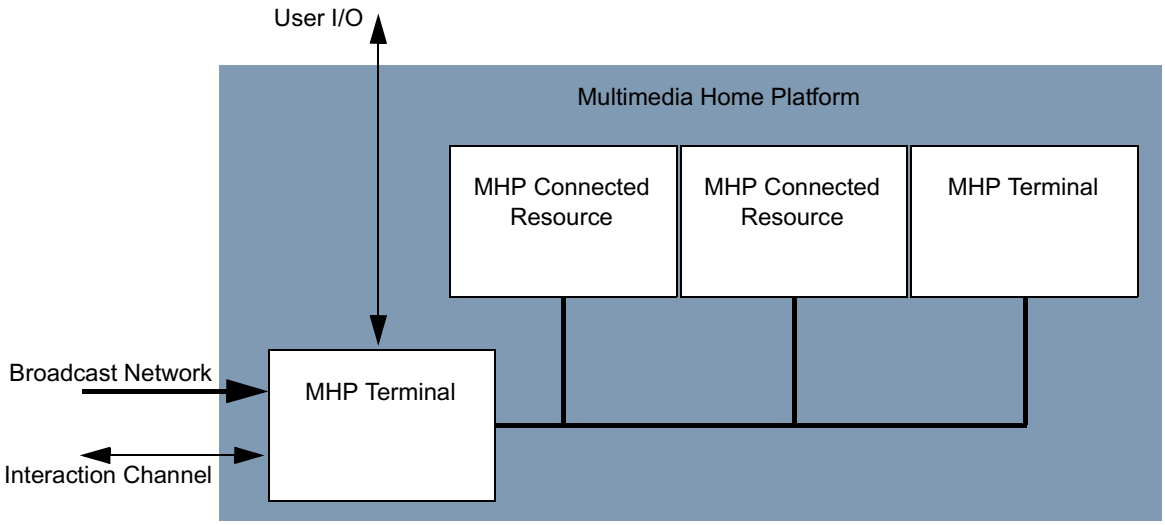


Figure 3: External interfaces between an MHP and the outside world

The resources of the MHP, accessible by an application, may be contained in a series of different but connected physical entities.

The local cluster may connect a number of MHP terminals and resources.

A cluster may also include resources which are not part of the MHP infrastructure and are not available to the application.

The local cluster is understood to be consistent with the DVB IHDN specification. The detailed description of the MHP in the local cluster is not in the first version of the specification.

5.2 Architecture

The Architecture describes how the MHP software elements are organized.

The MHP model considers 3 layers (figure 4):

- Resources.
- System software.
- Applications.

The API lies between the Applications and the System Software seen from the perspective of an application.

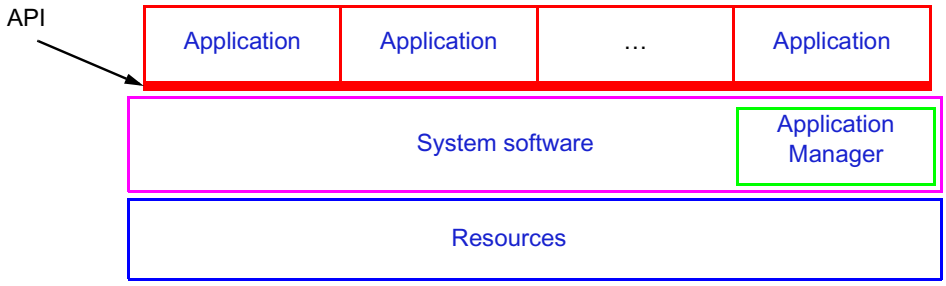


Figure 4: Basic architecture

5.2.1 Resources

The hardware entities in the platform include a number of functions. They are represented by hardware or software resources. There is no assumption about how they are grouped. The model considers that there can be more than one hardware entity in the total Platform.

From an abstract point of view it makes no difference if the logical resources are mapped into one or several hardware entities. What is important is that resources are provided to the MHP transparently. An application should be able to access all locally connected resources as if they were elements of a single entity.

5.2.2 System software

Applications will not directly address resources. The system software brings an abstract view of such resources. This middle layer isolates the application from the hardware, enabling portability of the application.

The implementations of the Resources and System software are not specified in the present document.

5.2.2.1 Application Manager

The system software includes an application management function, which is responsible for managing the lifecycle of all applications, including Interoperable ones.

5.2.3 Application

Applications implement interactive services as software running in one or more hardware entities. The interface for MHP applications is a top view from application to the system software.

Figure 4 illustrates an idealized architecture model of the processes which will occur in an MHP. A hierarchy of control is assumed in which each layer controls the processes in adjacent layers. The top layer is responsible for the control of the operation via interactive applications. The Application Manager is part of the System Software and as such is implementation specific. It interacts with all applications.

The System Software implements the API by presenting an abstract model of:

- Streams played from different sources and pipes for conducting them.
- Commands and events.
- Data records or files.
- The hardware resources.

The API provides the associated services to applications.

In fact there are many APIs which implement distinct services and interfaces. These are described in detail in the present document, either by reference to external documents, or by detailed specification.

The present document describes the interfaces between the network, the application and the system software of the MHP terminal. The implementation of any of these three is not specified in the present document.

5.3 Interfaces Between an MHP Application and the MHP System

Application(s) use the API to access the actual resources of the receiver, including: databases, streamed media decoders, static content decoders and communications. These resources are functional entities of the receiver and may be finally mapped onto the hardware of the receiver in some manner.

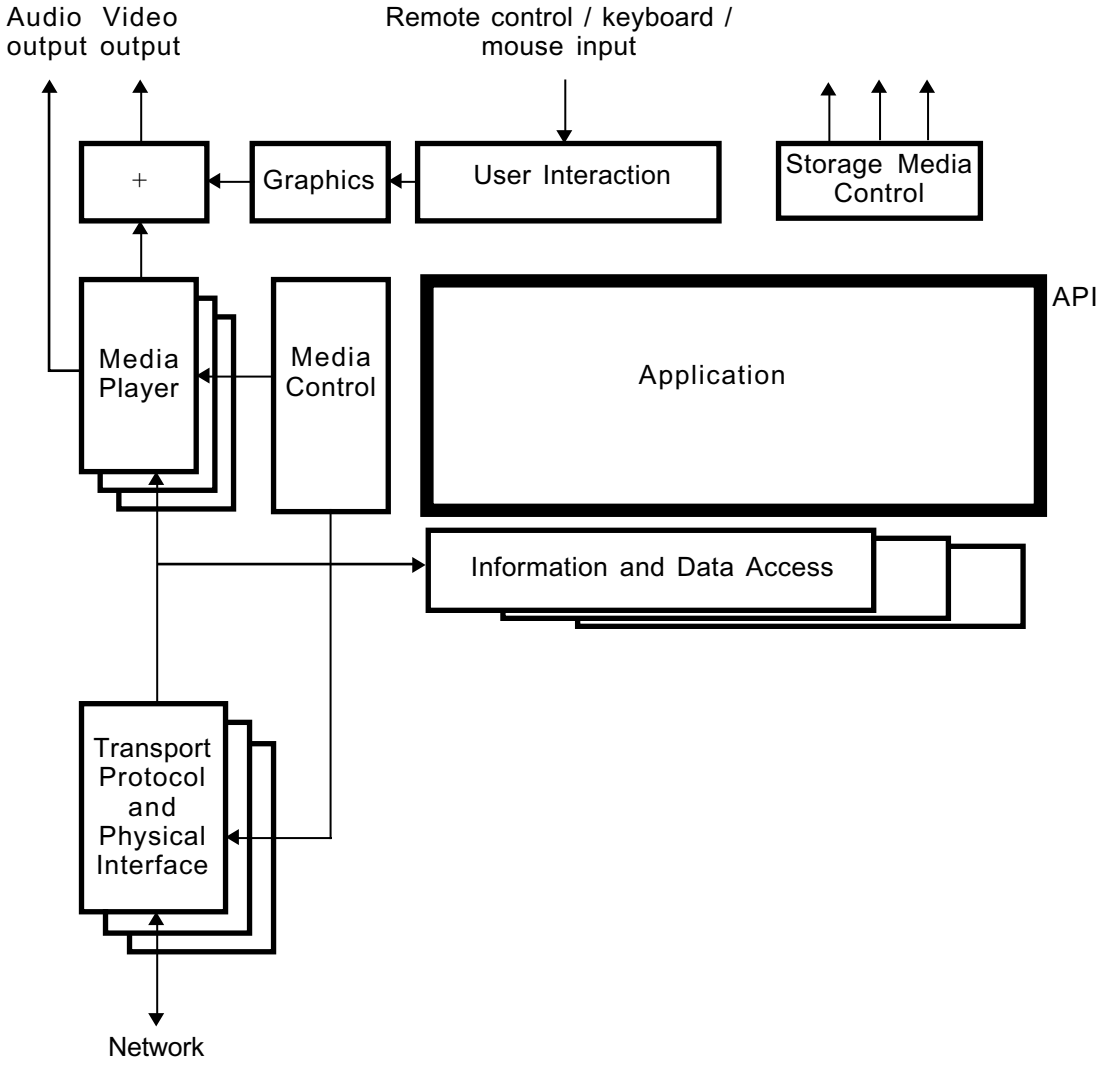


Figure 5: Interfaces between an MHP application and the MHP system

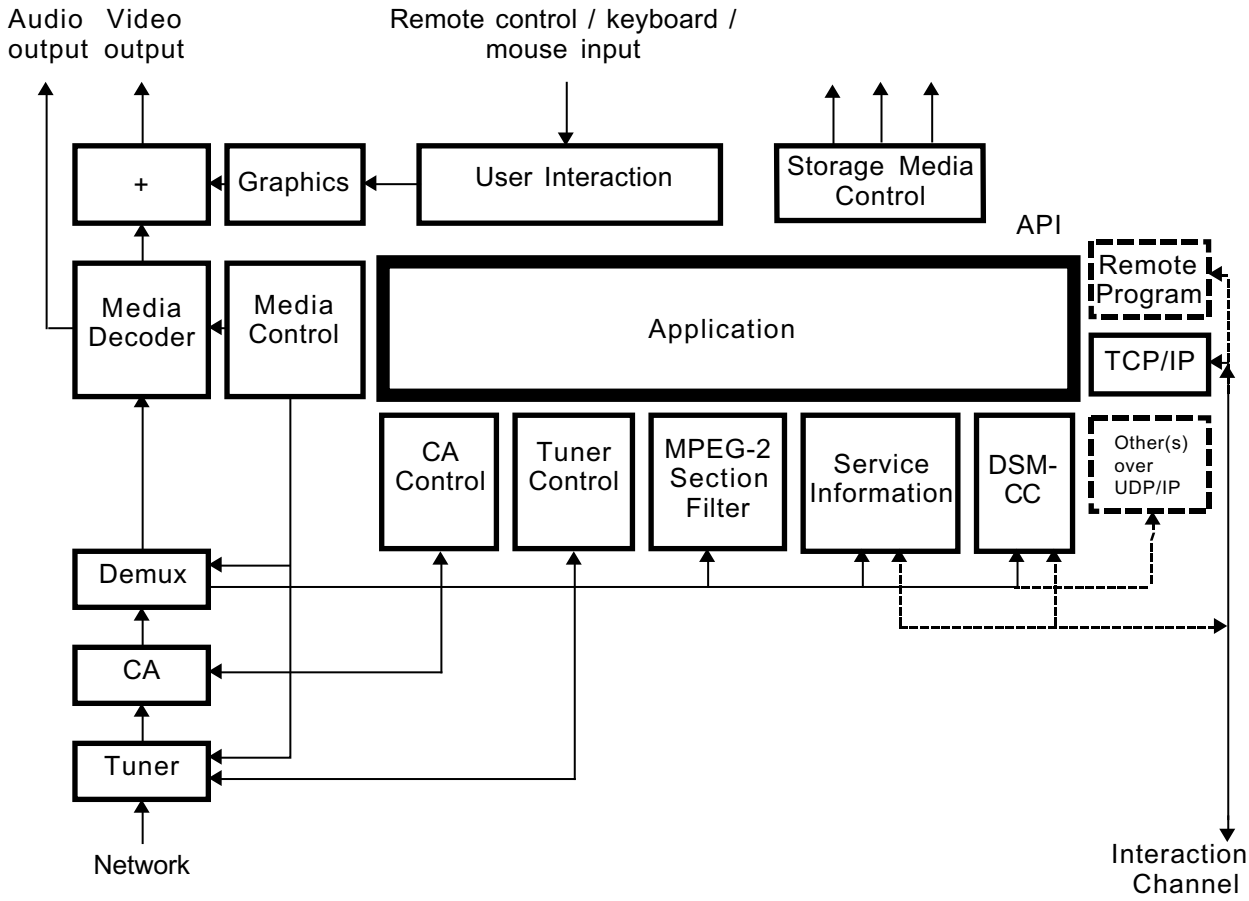


Figure 6: Interfaces between an MHP application and the MHP system with more details

The diagrams in figure 5 and figure 6 show these interfaces and their relationships to media and information flows within an MHP system - excluding any local cluster issues. The first diagram shows a generic MHP, the second a specific instance of an enhanced broadcast or interactive TV profile system, with optional additions shown.

In figure 5 and figure 6, only the border between the application and the rest of the system is in the scope of the present document. All the rest of each diagram is implementation dependent and shown for information purposes only.

5.4 Plug-ins

A "plug-in" is a set of functionality that can be added to a generic platform in order to provide interpretation of application and content formats not specified by the present document to be included in MHP terminals.

NOTE: Those organizations concerned with interoperation between the standard MHP platform and other platforms need to specify the plug-in properly for such platforms.

The choice of which plug-ins to use must be in the hands of the end-user in order that he can have a choice of sources of service. This option can be exercised in a number of ways, including the purchase of equipment with "built-in" plug-in functionality, the positive selection of a download, or the automatic selection of a download where there is no memory resource limitation.

The plug-in may stay resident where the design of the platform implementation allows. The MHP including the plug-in must behave, once the plug-in is loaded and operational, in the same way as a platform supporting the format of the delegated applications without the use of a plug-in.

Figure 7 illustrates the position of two types of Plug-in in the MHP.

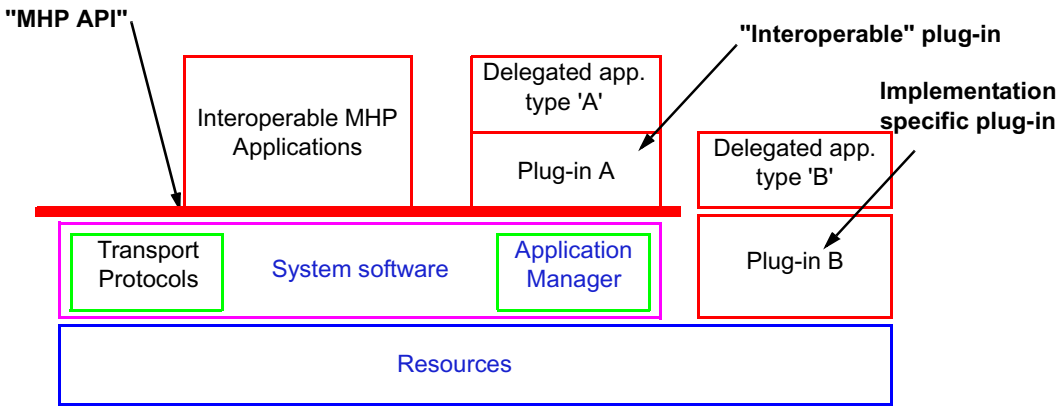


Figure 7: Illustrative plug-in implementation options

There are two possible types of Plug-in implementation:

- Using implementation-specific code (e.g. in native code, or using implementation-specific Java APIs). This is called an implementation- specific plug-in, illustrated as plug-in "B" in the figure.
- An MHP application. This is called an interoperable plug-in, illustrated as plug-in "A" in the figure.

The internal specification of both plug-ins ("A" and "B") is outside of the scope of the present document. They are illustrated to show their relationship to the platform.

There are two varieties of inter-operable plug-ins depending on the signalling used for the delegated applications.

- Ones which work with delegated applications signalled with MHP signalling and which implement `org.dvb.application.plugins.Plugin`. These delegated applications are visible to the MHP receiver and are managed by the MHP application manager.
- Ones which work with delegated applications signalled with native signalling and only look like an MHP application to the MHP receiver. These do not implement the plug-in interface. These delegated applications are invisible to the MHP receiver and totally managed by the plug-in.

5.4.1 Security Model

Plug-ins must have sufficient access to the resources in the platform to implement the specification concerned. An implementation-specific plug-in may have access to many of the resources of the platform irrespective of the MHP security model. All plug-ins are responsible for managing the security of the applications they execute.

If a plug-ins needs privileged access to resources not available to all downloaded applications (i.e. not in the "sand box") in order to provide equivalent function to the "legacy" supported they will require the appropriate authentication.

6 Transport Protocols

6.1 Introduction

In order to be able to talk to the external world, the MHP has to be able to communicate through different network types. This part of the MHP specification deals with the Network Independent Protocols and on the networks as defined in two specifications from the DVB project, as specified in ETS 300 802 [16] and EN 301 192 [5].

The protocols defined in these standards provide a generic solution for a variety of broadcast only and interactive services, through the use of DSM-CC User-to-User, Data and Object Carousel protocols, as specified in ISO/IEC 13818-6 [26] and support for IP over the interaction channel as well as over the broadcast channel through the Multiprotocol Encapsulation EN 301 192 [5].

Broadcast only services are provided on systems consisting of a downstream channel from the Service Providers to Service consumers.

Interactive services are provided on systems consisting of a downstream channel together with interaction channels.

There are many possible network configurations covering the currently specified DVB broadcast options including satellite, terrestrial, cable, SMATV and MMDS in conjunction with PSTN, ISDN, cable and other interactive channel options.

The network dependent protocols for the interaction channels in the DVB context are specified in ETS 300 800 [14], ETS 300 801 [15], EN 301 193 [6], EN 301 195 [7], EN 301 199 [8], TR 101 201 [i.4], EN 301 790 [82] respectively for CATV, PSTN/ISDN, DECT, GSM, LMDS, SMATV and satellite networks. The network dependent protocols work together with the Network Independent Protocols.

6.2 Broadcast Channel Protocols

This clause deals with the DVB defined or referenced broadcast channel protocols. This clause does not consider other protocols and the APIs that would provide access to them.

Other protocols and their APIs are considered as extensions to the DVB MHP platform, see annex H "(normative): Extensions" on page 551.

Figure 8 illustrates the set of DVB defined broadcast protocols that are accessible by MHP applications in some or all profiles (see clause 15 "Detailed platform profile definitions" on page 404). The full details of the APIs that provide access to these broadcast protocols are in clause 11 "DVB-J Platform" on page 261.

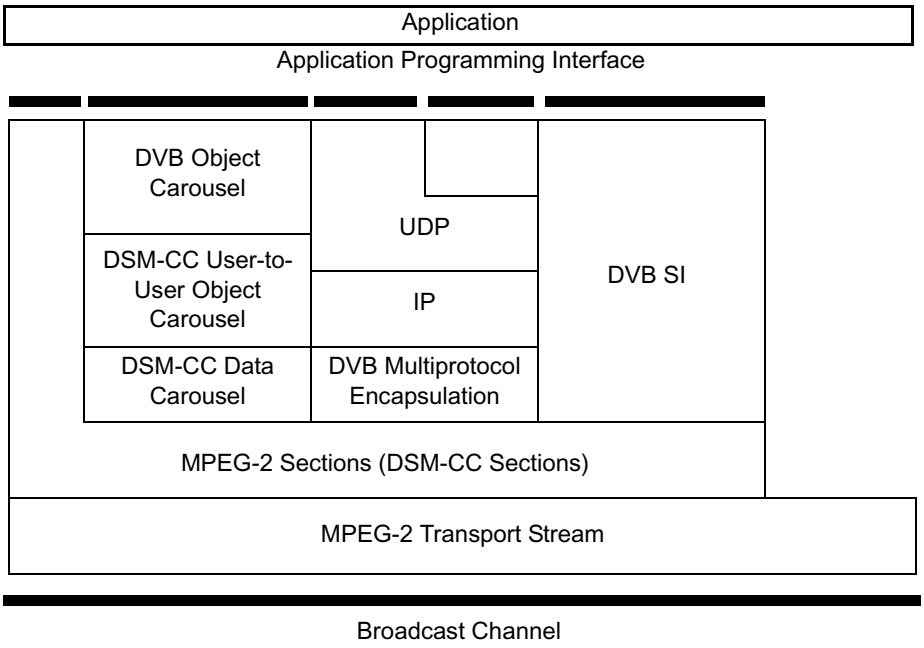


Figure 8: Broadcast Channel Protocol Stack

Except in the case of MPEG-2 sections (see clause 6.2.2 "MPEG-2 Sections" on page 60), when an MHP application attempts to access conditional access scrambled data through one of these broadcast channel protocols, the MHP terminal shall attempt to initiate descrambling of this data without the application needing to explicitly ask for it. Attempts to access conditional access scrambled data at the level of MPEG-2 sections shall not happen without the application explicitly asking for this.

6.2.1 MPEG-2 Transport Stream

MPEG-2 Transport Stream is defined in ISO/IEC 13818-1 [23].

6.2.2 MPEG-2 Sections

MPEG-2 private sections as defined in ISO/IEC 13818-1 [23] is based on the MPEG-2 Transport Stream protocol in clause 6.2.1.

6.2.3 DSM-CC Private Data

DSM-CC Private Data protocol as defined in ISO/IEC 13818-6 [26].

6.2.4 DSM-CC Data Carousel

DSM-CC Data Carousel as defined in ISO/IEC 13818-6 [26].

6.2.5 DSM-CC User-to-User Object Carousel

DSM-CC User-to-User Object Carousel protocols as defined in ISO/IEC 13818-6 [26] with the restrictions and extensions as defined in EN 301 192 [5], TR 101 202 [i.5] and annex B "(normative): Object carousel" on page 476.

6.2.5.1 Void

6.2.5.2 Void

6.2.5.3 Loss of Carousel Behaviour

Under some conditions, carousel data streams servicing broadcast file systems may become unavailable. The conditions for permanent loss of carousel are defined in clause B.2.9 "Unavailability of a carousel" on page 506. The conditions for temporary disconnection and reconnection of carousel are defined in clause 9.1.5 "Persistence of Applications Across Service Boundaries" on page 192.

When this happens, implementations may continue to provide data from carousels which have been lost where they have that data cached. The extent of this is clearly implementation dependent (but limited by clause B.5). It is also implementation dependent how this changes with time. Permanently lost carousels shall never be restored automatically. Temporary disconnections and reconnections are automatic and are largely invisible to the application. However, implementations must preserve Java IO semantics. For example, the `InputStream.available()` method should accurately report the number of bytes available without blocking.

Data not in such a cache shall be unavailable to applications. When applications attempt to access unavailable data from permanently lost carousels, the operation shall fail. The failure mode shall be one appropriate to the content format and the mechanism being used to access the data.

Failure modes for DVB-J applications are defined in clause 11.5.1.3 "Behaviour following loss of a broadcast carousel" on page 280.

When an application attempts to access unavailable data from a temporarily disconnected carousel, the operation shall block until the data becomes available, or it is interrupted. This includes any operations that indirectly cause synchronous loading operations, as stated in clause 11.5.1.1 "Constraints on the java.io.File methods for broadcast carousels" on page 279.

Upon reconnection to a carousel, the system shall start fetching any outstanding data. Any blocked I/O operations shall return once the data is received.

A temporarily disconnected service may become permanently lost if the system determines that the loss of connection is irrecoverable - as stated in annex P "(normative): Broadcast Transport Protocol Access" on page 746, org.dvb.dsmcc.ServiceDomain. The cases in which this may occur are:

- The carousel becomes permanently unavailable, as stated in clause B.2.9 "Unavailability of a carousel" on page 506.
- The period since the carousel became disconnected is at least 60 seconds.

If this occurs, any blocked I/O operations shall terminate with `InterruptedIOException` and the `ServiceDomain` shall enter the detached state. An implementation may choose to use longer timeouts other strategies to determine when to permanently lose carousels, within the constraints listed above. For example, boot carousels for running applications may be kept in preference to carousels mounted by applications.

6.2.6 DVB Multiprotocol Encapsulation

DVB Multiprotocol Encapsulation as defined in EN 301 192 [5] provides support for IP and is based on the DSM-CC Private Data protocol. This specification only defines support for carriage of multicast IP in MPE and not support for carriage of unicast IP.

6.2.7 Internet Protocol (IP)

Internet Protocol as defined in RFC 791 [43].

6.2.8 User Datagram Protocol (UDP)

User Datagram Protocol as defined in RFC 768 [42].

6.2.9 DVB Service Information

DVB Service Information as defined in EN 300 468 [4] and TR 101 211 [i.2]

6.2.10 IP signalling

IP Notification Table (INT) as defined in EN 301 192 [5].

6.3 Interaction Channel Protocols

This clause deals with the DVB defined or referenced interaction channel protocols. This clause does not consider other protocols and the APIs that would provide access to them. Other private protocols and possibly APIs are not precluded and are outside of the scope of the MHP.

Figure 9 illustrates the set of DVB defined interaction channel protocols that are accessible by MHP applications in some or all profiles (see clause 15 "Detailed platform profile definitions" on page 404). The full details of the APIs that provide access to these interaction protocols are in clause 11 "DVB-J Platform" on page 261.

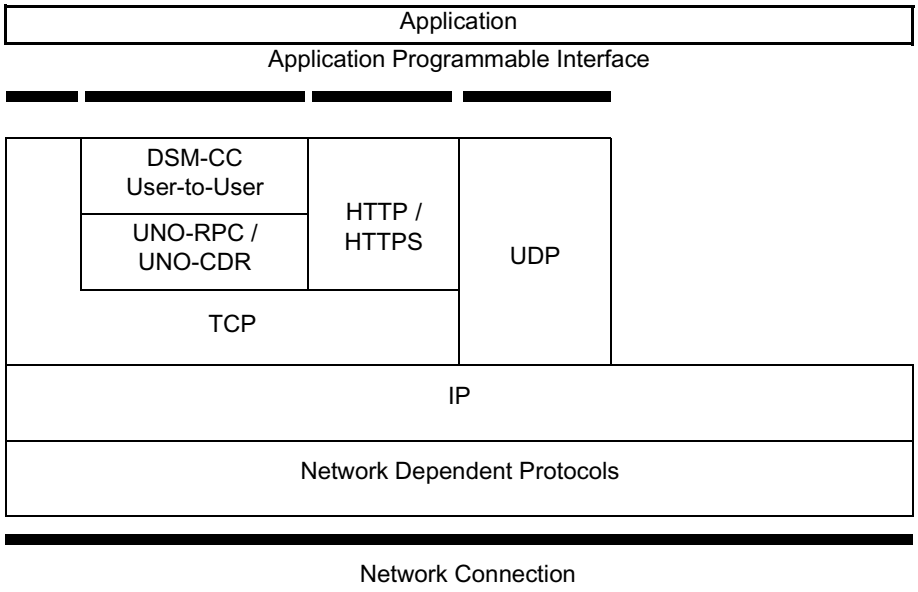


Figure 9: Interaction Channel Protocol Stack

6.3.1 Network Dependent Protocols

As defined in ETS 300 800 [14], ETS 300 801 [15], EN 301 193 [6], EN 301 195 [7], EN 301 199 [8], TR 101 201 [i.4], EN 301 790 [82] respectively for CATV, PSTN/ISDN, DECT, GSM, LMDS SMATV and satellite networks.

For connection based interaction channels, the PPP protocol is used as defined in RFC 1332 [88], RFC 1661 [89], RFC 1717 [90]. Network supplied DNS server addresses shall be supported as in RFC 1877 [87].

6.3.2 Internet Protocol (IP)

Internet Protocol as defined in RFC 791 [43].

6.3.3 Transmission Control Protocol (TCP)

Transmission Control Protocol as defined in RFC 793 [44].

6.3.4 UNO-RPC

The UNO-RPC consists of the Internet Inter-ORB Protocol (IIOP) as specified in CORBA/IIOP [2].

6.3.5 UNO-CDR

The UNO-CDR as defined in CORBA/IIOP [2].

6.3.6 DCM-CC User to User

DSM-CC User-to-user as defined in ISO/IEC 13818-6 [26] with the restrictions and extensions as defined in EN 301 192 [5] and TR 101 202 [i.5].

6.3.7 Hypertext Transfer Protocol (HTTP)

6.3.7.1 HTTP 1.1

Hypertext Transfer Protocol as defined in RFC 2616 [40].

6.3.7.2 MHP profile of HTTP 1.0

HTTP 1.0 is defined in RFC 1945 [92]. MHP terminals supporting HTTP 1.0 are required to support persistent connections as defined below. MHP terminals implementing profiles where HTTP 1.0 is required are also allowed to implement subsequent versions of the HTTP specification (e.g. HTTP 1.1, RFC 2616 [40]) as long as these are backwards compatible and persistent connections or their equivalent in the subsequent version of the specification are supported.

With no support for persistent connections, a separate TCP connection has to be established to fetch each URL, increasing the load on HTTP servers and causing congestion. The use of multiple separate image files and other associated data, for example often require a client to make multiple requests to the same server in a short amount of time. Therefore an MHP terminal implementation shall include support for persistent connections.

The following section explains how persistent connection is to be used within the MHP. The original form of HTTP 1.0 persistent connections is defined as informational text in RFC 2068 [11]. The normative specification text included here is intended to be fully compatible with this RFC.

6.3.7.2.1 HTTP 1.0 persistent connections

When connecting to a server, an MHP terminal shall send the Keep-Alive connection-token:

```
Connection: Keep-Alive
```

An HTTP server (1.0 or 1.1) would then respond with the Keep-Alive connection token and the client may proceed with an HTTP 1.0 (Keep-Alive) persistent connection.

6.3.7.2.2 The Keep-Alive Header

When the Keep-Alive connection-token has been transmitted with a request or a response, a Keep-Alive header field may also be included. The Keep-Alive header field takes the following form:

```
Keep-Alive-header = "Keep-Alive" ":" 0# keepalive-param
keepalive-param = param-name "=" value
```

where the "0#" notation means that the "keepalive-param" field may be repeated 0 or more times and they are separated by a comma character "," if the field is included more than once.

The Keep-Alive header itself is optional, and is used only if a parameter is being sent. The present document does not define any parameters.

If the Keep-Alive header is sent, the corresponding connection token must be transmitted. The Keep-Alive header must be ignored if received without the connection token.

6.3.7.2.3 MHP and proxies

An MHP terminal must not send the Keep-Alive connection token to a HTTP 1.0 proxy server, as HTTP 1.0 proxy servers do not obey the rules of HTTP 1.1 for parsing the Connection header field.

If an MHP terminal sends Keep-Alive to a proxy server that doesn't understand Connection, which would then erroneously forward it to the next inbound server, which would establish the Keep-Alive connection and result in a hung HTTP 1.0 proxy waiting for the close on the response. The result is that the MHP terminal must be prevented from using Keep-Alive when talking to proxies that doesn't understand Connection.

6.3.7.2.4 Version compatibility

An HTTP 1.1 server may also establish persistent connections with an MHP terminal upon receipt of a Keep-Alive connection token. However, a persistent connection with an MHP terminal can't make use of the chunked transfer coding, and therefore MUST use a content-length for marking the ending boundary of each message.

For servers used for MHP applications, it is recommended that if HTTP 1.1 servers are used, they should support the HTTP 1.0 persistent connections when initiated by an HTTP 1.0 client using the Keep-Alive connection token.

6.3.7.3 HTTPS

This is described in RFC 2818 [112].

6.3.8 Void

6.3.9 User Datagram Protocol (UDP)

User Datagram Protocol as defined in RFC 768 [42].

6.3.10 DNS

MHP terminals shall implement at least the DNS resolver protocols that enable forward translation of fully qualified domain names to IP addresses as defined by RFC 1034 [83] and RFC 1035 [75] and clarified by RFC 1982 [85] and RFC 2181 [86].

In connection based return channels, where DNS server addresses are provided both from the network as part of connection setup and from an MHP application, those provided from the network shall take precedence.

6.4 Transport protocols for application loading over the interaction channel

Three scenarios are envisaged:

- The file system is completely implemented in the broadcast channel (the classic MHP 1.0 model which is not described further here).
- File system implemented only via the interaction channel.
- Hybrid between broadcast stream and interaction channel.

6.4.1 File system implemented only via the interaction channel

This clause addresses the case where the interaction channel presents the only file system i.e. where the protocol ID is 0x0003.

6.4.1.1 File system logical structure

The list of items signalled in the transport protocol descriptor(s) (see clause 10.8.1.3 "Transport via interaction channel" on page 240) are considered to form a single name space.

The MHP terminal when trying to locate a file specified by an incomplete (relative) filename, shall attempt to fetch a file from each of the items in that list in the order in which they are found in the list until the file is found or the list is exhausted.

The items in the list shall either be references to .zip files (see ZIP [91]) or base URLs ending in /' onto which the path of the requested file shall be concatenated. Any items in the list which are not one of these two types shall be ignored. Errors in discovering whether a specific file can be reached through a specific list item shall be ignored. The list must contain at least one item.

As an example, consider the MHP platform retrieving the "dvb.fontindex" file for an application from an which AIT includes two transport protocol descriptors with the following contents;

Table 1: Example transport descriptor selector byte payload

URL base	URL extension
"http://www.dvb.org"	"applications/application1.zip"
	"graphics/"
	"shared/utils.zip"
"http://www.ebu.ch"	"general/misc.zip"
"http://www.dvb.org"	"other_stuff/we_dont_use_this_very_often.zip"

Then the search order for "dvb.fontindex" would be the following:

a) In the contents of http://www.dvb.org/applications/application1.zip.

b) From the URL http://www.dvb.org/graphics/dvb.fontindex.

c) In the contents of http://www.dvb.org/shared/utils.zip.

d) In the contents of http://www.ebu.ch/general/misc.zip.

e) In the contents of http://www.dvb.org/we_dont_use_this_very_often.zip.

The search order for "abc/dvb.hashfile" would be the following:

a) For "abc/dvb.hashfile" in the contents of http://www.dvb.org/applications/application1.zip.

b) From the URL http://www.dvb.org/graphics/abc/dvb.hashfile.

c) For "abc/dvb.hashfile" in the contents of http://www.dvb.org/shared/utils.zip.

d) For "abc/dvb.hashfile" in the contents of http://www.ebu.ch/general/misc.zip.

These file system semantics shall be followed for all files fetched by or on behalf of an MHP application. This includes the files whose names and locations are standardized by the present document, e.g. 'dvb.fontindex', 'dvb.hashfile', 'dvb.signature.x' and dvb.certificate.x'.

For DVB-J, with the following application location descriptor:

a) base_directory "/app1/starting".

b) classpath_extension "/shared;/app1/later".

c) initial_class "org.dvb.demo.myXlet".

The search order for a class would be the following:

a) For "app1/starting/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/applications/application1.zip.

b) From the URL http://www.dvb.org/graphics/app1/starting/org/dvb/demo/myXlet.class.

c) For "app1/starting/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/shared/utils.zip.

d) For "app1/starting/org/dvb/demo/myXlet.class" in the contents of http://www.ebu.ch/general/misc.zip.

e) other_stuff/we_dont_use_this_very_often.zip.

f) For "/app1/starting/shared/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/applications/application1.zip.

g) From the URL http://www.dvb.org/graphics/app1/starting/shared/org/dvb/demo/myXlet.class.

h) For "/app1/starting/shared/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/shared/utils.zip.

i) For "/app1/starting/shared/org/dvb/demo/myXlet.class" in the contents of http://www.ebu.ch/general/misc.zip.

j) other_stuff/we_dont_use_this_very_often.zip.

k) For "/app1/starting/app1/later/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/applications/application1.zip.

l) From the URL http://www.dvb.org/graphics/app1/starting/app1/later/org/dvb/demo/myXlet.class.

m) For "/app1/starting/app1/later/org/dvb/demo/myXlet.class" in the contents of http://www.dvb.org/shared/utils.zip.

n) For "/app1/starting/app1/later/org/dvb/demo/myXlet.class" in the contents of http://www.ebu.ch/general/misc.zip.

o) other_stuff/we_dont_use_this_very_often.zip.

6.4.1.2 File transfer

Files to be transferred from an "http" URL shall be transferred using either HTTP 1.1 as defined in clause 6.3.7.1 "HTTP 1.1" on page 63 or the profile of HTTP specified under clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63.

Files to be transferred from an "https" URL shall be transferred as defined in clause 6.3.7.3 "HTTPS" on page 64.

6.4.1.3 Class encoding

The classes of DVB-J applications can be delivered either as discrete class files or within ZIP files (see ZIP [91]).

NOTE 1: This contrasts to the broadcast case where object carousel files are simply class files.

The classes of DVB-J applications shall be delivered as discrete class files at the level of the file system.

NOTE 2: This means that DVB-J class files are allowed to be held on an HTTP server either as discrete class files or in ZIP files (see ZIP [91]) where ZIP files form part of the overall file system.

6.4.1.4 Directory listing in this file system

For the authentication (see clause 12.4.1.5 "Special authentication rules" on page 322), this file system shall be considered to be one not supporting directory listing.

For listing the files in a directory (see clause14.7), this file system shall be considered to be one where the MHP terminal is never certain of the complete contents of a directory.

6.4.2 Hybrid between broadcast stream and interaction channel

In the hybrid case all directory information is provided in the broadcast stream but some, or possibly all, of the file contents are provided via the interaction channel.

6.4.2.1 File transfer

6.4.2.1.1 Broadcast file delivery

The file contents are carried via a BIOP::File as is the normal case for an Object Carousel defined in MHP 1.0. As described in MHP 1.0 the IOR from the file binding to the file contents uses either a BIOPProfileBody or a LiteOptionsProfileBody.

6.4.2.1.2 Interaction channel delivery

In this case the IOR from the file binding to the file contents uses the HTTPProfileBody (see table 2) to identify the location of the file contents on the interaction channel.

This form of IOR shall only be used for BIOP::File objects.

See clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63 for the profile of HTTP that is used to retrieve the contents of the file.

6.4.2.1.3 HTTPProfileBody

The HTTP Profile body specifies host, port and path_segments. In HTTP requests these are concatenated to form a URL of the form:

```
http://host:port/path_segments
```

Table 2: HTTP Profile Body syntax

Syntax	bits	Type	Value	Comment
HTTPProfileBody {				
profileId_tag	32	uimsbf	0x44564200	
profile_data_length	32	uimsbf	*	
profile_data_byte_order	8	uimsbf	0x00	big endian byte order
version.major	8	uimsbf	0x01	protocol major version 1
version.minor	8	uimsbf	0x00	protocol minor version 0
host_data_length	8	uimsbf	N1	
for (k=0; k<N1; k++) {				
host_data	8	uimsbf	+	
}				
port	16	uimsbf		
objectKey_length	16	uimsbf	N2	
for (k=0; k<N2; k++) {				
objectKey_data	8	uimsbf	+	
}				
}				
NOTE: The tag values 0x44564201 to 0x44564201 have been reserved for future use by the DVB. 0x44 is ASCII for "D", 0x56 is "V" and 0x42 is "B".				

version: These 8-bit fields indicate the version of the protocol that the server will use to deliver the file specified. The version value 1.0 indicates that the transport protocol is as defined in clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63.

host_data: These bytes convey the identifier of the Internet host to which messages may be sent. It may be a fully qualified domain name or Internet standard "dotted decimal" form (e.g. "192.231.79.52").

port: This 16 bit unsigned integer is the TCP/IP port number at the specified host where the target agent is listening for requests.

objectKey_data: These bytes form a string which carries the path_segments portion of the URL which uniquely identifies the object on the server RFC 2396 [41].

7 Content formats

7.1 Static formats

7.1.1 Bitmap image formats

7.1.1.1 Image encoding restrictions

Any indications in the transmitted image with respect to pixel scaling, colour space or gamma are to be ignored in the presenting of the image. One image pixel shall be mapped to one graphics pixel in the current graphics configuration, unless otherwise scaled by the application directly.

See also clause 7.5 "Colour Representation" on page 74.

7.1.1.2 JPEG

JPEG as defined in ISO/IEC 10918-1 [21] using the JFIF [35] file exchange format.

Only coding using sequential DCT-based mode or progressive DCT-based mode is required to be supported by implementations.

Specifically, lossless and hierarchical modes and arithmetic coding of DCT coefficients need not be supported.

The thumbnail feature of JFIF [35] need not be supported. MHP terminals not supporting thumbnails shall skip them if present and continue decoding the rest of the image.

7.1.1.3 PNG

PNG is defined as in PNG [37].

See also clause 15.1 "PNG - restrictions" on page 407.

7.1.1.4 GIF

GIF is defined as in GIF 89a [17].

7.1.2 MPEG-2 I-Frames

MPEG-2 I-Frames are defined as in ISO/IEC 13818-2 [24].

The payload of a file delivering an MPEG -2 I frame shall:

- Be a valid video_sequence() including a sequence_extension().
- Contain one I frame only, i.e. one picture_header(), one picture_coding_extension(), and one picture_data() encoded as an intra coded frame, with picture structure = "frame".

That is the structure is:

```
sequence_header()
sequence_extension()
extension_and_user_data(0)
optional group_of_pictures_header() and extension_and_user_data(1)
picture_header ( picture_coding_type = "I frame")
picture_coding_extension ( picture_structure = "frame picture")
extension_and_user_data(2)
picture_data()
sequence_end_code()
```

MPEG I-frames shall be presented with no DecFC (except for any scaling) i.e. the raster's encoded aspect ratio and any AFD shall be ignored.

7.1.3 MPEG-2 Video "drips"

The drip feed mode consists of letting an application progressively feed the MPEG-2 video decoder with chunks of an MPEG-2 video stream. In this mode, it is only required for the decoder to handle I and P frames (i.e. not B frame). Each chunk shall contain one frame and a certain number of syntactic elements (as described in ISO/IEC 13818-2 [24]) such as `sequence_header()` or `group_of_picture_header()`.

Firstly, the content of each of the chunks of bytes fed to the decoder shall comply with the following syntax:

```
optional {
      sequence_header()
      sequence_extension()
      extension_and_user_data(0)
      optional {
            group_of_pictures_header()
            extension_and_user_data(1)
      }
}

picture_header ( picture_coding_type = "I frame" or "P frame")
picture_coding_extension ( picture_structure = "frame picture")
extension_and_user_data(2)
picture_data()
optional {
      sequence_end_code()
}
```

In addition, the overall concatenation of chunks over time shall respect the authorized combinations of syntactic elements described in ISO/IEC 13818-2 [24] to build a legal MPEG-2 video stream. The following diagram, extracted from ISO/IEC 13818-2 [24], reflect the rules defined in that standard:

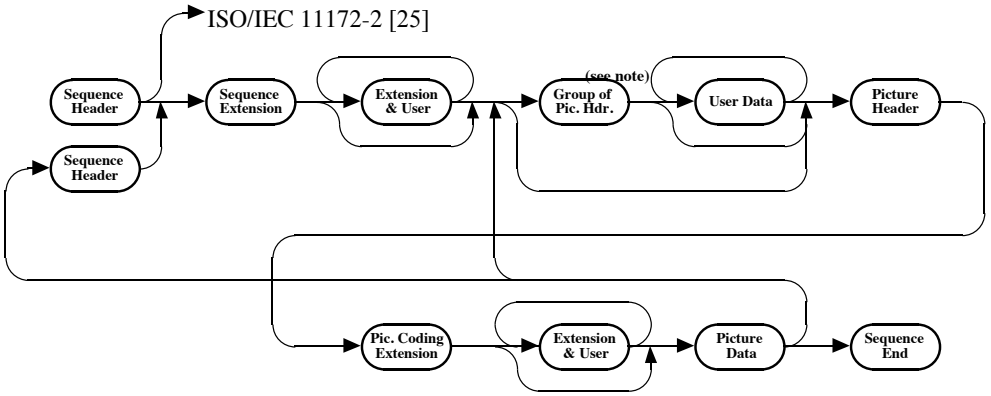


Figure 10

NOTE: After a GOP the first picture shall be an I-picture.

The following restrictions are applied to P-frames:

- The P-frame shall contain no prediction information (i.e. no motion vector shall be present in macroblock elements).
- The allowed macroblock_types for P-frames are:

  - "Intra" (i.e. VLC code 0001 1).
  - "Intra, Quant" (i.e. VLC code 0000 01).
  - "No MC, Coded" (i.e. VLC code 01).
  - "No MC, Coded, Quant" (i.e. VLC code 0000 1).

NOTE: The standard semantics for P-frames allow `macroblock_escape` and `macroblock_address_increment` to signal skipped macroblocks. This allows P-frames to be very sparse, only carrying macroblocks positioned at certain locations on the screen. This contrasts with semantics for an I-frame where macroblocks are required to fill the full screen.

If invalid content is fed to the MPEG-2 video decoder, the content is discarded and there are no guarantees when subsequent valid chunk of byte fed to the decoder will be displayed (unless the decoder is restarted).

This mode requires the decoder to be in the "low delay" mode as defined in ISO/IEC 13818-2 [24].

This mode can be used by connecting a `org.dvb.media.DripFeedDataSource` instance to a Player representing a MPEG-2 video decoder. See annex N "(normative): Streamed Media API Extensions" on page 688.

MPEG video drips shall be presented with no DecFC (except for any scaling) i.e. the raster's encoded aspect ratio and any AFD shall be ignored.

7.1.4 Monomedia format for audio clips

The format for audio clips is MPEG-1 Audio (Layer 1 and 2) ES data as defined as in ISO/IEC 11172-3 [22] and constrained inTS 101 154 [9].

Each "file" of audio content is a binary data file carrying Audio elementary stream data. Each "file" delivers an integer number of audio access units and the first byte of each file is the first byte of an audio access unit. The MPEG Audio data in all other respects conforms to the specifications provided inTS 101 154 [9].

Implementations decoding audio clips can assume that they have an approximately constant number of bytes per second. If this not true then the behaviour is implementation dependent.

7.1.5 Monomedia format for text

Java modified UTF-8 as defined in the specification of the method `java.io.DataOutput.writeUTF`.

NOTE: Based on ISO 10646-1 [18] but modified with respect to the encoding of the character code zero.

7.1.5.1 Built-in character set

See annex **E "(normative): Character set" on page 533**.

7.2 Broadcast streaming formats

7.2.1 Audio

MPEG Audio with the restrictions and enhancements defined inTS 101 154 [9]

7.2.2 Video

MHP terminals for 625-line/50Hz markets shall support video as defined in clause 5.1 ofTS 101 154 [9].

MHP terminals for 525-line/60Hz markets shall support video as defined in clause 5.3 ofTS 101 154 [9].

If high definition MPEG-2 video is supported then it shall be supported as defined in clause 5.2 or 5.4 ofTS 101 154 [9].
If high definition MPEG-4/AVC video is supported then it shall be supported as defined in clause 5.7 ofTS 101 154 [9].

7.2.3 Subtitles

The content formats supported for subtitles are:

- DVB Subtitles.
- Teletext.

See clause 13.5 "Subtitles" on page 389.

In the event that both DVB Subtitles and DVB Teletext are available then DVB Subtitles will take precedence (i.e. if a stream is flagged as having both DVB Subtitles and Teletext Subtitles then the DVB Subtitles will be displayed).

Teletext Subtitles conform to the same display model, as DVB subtitles.

Application control and detection of subtitles, whether they be DVB Subtitles or Teletext Subtitles, will be through JMF. The application will have no knowledge of the delivery/presentation protocol being used to provide subtitles.

No APIs will be provided to access Teletext data packets and no timing model is provided for the decoding of Teletext subtitle. Text subtitles will be decoded as soon as the data becomes available.

7.2.3.1 DVB Subtitles

DVB Subtitles are defined as in EN 300 743 [13].

7.2.3.2 Teletext

Transmission of the text is as defined in EN 300 472 [12]. The data format is as defined in ETS 300 706 [61] but restricted to presentation level 1,5 or lower. Signalling of the Teletext subtitle page will be via the Teletext descriptor as defined in EN 300 468 [4].

Within the MHP specification Teletext is only supported as an alternative content format for delivery of subtitles. The MHP specification does not address its possible use as a navigable content format.

NOTE: Manufactures remain free to implement full Teletext support based on regulatory requirement or market demand. Such support would be implemented outside of the MHP environment, by VBI re-insertion of the non-subtitle text or through a native Teletext Decoder. The user interface integration is then an issue for the manufacturer to resolve.

It is envisaged that broadcasters will use MHP applications to deliver navigable text services providing a greater level of interactivity and enhanced graphics.

7.3 Resident fonts

See clause G.4 "Resident fonts and text rendering" on page 546.

See also annex D "(normative): Text presentation" on page 514.

7.4 Downloadable Fonts

7.4.1 PFR

PFR0 (Portable Font Resource version 0) is defined as in DAVIC 1.4.1p9 [3] as the coding format for fonts. Receivers are only required to provide support for the outline version of the font.

The `charCode` value in the PFR `charRecord` and `bmapCharRecord`, and the `charCode1` and `charCode2` fields of the pairKernData() structure, shall be the ISO 10646-1 [18] code for the glyph. If these fields are 16-bit, they are encoded using UCS-2 and shall not be a high-surrogate or a low-surrogate code value. If these fields are 8-bit, then the one-byte character code shall be the least significant 8 bits of a 16-bit UCS-2 code, where the most significant 8 bits are all zero.

See also clause D.2.2 "Downloaded fonts" on page 514.

For fonts in the PFR format, the font name shall be the `fontID` field in the font file. The `fontID` field in the font file shall be encoded using the Java modified UTF-8 encoding (see clause 7.1.5).

Each font in a PFR file can have auxiliary data in its physical font record. If present this auxiliary data shall adhere to the syntax as specified in table 3. It shall consist of a number of blocks terminated by a block of length 0 and type 0.

Table 3: PFR auxiliary data

	No.of Bits	Identifier
auxDataFontRecord() {		
do {		
blockLength	16	uimsbf
blockType	16	uimsbf
switch (blockType) {		
case 2:		
for (i = 0; i < 10; i++) {		
reserved	8	uimsbf
}		
ascent	16	tcimsbf
descent	16	tcimsbf
reserved	32	uimsbf
externalLeading	16	tcimsbf
for (i = 0; i < (blockLength - 24); i++) {		
reserved	8	uimsbf
}		
break;		
default:		
for (i = 0; i < (blockLength - 4); i++) {		
reserved	8	uimsbf
}		
break;		
}		
} while (blockLength > 0 || blockType != 0)		
}		

An auxiliary data font record consists of a number of blocks terminated by a block of length 0 and type 0.

blockLength: The total number of bytes in this block, including the blockLength and the blockType.

blockType: A number that defines the type of data in the block. 0x0000 to 0x7fff are reserved, 0x8000 to 0xffff are user defined types.

ascent: Represents the font ascent, which is the distance from the base line to the top of most alphanumeric characters.

descent: Specifies the descent (units below the base line) of most alphanumeric characters.

externalLeading: Specifies the amount of extra leading (space) that the application adds between rows. The designer may set this member to zero.

MHP terminals shall ignore the contents of the reserved fields within block type 2 for the purposes of computing font metrics. MHP terminal behaviour for block types other than 2 is implementation dependent and these should not be used by MHP applications.

7.4.2 OpenType

OpenType® is standardized in ISO/IEC 14496-18 [115] as the font format for MPEG-4, and is a full-featured font format that supports advanced typographic features, multi-lingual text processing and international character sets.

ISO/IEC 14496-18 [115] defines different MPEG text profiles and levels of functionality. MHP receivers shall support OpenType fonts with TrueType™ outlines, as defined by Advanced Simple Text Profile at Level 2 in [115], section. 6.2.5. OpenType fonts with TrueType outlines enable the highest quality of text rendering on low-resolution displays.

For OpenType fonts, the font name used by MHP application shall be the full font name specified in the Naming ('name') table of OpenType font with the `NameID = 4`.

See also clause D.2.2.

7.5 Colour Representation

7.5.1 Background (informative)

The method of colour encoding is critical to how consistently the colours in an image can be reproduced across different systems. The description must be cast in a way which is independent of the mechanisms by which it will finally be reproduced for the viewer.

The International Colour Consortium (ICC) has proposed a thorough solution to the precise communication of colour in open systems. However the ICC profile format is somewhat over-specified for the MHP. The ICC mechanism for ensuring that a colour is correctly mapped from an input to the output colour space is by attaching a profile for the input colour space to the image in question. This is appropriate for high end systems, especially those in the print media. However, a primarily CRT based home platform neither needs, nor has the processing power and available bandwidth, to handle an embedded profile mechanism. It would also require some sophistication on the part of the end consumer to set up properly.

Fortunately by adopting a single default colour space that can be processed as an **implicit** ICC profile the advantages of the ICC approach are gained, and the system is later scalable to a full colour management system with a clear relationship to existing ICC colour management systems while minimizing software and support requirements in an MHP today.

A colour space is a model for representing colour numerically in terms of three or more coordinates or tristimulus values. An RGB colour space represents colours in terms of Red, Green and Blue coordinates. The MHP format shall use the specific RGB encoding for colour imagery, sRGB as defined in IEC 61966-2-1 [27]. This is suitable for a wide range of presentation environments including TV's and has become widely adopted in the computer environment and WWW. It is, for example, compatible with CCIR Recommendation ITU-R Recommendation BT.709-5 [30] standard for colour encoding in HDTV. This format has the advantage of device independence without a great deal of additional overhead.

For sRGB, the goal is to communicate the appearance of colours as displayed on a reference monitor in terms of 8-bit digital code values for each coordinate. sRGB colour values represent colour appearance with respect to a defined reference viewing environment.

For colour stimuli viewed in the reference viewing environment, sRGB values are defined by a series of simple mathematical operations from standard CIE colourimetric values.

The sRGB format is a good match for 24 bit colour on most CRT's. In devices where a great deal of damage is done to the colour space it may not give consistent results. For example dithering to a 4-bit per primary colour map will violate the gamma assumptions.

7.5.2 Specification

All images transmitted shall be within the gamut encompassed by the sRGB colourspace. Where possible this should be coded so that the terminal does not have to translate. Where this is impractical the sRGB image may be transcoded into a different colourspace provided the gamut assumption is not violated (i.e. to be consistent with JFIF, JPEG images shall be sent in the region of the YC_rC_b colourspace that overlaps with the sRGB gamut).

NOTE: that the presentation of images using colours outside of the sRGB gamut shall be platform dependent.

Images created in the MHP will be in the sRGB colourspace by default, although manufacturers are free to provide support for other colour spaces if they choose. All MHPs shall support transformations from sRGB to the colour spaces allowed by the MPEG-2 definition (e.g. BT 709 and BT 420) and vice versa, manufacturers may choose to support transformations to and from other colour spaces.

7.5.2.1 The sRGB Reference Viewing Environment

The reference display conditions and viewing environment for sRGB are partly described in table 4. A reference viewing environment must be provided to allow for the unambiguous definition of colour, the sRGB reference viewing environment corresponds to conditions typical of indoor viewing of CRTs – further details can be found in the IEC 61966-2-1 [27].

The sRGB reference conditions therefore provides a well defined reference compatible with ITU-R Recommendation BT.709-5 [30].

Table 4: sRGB reference Display conditions

Condition	sRGB
Viewing flare	1,0 %
Reference Background	20 %
Display model Offset	0,055
Display Gun/Phosphor Gamma	2,4
Display white point	x = 0,3127 y = 0,3290 (D65 Hunt, R.W.G. [52])
Ambient Lighting	64 lx
Display Luminance level	80 cd/m^2

7.5.2.2 Colourimetric Definitions and Encodings

sRGB tristimulus values can be computed as follows, firstly linear sRGB tristimulus are computed as linear combinations of the 1931 CIE XYZ (CIE 15 []) values using the following relationship:

$$\begin{bmatrix} R_{sRGB} \\ G_{sRGB} \\ B_{sRGB} \end{bmatrix} = \begin{bmatrix} 3,2410 & -1,5374 & -0,4986 \\ -0,9682 & 1,8760 & -0,0416 \\ 0,0556 & -0,2040 & -1,0570 \end{bmatrix} \begin{bmatrix} X_{D65} \\ Y_{D65} \\ Z_{D65} \end{bmatrix}$$

In the encoding process, negative sRGB tristimulus values, and sRGB tristimulus values greater than 1,00 are not retained. The luminance dynamic range and colour gamut of sRGB is limited to the tristimulus values between 0,0 and 1,0 by simple clipping. This gamut, however, is large enough to encompass most colours that can be displayed on CRT monitors.

For comparison, the CIE chromaticities for the red, green, and blue ITU-R Recommendation BT.709-5 [30] and ITU-R Recommendation BT.470-6 [28] reference primaries, and for CIE Standard Illuminant D65 (IEC 61966-2-1 [27]), are given in tables 5, 6. From these primaries the YC_bC_r transmitted values are computed by similar relationships.

Therefore ITU-R Recommendation BT.709-5 [30] YC_bC_r colourspace and similar video colour spaces can be converted to sRGB and vice versa by way of CIE XYZ. Chromaticities for other video formats allowed in MPEG streams can be found in their respective standards.

Table 5: ITU-R Recommendation BT.709 reference primaries and CIE standard illuminant

	Red	Green	Blue	D65
x	0,6400	0,3000	0,1500	0,3127
y	0,3300	0,6000	0,0600	0,3290
z	0,0300	0,1000	0,7900	0,3583

Table 6: ITU-R Recommendation BT.470-2 reference primaries and CIE standard illuminant

	Red	Green	Blue	D65
x	0,6700	0,2100	0,1400	0,3100
y	0,3300	0,7100	0,0800	0,3160
z	0,0100	0,0800	0,7800	0,3740

The linear sRGB tristimulus values are next transformed to non linear sR'G'B' values. This process closely approximates the effect of a "gamma" curve of 2,2 with a slight offset. This makes sRGB consistent with legacy systems and images.

if $R_{sRGB} > 0,00304$ and $G_{sRGB} > 0,00304$ and $B_{sRGB} > 0,00304$

then

$R'_{sRGB} = 1,055 \times R_{sRGB} \wedge (1,0/2,4) - 0,055$

$G'_{sRGB} = 1,055 \times G_{sRGB} \wedge (1,0/2,4) - 0,055$

$B'_{sRGB} = 1,055 \times B_{sRGB} \wedge (1,0/2,4) - 0,055$

else

$R'_{sRGB} = 12,92 \times R_{sRGB}$

$G'_{sRGB} = 12,92 \times G_{sRGB}$

$B'_{sRGB} = 12,92 \times B_{sRGB}$

end if

Finally, the non-linear sR'G'B' values are converted to digital code values. This conversion scales the sR'G'B' values by using the equation below where WDC represents the white digital count and KDC represents the black digital count.

$R_{8bit} = ((WDC - KDC) \times R'_{sRGB}) + KDC$

$G_{8bit} = ((WDC - KDC) \times G'_{sRGB}) + KDC$

$B_{8bit} = ((WDC - KDC) \times B'_{sRGB}) + KDC$

The current sRGB specification uses a black digital count of 0 and a white digital count of 255 for 24-bit (8-bits/channel) encoding, and the MHP shall adopt the same convention.

NOTE: Some digital video signals may use a black digital count of 16 and a white digital count of 235 in order to provide a larger encoded colour gamut.

Details of the reverse transformation from sRGB to CIE XYZ are given in IEC 61966-2-1 [27], mappings from ITU-R Recommendation BT.709-5 [30] and ITU-R Recommendation BT.470-6 [28] to CIE XYZ are given in ISO/IEC 13818-2 [24].

7.6 MIME Types

Table 7: File type identification

MIME type	Extension (note)	Definition of content
"image/jpeg"	".jpg"	As defined in clause 7.1.1.2 "JPEG" on page 69.
"image/png"	".png"	As defined in clause 7.1.1.3 "PNG" on page 69 possibly with a constrained profile as defined in clause 15.1 "PNG - restrictions" on page 407.
"image/gif"	".gif"	As defined in clause 7.1.1.4 "GIF" on page 69.
"image/mpeg"	".mpg"	As defined in clause 7.1.2 "MPEG-2 I-Frames" on page 69.
"video/mpeg"	".mpg"	As defined in clause 7.2.2 "Video" on page 71.
"video/dvb.mpeg.drip"	".drip"	As defined in clause 7.1.3 "MPEG-2 Video "drips"" on page 70.
"audio/mpeg"	".mp2"	As defined in clause 7.1.4 "Monomedia format for audio clips" on page 71 or as defined in clause 7.2.1 "Audio" on page 71.
"text/dvb.utf8"	".txt"	As defined in clause 7.1.5 "Monomedia format for text" on page 71.
"text/xml"	".xml"	As defined in clause 8 "DVB-HTML" on page 80.
"text/css"	".css"	As defined in clause 8.6 "CSS" on page 110.
"text/plain"	".txt"	As defined in clause 7.1.5 "Monomedia format for text" on page 71.
"text/ecmascript"	".js"	As defined in clause 8.4.11 "Script content" on page 96.
"image/dvb.subtitle"	".sub"	As defined in clause 7.2.3 "Subtitles" on page 71.
"text/dvb.subtitle"		
"text/dvb.teletext"	".tlx"	As defined in clause 7.2.3.2 "Teletext" on page 72.
"application/dvb.pfr"	".pfr"	As defined in clause 7.4 "Downloadable Fonts" on page 72.
"application/dvbj"	".class"	A DVB-J class file.
"application/xml"	".xml"	As defined in clause 8 "DVB-HTML" on page 80.
"multipart/dvb.service"	".svc"	An MPEG Program (DVB Service) conforming to DVB norms.
NOTE: Future formats may use more characters in the extension		

7.6.1 Rationale

The MIME types are defined to reserve a name space for the possible future support of downloadable JMF players.

The file name extensions shall be included in broadcasts to assist receivers identify the type of the content. For DVB-J applications, this is described in table 117 "Return types of URL.getContent()" on page 265).

Not all MIME and filename extensions defined in the above table are actually used in the present document. For DVB-J, the APIs which consume media types are described in clause 15.2 "Minimum media formats supported by DVB-J APIs" on page 407. With MIME types whose corresponding media is not listed for a particular profile, access to that content type from files is not defined for that profile.

7.6.2 Profiles

There is only one DVB-HTML profile defined see clause 15 "Detailed platform profile definitions" on page 404.

7.7 Architecture

7.7.1 Context

A DVB-HTML application in the context of MHP is a set of resources selected from the DVB-HTML family of content formats as defined in the present document. The resources of a DVB-HTML application form a directed graph, rooted by the resource referenced in the Application Entry Point (see clause 10.10.2). The allowed extent of the graph is described by the application boundary descriptor, the nodes of the graph are the physical representation of the resources, the arcs are naming references defined in the content formats. The interpretation of a DVB-HTML application is handled by a support application (commonly called a user agent in W3C terminology). For the purposes of exposition DVB defines an "actor" which is the runtime context associated with a DVB-HTML application maintained by the user agent, there is a one to one correspondence between actors and running applications. There may be a many to one relationship between actors and user agents. The lifecycle of a DVB-HTML application is described in clause 9.3 "DVB-HTML Model" on page 200.

During the lifetime of a DVB-HTML application the user agent performs three types of processing on resources to enable the behaviour of the DVB-HTML application:

- **Decoding**
- **Presentation**
- **Interaction**

Decoding is the process of reading the bit representation of the resource and constructing a runtime representation in the actor context. The nature of the runtime representation is not specified, but it shall respect the required semantics of the resource type. Most resource types have a visible or audible representation, and **Presentation** is the process of rendering the runtime representation of a resource to the relevant device. Many resources can be partially presented whilst decoding is taking place, it is an implementation option as to whether this occurs in any given user agent. Some resource types have a behavioural model, and **Interaction** is the generic term used for the processing required by the user agent to correctly exhibit the behaviour model defined by the semantics of the resource. Similarly it is possible that the interaction processing may overlap with decoding and presentation.

7.7.2 Integration Aspects

7.7.2.1 Accessing DVB-J from ECMAScript

All of the APIs available to DVB-J shall be available to ECMAScript, See clause 8.8.2 "Interface between ECMAScript and DVB-J" on page 129.

7.7.2.2 Implementation of user agents via plug-ins

In the case that the user agent is implemented as an interoperable plug-in, at least the following clauses of the present document will be relevant:

- 5 "Basic Architecture" on page 53
- 9.8 "Plug-ins" on page 214
- 10 "Application Signalling" on page 220

  10.13 "Plug-in signalling" on page 253
- 12 "Security" on page 316

  12.13 "Plug-ins" on page 368

7.8 Application Format

7.8.1 Basic Considerations

The main parts of the present document are based on World Wide Web Consortium (W3C) recommendations. W3C provides the fundamental building block standards of the WWW, that are also used in the DVB-HTML standard as well as for HTML standards for other devices like cell phones, PDAs and Internet appliances. Authoring tools and software used for displaying content for the WWW are based on these recommendations. The present document uses W3C recommendations, as far as possible, to allow authoring of a common content basis for both the DVB-HTML applications and the content distributed on the WWW.

In particular the following technologies are used:

- XHTML (see clause 8.3)
- CSS (see clause 8.6)
- DOM (see clause 8.9)
- ECMAScript (see clause 8.8)
- XML (see clause 8.2)

7.8.2 Approach to Subsetting

The W3C recommendations contain conformance clauses under which a product or code implementing the specification is considered a conformant implementation. In the present document this approach is supported to the largest extent possible. If in special cases deviation is required it is clearly marked in the text.

8 DVB-HTML

NOTE: The contents of this clause may be substantially replaced in a later release of the present document. Readers are encouraged to check for the existence of such a later release before proceeding.

8.1 Introduction

8.1.1 Application Area

One application area considered of commercial importance for the Multimedia Home Platform (MHP) is that of the provision of a hypertext or "super teletext" system for the presentation of information alongside broadcast. In order to promote interoperability, both between different MHP vendors and where possible with the wider internet, the present document describes a specific subset of the data formats defined for use in the World Wide Web adopted by the MHP, plus DVB specific extensions.

The DVB MHP specification provides the basic definitions needed for integration of DVB HTML applications into the MHP:

- Definition of the term DVB HTML application and its lifecycle in clause 9.3.1 "The DVB-HTML Application" on page 200.
- How to signal a DVB HTML application in clause 10 "Application Signalling" on page 220.
- The definition of content for DVB HTML in this clause.

8.2 XML

XML is a license-free, platform-independent and well-supported method for structuring data in textual form. The DVB-HTML language as defined in clause 8.3 "DVB Mark-up Language (DVB-HTML)" on page 81 conforms to XML 1.0 [65]. Since its creation XML has become the foundation of new internet mark-up languages specified by the W3C.

The grammar of the DVB-HTML language is described in the DTD (Document Type Definition) in annex AA. This DTD conforms to the XHTML Host Language Document Type conformance clauses defined in the XHTML modularization specification Modularization [94].

8.3 DVB Mark-up Language (DVB-HTML)

DVB-HTML is an application of XML. The XML document character set for DVB-HTML shall be either the UTF-8 or UTF-16 transformation format of the Universal Multiple-Octet Coded Character Set (UCS) ISO 10646-1 [18]. The set of characters that shall be displayable is defined in annex E "(normative): Character set" on page 533.

8.3.1 Conformance considerations

8.3.1.1 Document conformance

An XML document is a DVB-HTML conformant document if it conforms to all the general rules in clause 8.3.1.1.1 "General rules." on page 81 and is either:

- a valid document against the DVB-HTML DTD.
- an invalid document made conformant by the clauses in 8.3.1.1.2 "Invalid but conformant documents" on page 82.

DVB HTML documents shall either not include a standalone declaration, or shall use the value "no".

8.3.1.1.1 General rules.

A DVB-HTML conformant document shall be well-formed.

A DVB HTML conformant document should include an XML declaration.

A DVB-HTML conformant document shall respect the following clauses:

a) The root element shall be <html>.

b) The root element of the document shall designate the XHTML namespace using the xmlns attribute defined in Namespaces in XML [103]. The namespace designator for XHTML is "http://www.w3.org/1999/xhtml".

c) There shall be a DOCTYPE declaration in the document prior to the root element. The public identifier included in the DOCTYPE declaration shall be present and should reference the DTD found in annex AA using its Formal Public Identifier (FPI).

The FPIs that reference the DVB-HTML DTD shall be:

```
"-//DVB//DTD XHTML DVB-HTML x.y//EN"
```

Where values of x and y are found in Table 8 "Version identifiers" on page 82 for this version of the DVB-HTML 1.0 DTD

The following system identifiers are guaranteed to locate the above DTD. Other system identifiers may be used to locate the DVB DTD if required. Implementations of the present document are required to work correctly without fetching any DTDs from this location as part of their normal operation.

```
http://www.dvb.org/mhp/dtd/dvbhtml-x-y.dtd
```

Where values of x and y are found in Table 8 "Version identifiers" on page 82 for this version of the DVB-HTML 1.0 DTD

Table 8: Version identifiers

	x	y
value	1	0

The following DOCTYPE declaration example indicates recommended practice in DVB-HTML documents:

```
<?xml version="1.0"?>
<!DOCTYPE html PUBLIC "-//DVB//DTD XHTML DVB-HTML 1.0//EN"
"http://www.dvb.org/mhp/dtd/dvbhtml-1-0.dtd"
>
```

8.3.1.1.2 Invalid but conformant documents

The MHP platform is designed to support future compatibility and the possible presence of proprietary extensions; the present document defines how this is done in a way that authors can be sure of the behaviour of an MHP implementation that does not support the extension. Therefore, in addition to the support of the general rules, a DVB-HTML conformant document is also defined by one or more of the following conditions:

- An invalid document with respect to the DTD found in annex AA and for which invalidity is only due to the presence of additional elements and attributes in a different namespace to the XHTML or DVB-HTML namespaces, and which does not define a new default namespace (see Namespaces in XML [109]).
- An invalid document with respect to the DTD found in annex AA with an FPI in the document type declaration identifying a strictly later version of DVB-HTML than that defined in the present document and with additional elements or attributes in the XHTML or DVB-HTML namespaces, which, when removed, results in a document that would validate against the DTD found in annex AA.

A non-conformant document is one which is not valid with respect to the DTD found in annex AA, and is not made conformant by the above clauses.

Handling of non-conformant DVB-HTML documents is specified in clause 8.3.1.2.1 "Error handling" on page 84

A document that is DVB-HTML conformant but not valid with respect to the DTD found in annex AA, is handled as detailed in clause 8.3.1.2.2 "Handling of invalid but conformant documents" on page 84.

8.3.1.2 DVB-HTML user agent conformance

The DVB-HTML user agent shall be conformant with the XHTML Family User Agent conformance clauses defined in Modularization [94].

Additionally, before attempting to use it as part of an application the DVB-HTML user agent shall assess the conformance of:

- any received XML document signalled in the AIT as being part of the DVB-HTML application.
- any XML document whose document type declaration contains one of the DVB-HTML FPIs (see clause 8.3.1.1 "Document conformance" on page 81).

For the purpose of validation, it shall:

- remove from the XML document any elements and attributes in a different namespace than the XHTML or DVB-HTML namespaces.
- if the FPI of the document indicates that the version of the DVB-HTML document strictly superior to the version of the DVB-HTML language the implementation supports: remove any elements and attributes in the DVB-HTML or default XHTML namespace not present in the supported DVB-HTML DTD.

It shall subsequently validate (see clause 5.1 in XML 1.0 [65]) the resulting XML document against the DTD found in annex AA. Validation is performed by checking that the document does not violate any validity constraints as listed in table 9. Any violation report indicates the non conformance of the received XML document. Corresponding error handling is described in clause 8.3.1.2.1 "Error handling" on page 84.

The way this process is performed is implementation dependent.

The document conformance shall be assessed before the generation of the DVBDOMStable event (see clause 8.9.2.3.2). This conformance status shall be re-assessed by the DVB-HTML user agent in the presence of modification of the DOM tree. The way this constraint is checked is implementation dependent, but the invariant must be that the document continues to be conformant. If a document becomes at any point non-conformant, it shall be handled as described in clause 8.3.1.2.1.2 "On DOM mutation" on page 84.

The DVB-HTML user agent is not required to be a full validating processor (according to W3C terminology in XML 1.0 [65]), in the sense that it is not required to be able to read and process any arbitrary DTDs and external parsed entities referenced in the document. It is also not required to handle an internal DTD subset attached to the document type declaration. For that reason, only the following XML validity constraints (see XML 1.0 [65]) are required to be checked:

Table 9: List of applicable validity constraints

Validity constraint	Required
Root element type	Yes
Proper Declaration/PE Nesting	
Standalone Document Declaration	No (note 1)
Element Valid	Yes
Attribute Value Type	Yes
Unique Element Type Declaration	
Proper Group/PE Nesting	
No Duplicate Types	
ID	Yes
One ID per Element Type	
ID Attribute Default	
IDREF	Yes
Entity Name	
Name Token	Yes
Notation Attributes	
One Notation Per Element Type	
No Notation on Empty Element	
Enumeration	Yes
Required Attribute	Yes
Attribute Default Legal	
Fixed Attribute Default	Yes
Proper Conditional Section/PE Nesting	
Entity Declared	Yes (note 2)
Notation Declared	
Unique Notation Name	

NOTE 1: the user agent is not required to fetch and interpret the external mark up declarations or any internal DTD subset attached to the document type declaration.

NOTE 2: only the requirement on entity reference matching is applicable. A DVB-HTML user agent is not required to check the XML requirements on parameter-entity or general entities declarations locations.

8.3.1.2.1 Error handling

The user agent shall not present or allow interaction with a document which is not conformant (see clause 8.3.1.1 "Document conformance" on page 81). The DVBDOMStable event in clause 8.9.2.3.2 shall not be generated for the present document.

8.3.1.2.1.1 On receipt of a document

If the non-conformant document is the root document of a DVB-HTML application, this application shall not be started, i.e. the corresponding DVB-HTML actor shall go from the Loading state to the Killed state. If the non-conformant document is not the root document, then the DVB-HTML application shall remain in the current state and the non-conformant document is treated as an unreachable resource.

During the parsing of a document, the DOM structure will necessarily be incomplete. No DOMExceptions indicating invalid structure will be thrown during this phase, and authors should make no assumptions on which elements will be available. See clause 8.9.2.3.2 "DVBDOMStable event" on page 139.

If an attempt is made to alter the DOM structure using the DOM APIs prior to delivery of the DVBDOMStable event then the DOMException with the error code INVALID_STATE_ERR shall be raised.

8.3.1.2.1.2 On DOM mutation

A DVBException with the error code NON_CONFORMANT_ERR may be raised if an attempted modification of the DOM would result in a non-conformant document. The DOM shall remain unchanged on generating the exception (see clause 8.9.5 "DVB Exceptions" on page 158).

NOTE: The DOM allows for a `DocumentFragment` object for construction of partial intermediate structures which are not required to be valid or conformant.

Documents generated using `document.write` shall be handled as defined in clause 8.3.1.2.1.1 "On receipt of a document" on page 84, on closing the document.

8.3.1.2.2 Handling of invalid but conformant documents

When using only the default style sheet, the user agent shall not present or allow interaction with elements that make a conformant document invalid. Such elements are removed from presentation by the default style sheet (see annex AB "(normative): DVB HTML StyleSheet" on page 983), however the elements shall be retained in the DOM.

Implementations supporting such elements, or documents using them, may override the stylesheet to cause them to be presented to the user. The XHTML Family User Agent conformance clauses require that the text content of any unrecognized elements be presented to the user (unless a stylesheet changes this), so the stylesheet should not be overridden unless it is certain that the elements are supported and/or have no text content.

Attributes that make a conformant document invalid may be ignored by the user agent.

8.3.2 Set of modules required by the present document

The DVB-HTML document type definitions are made up of the following abstract modules indicated in table 10. The modules are defined in [p.15] of Modularization [94]. An implementation of the DTD is defined in annex AA.

Table 10: Required modules for DVB-HTML

Modularization	Required
Structure	Yes
Text	Yes
Hypertext	Yes
List	Yes
Applet	
Presentation	Yes
Edit	
Bi-directional Text	Yes

Modularization	Required
Basic Forms	
Forms	Yes
Basic Tables	Yes
Tables	
Image	Yes
Client side Image map	Yes
Server side image map	
Object	Yes
Frames	Yes
Target	Yes
Iframe	Yes
Intrinsic events	
DVB Intrinsic events	Yes
Metainformation Module	Yes
Scripting	Yes
Style sheet	Yes
Style Attribute	Yes
Link	Yes
Base	Yes
Name Identification	
Legacy	

8.3.3 Semantics for modules

8.3.3.1 XHTML modules

For the modules defined by Modularization [94] the semantics are as defined there except as elaborated below and in clause 8.4 "Media Types" on page 90.

8.3.3.1.1 Structure

Media types for which semantics have been specified when used in the profile link in the <head> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.2 Text

Media types for which semantics have been specified when used in the `cite` attribute in the <q> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.3 Hypertext

Media types for which semantics have been specified when used in the `href` attribute (hypertext links) in the <a> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.4 Presentation

NOTE: The HTML conformance clause (see HTML 4 [104]) for this module does not require text to be rendered with a different appearance when these elements are used in the absence of other styling information.

8.3.3.1.5 Forms

Media types for which semantics have been specified when used in the `action` attribute in the <form> element and the `src` attribute in the <input> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91

NOTE: An implementation is not required to support uploading of local files, therefore where input type="file" appears in a DVB-HTML document, the implementation may substitute input type="hidden".

8.3.3.1.6 Client-side Image Map

Semantics on the way to associate an image map with an element are defined in section 13.6.1 in HTML 4 [104] with the following exception:

- the URI in the `usemap` attribute shall point to the identifier of the <map> element as set by the `id` attribute.

If no <map> element is identified through the `usemap` attribute, then no association shall be assumed. This is in line with the module DTD implementation as defined in Modularization [94]. In HTML 4 [104] this association was performed using the `name` attribute of the <map> element.

8.3.3.1.7 Image

Media types for which semantics have been specified when used in the `longdesc` and `src` attributes in the <img> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91

8.3.3.1.8 Object

Media types for which semantics have been specified when used in the `archive`, `classid`, `codebase` and `data` attributes in the <object> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

When the referenced object is an MPEG stream, see clause 8.4.7 "MPEG Audio" on page 94 and clause 8.4.8 "MPEG Video" on page 95.

When the referenced object is a DVB service, see clause 8.4.9 "DVB Services" on page 96.

When the referenced object is an Xlet see clause 8.7 "Xlet integration" on page 127.

For other media types, see clause 8.4.10 "Graphics content" on page 96.

8.3.3.1.9 Frames

Media types for which semantics have been specified when used in the `src` attributes in the <frame> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.10 Target

The semantics of specifying target frame information is described in section 16.3 in HTML 4 [104] with the following exception:

- the value of the `target` attribute shall point to the identifier of the frame as set through the `id` attribute.

If a target attribute refers to an unknown frame, then no action shall be performed.

NOTE: In HTML 4 [104], this was performed through the `name` attribute. Appendix B.8 in HTML 4 [104] is not relevant any more.

Use of target names are also subject to security considerations, see clause 8.12.3.1 "Restrictions on DOM elements introduced for security" on page 178.

8.3.3.1.11 Iframes

Media types for which semantics have been specified when used in the `src` and `longdesc` attributes in the <iframe> element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.12 Metainformation

See clause 8.8.2.1 "ECMAScript APIs for accessing DVB-J" on page 129.

8.3.3.1.13 Scripting

Media types for which semantics have been specified when used in the `src` attribute in the `<script>` element are defined in clause 8.4.2 "MIME media type use restrictions" on page 91.

8.3.3.1.14 Link

Only the following `LinkTypes` are required to be supported in DVB-HTML for the `rev` and `rel` attributes:

Alternate: Designates substitute versions for the document in which the link occurs. When used together with the `lang` attribute, it implies a translated version of the document. When used together with the `media` attribute, it implies a version designed for a different medium (or media). Without one of these other attributes the value may be ignored.

Stylesheet: Refers to an external style sheet.

Style Sheets can also be associated with a DVB-HTML document by using a processing instruction whose target is `xml-stylesheet` as defined in Associating Style Sheets with XML documents [113]. This processing instruction follows the behaviour of the `<link rel="stylesheet">` semantics.

Start: Refers to the first document in a collection of documents. Use of this information is user agent specific.

Next: Refers to the next document in a linear sequence of documents. Use of this information is user agent specific.

Previous: Refers to the previous document in an ordered series of documents. the synonym "`Prev`" may also be used. Use of this information is user agent specific.

Help: Refers to a document offering help (more information, links to other source information, etc.). Navigation to this resource is user agent specific.

8.3.3.1.15 Base

Any media type is allowed for the `href` attribute in the `<base>` element since it is the structure of the `href` itself which is relevant, and not the resource referenced (which need not be accessed, or even present).

8.3.3.2 XHTML attributes

8.3.3.2.1 Longdesc, alt and cite attributes

DVB-HTML user agents shall make available a mechanism to access the alternate text or referenced resource and present it to the user. The specific means are implementation dependent.

8.3.3.2.2 Accesskey attribute

The `accesskey` attribute of HTML 4 [104] assigns an access key to an element. An access key is a single character from the document character set, which if pressed gives focus to the element, the semantics of giving focus to an element are element specific (see HTML 4 [104] section 17.11.2).

In order to have some measure of compatibility with the JAVA AWT PBP 1.1 [116] and HAVi HAVi [50] event sets, the DTD used by the user agent points to an implementation specific DVB character entities module which shall define a set of XML entities which map all of the JAVA AWT PBP 1.1 [116] and HAVi HAVi [50] "VK_" events onto implementation specific characters.

The specific range of characters mapped to the "VK_" entities is implementation specific, but shall not overlap with any character range that might be generated by an end user (e.g. on an optional attached keyboard).

So, for example given the following text in DVB-HTML:

```
<A accesskey="&VK_GUIDE;" href="guide/contents.html">
Guide information
</A>
```

The user agent shall, on receipt of the device specific operation that would generate a VK_GUIDE event, give the focus to the <a> element (which in this case would cause the link to the guide content to be traversed).

It is not required for implementations to generate "VK_" events other than the minimum set specified in table G.5 "Minimum set of input events" on page 547. But the user agent shall allow documents to refer to any of them. Generation of the "VK_" events is allowed to be contextual, for example, when a text area element has the focus the "VK_0" event may not be generatable by the user, since the device specific operation may generate a "0" character instead.

NOTE: The range of Unicode values 0xFB50 to 0xFDFF is unlikely ever to be used for legitimate input characters as they are presentations forms that don't belong in the Unicode coding space and could be used as a coding set.

The following is a partial example DTD fragment that defines the minimum set of entities:

```
<!ENTITY % VK_0 "&#01">
<!ENTITY % VK_1 "&#02">
<!ENTITY % VK_2 "&#03">
<!ENTITY % VK_3 "&#04">
<!ENTITY % VK_4 "&#05">
<!ENTITY % VK_5 "&#06">
<!ENTITY % VK_6 "&#07">
<!ENTITY % VK_7 "&#08">
<!ENTITY % VK_8 "&#09">
<!ENTITY % VK_9 "&#0A">
<!ENTITY % VK_UP "&#0B">
<!ENTITY % VK_DOWN "&#0C">
<!ENTITY % VK_LEFT "&#0D">
<!ENTITY % VK_RIGHT "&#0E">
<!ENTITY % VK_ENTER "&#0F">
<!ENTITY % VK_TELETEXT "&#10">
<!ENTITY % VK_COLORED_KEY_0 "&#11">
<!ENTITY % VK_COLORED_KEY_1 "&#12">
<!ENTITY % VK_COLORED_KEY_2 "&#13">
<!ENTITY % VK_COLORED_KEY_3 "&#14">
```

8.3.3.3 DVB-HTML modules

8.3.3.3.1 DVB Intrinsic events

DVB Intrinsic events are attributes that are used in conjunction with elements that can have specific actions occur when certain events are performed by the user. The attributes indicated in the following table are added to the attribute set for their respective elements. Attributes defined by this module are:

Table 11: Elements of DVB Intrinsic events

Elements	Attributes
body&	onload (Script), onunload (Script) (see clause 8.8 "Scripting" on page 129). ondvbdomstable (Script) (see clause 8.9.2.3.2 "DVBDOMStable event" on page 139).
frame&	onload (Script), onunload (Script) (see clause 8.8 "Scripting" on page 129). ondvbdomstable (Script) (see clause 8.9.2.3.2 "DVBDOMStable event" on page 139).

If these attributes are used then they must be within the scope of a namespace definition, namely "`http://www.dvb.org/mhp`". The namespace prefix shall be declared on the element of the document that uses them. And the namespace shall be "dvbhtml" (see Namespaces in XML [103]).

The following is an example of how these attributes should be used.

```
<?xml version="1.0"?>
<!DOCTYPE html
     PUBLIC "-// DVB//DTD XHTML DVB-HTML 1.0//EN"
     "http://www.dvb.org/mhp/dtd/dvbhtml-1-0.dtd">
<html xmlns="http://www.w3.org/1999/xhtml" >

<head>
   <title>Namespace vs. Intrinsic Events Example></title>
   <script type="text/ecmascript" src="setupEventHandlers.js" />
</head>
<body xmlns:dvbhtml="http://www.dvb.org/mhp" dvbhtml:ondvbdomstable="setupEventListeners()">
   <!-- rest of document here -->
</body>
</html>
```

8.4 Media Types

A DVB-HTML user agent shall be able to recognize and handle (in accordance with the appropriate conformance clauses see clause 7 "Content formats" on page 69) the following media types:

Table 12: Content types accessible in DVB-HTML

MIME media type	Common name
text/xml	XML
application/xml	
text/css	CSS
text/plain	Monomedia format for text
text/dvb.utf8	
audio/mpeg	Monomedia format for audio clips or Audio
image/jpeg	JPEG
image/png	PNG
image/gif	GIF
image/mpeg	MPEG-2 I-Frames
video/dvb.mpeg.drip	MPEG-2 Video drips
video/mpeg	MPEG video
multipart/dvb.service	Multipart DVB Service
application/dvb.pfr	Downloadable Fonts
application/dvbj	A DVB-J class file
text/ecmascript	ECMAScript

Resources of these MIME media types can be referenced using the locators defined in clause 14 "System integration aspects" on page 393 and clause 8.14.5 "DVB-HTML specific locators" on page 187 subject to the usage conditions below.

NOTE: User agents are recommended to be prepared to handle the eventuality that the MIME media type is incorrectly indicating the media type, alternative strategies (e.g. based on the filename, and inspecting the contents) should be employed. In addition a resource labelled as a specific MIME media type may or may not be conformant with the subsetting restrictions imposed by the present document (see clause 15.1 "PNG - restrictions" on page 407, clause 15.3 "JPEG - restrictions" on page 407). How the User Agent detects and handles this is implementation specific.

8.4.1 Uses of MIME media types

%ContentType.datatype; The DVB HTML DTDs define the entity "%ContentType.datatype;", for use in attribute declarations where MIME media types may be used. The following table lists these attributes along with the XHTML Modules in which they occur.

Table 13: Use of ContentType attribute on elements

elem.attr	XHTML Modules
a.type	Hypertext
link.type	Link
object.type	Object
object.codetype	Object
param.type	Object
form.enctype	Basic Forms, Forms
style.type	Stylesheet
script.type	Scripting

%URI.datatype; The DTDs also define "%URI.datatype;", describing where URIs shall be supported. The following table lists those attributes with the relevant XHTML Modules for reference.

Table 14: Use of URI attribute on elements

elem.attr	XHTML Module(s)
a.href	Hypertext
area.href	Client-side Image Map
base.href	Base
blockquote.cite	Basic Text
form.action	Basic Forms, Forms
frame.longdesc	Frames
frame.src	Frames
head.profile	Structure
iframe.longdesc	Iframe
iframe.src	Iframe
img.src	Image
img.longdesc	Image
img.usemap	Client-side Image Map
input.src	Basic Forms, Forms
input.usemap	Basic Forms, Forms
link.href	Link
object.archive	Object
object.classid	Object
object.codebase	Object
object.data	Object
object.usemap	Client-side Image Map
q.cite	Basic Text
script.src	Scripting

8.4.2 MIME media type use restrictions

The behaviour of the MHP terminal is only specified where there is an "X" at the intersection of element.attribute and MIME media type in table 15.

Table 15: Use of MIME media type by element

Element. attribute	MIME media type													
	text/xml	application/xml	text/css	text/plain	text/dvb.utf8	audio/mpeg	image/jpeg	image/png	image/gif	image/mpeg	video/mpeg	multipart/dvb.service	application/dvbj	video/dvb.mpeg.drip	text/ecmascript
As root element	X														
a.type	X					X						X	X		
link.type (note)	X		X												
object.type	X					X	X	X	X	X	X	X		X	
object.codetype													X		
param.type	(note)														

Element. attribute	MIME media type													
	text/xml	application/ xml	text/css	text/plain	text/dvb.utf8	audio/mpeg	image/jpeg	image/png	image/gif	image/mpeg	video/mpeg	multipart /dvb.service	application/ dvbj	video/dvb.mpeg.drip	text/ ecmascript
style.type			X												
script.type															X
NOTE: Informative, authoring guideline: MIME media type constraints only apply to this attribute when the param.valuetype attribute has value "ref". No allowed object types required to be supported by the present document make use of this "type" attribute.															

The following table shows whether the resource identified by the URI value of each element.attribute pair (vertical axis) has DVB defined semantics for each MIME media type (horizontal axis) in DVB-HTML; "X" = Yes, blank = No.

Table 16: MIME media type usage

Element.attribute	exit:	MIME media type													
		text/xml	application/ xml	text/css	text/plain	text/dvb.utf8	audio/mpeg	image/jpeg	image/png	image/gif	image/mpeg	video/mpeg	multipart/ dvb.service	application/ dvbj	video/dvb.mpeg.drip	text/ ecmascript
a.href	X[a]	X[d]				X[b]						X[e]	X[d]		
area.href	X[a]	X[d]				X[b]						X[e]	X[d]		
base.href		X (note 1)													
blockquote.cite					X[f]										
form.action (see clause 8.4.13)															
frame.longdesc					X[f]										
frame.src		X[g]													
head.profile															
iframe.longdesc					X[f]										
iframe.src		X[g]													
img.src							X[h]	X[h]	X[h]	X[h]	X[c]			X	
img.longdesc					X[f]										
img.usemap		X[d]													
input.src							X[h]	X[h]	X[h]	X[h]	X[c]			X	
input.usemap		X[d]													
link.href		X[d]	X[j]												
object.archive		(note 2)													
object.classid													X[d]		

Element.attribute	exit:	MIME media type													
		text/xml	application/xml	text/css	text/plain	text/dvb.utf8	audio/mpeg	image/jpeg	image/png	image/gif	image/mpeg	video/mpeg	multipart/dvb.service	application/dvbj	video/dvb.mpeg.drip	text/ecmascript
object.codebase		(note 1)														
object.data		X[d]					X[b]	X[h]	X[h]	X[h]	X[h]	X[c]	X[e]		X[h]	
object.usemap		X[d]														
q.cite					X[f]											
script.src																X[i]

NOTE 1: MIME type is irrelevant here as it's just the URI that matters, not the thing it identifies.
NOTE 2: Specific to the object.

8.4.3 Semantics of media type

a) See clause 8.14.5.2 "Exit locator" on page 188.

b) See clause 8.4.7 "MPEG Audio" on page 94

c) See clause 8.4.8 "MPEG Video" on page 95

d) See clause 8.4.5 "Application content" on page 93.

e) See clause 8.4.9 "DVB Services" on page 96.

f) See clause 8.3.3.2.1 "Longdesc, alt and cite attributes" on page 87

g) See clause 8.4.4 "Frame content" on page 93

h) See clause 8.4.10 "Graphics content" on page 96

i) See clause 8.4.11 "Script content" on page 96

j) See clause 8.4.12 "Style sheet content" on page 96

8.4.4 Frame content

The contents of a frame are restricted to be conformant DVB-HTML documents.

NOTE: An implementation is not required to provide a scrolling mechanism for frames.

8.4.5 Application content

8.4.5.1 When referenced via an AIT locator

An AIT locator is a locator of the form "`dvb://current.ait/...`" which is used to refer to application content via the AIT signalling. Using this form of locator, DVB-HTML applications are able to refer to currently available applications (see clause 11.7.2 "Application discovery and launching APIs" on page 290). For example:

```
<a type="application/dvbj" href="dvb://current.ait/Orgid.Appid?arg_0=val">
   Click here to launch application
</a>
```

The literal text of the locator, and not the translated form is stored in the DOM.

Activating such a link shall request the application manager to start the application referenced by this URL, passing to that application the specified parameters. The type attribute is used as a hint in the case that there are multiple application types with the same AppID and OrgID and should give preference to applications of the indicated type. The application shall be started depending on machine resources etc.

NOTE: Starting the new application may involve terminating the launching application.

This activation will fail as if the resource were not found if the launching application does not have the authority to start applications.

8.4.5.2 When not referenced via an AIT locator

Other references to DVB-HTML documents or fragments content can occur as a result of:

href: The semantics are as defined in HTML 4 [104].

usemap: The referenced element defines a map to overlay on the image. The semantics are as defined in HTML 4 [104].

object.data: The referenced document is rendered within the object as if it were a frame. The semantics are as defined in HTML 4 [104].

src: The referenced document is rendered within a frame or iframe. The semantics are as defined in HTML 4 [104].

8.4.6 Relative linking

The MIME media types allowed for this attribute depend on the value of the `link.rel` attribute.

For `link.rel="stylesheet"`, only the type `"text/css"` is defined and the user agent shall interpret this as specified in "14.3.2 Specifying external style sheets" of HTML 4 [104].

For all other values of `link.rel`, the resource pointed to shall be a conformant DVB-HTML document. The user agent may use this information in implementation specific ways (e.g. to prefetch the referenced document).

8.4.7 MPEG Audio

DVB HTML shall be able to reference MPEG audio as indicated in table 15. The referenced audio may be of either indefinite (see clause 7.2.1 "Audio" on page 71) or definite duration (see clause 7.1.4 "Monomedia format for audio clips" on page 71).

8.4.7.1 Resources of indefinite duration

Links to an MPEG elementary stream of indefinite length carried in the broadcast as specified in clause 7.2.1 "Audio" on page 71 shall select the service component for presentation into the current service context. If an audio service component is currently playing, it is replaced in its entirety by the specified selection

If the reference requires specific interaction to invoke (i.e: `a.href, area.href`) then the audio selection shall be after the reference is actioned. An implementation may impose a short delay before audio is audible, but this shall not be so long as to make the new audio appear unconnected to the user action.

If the reference does not require a specific reference to invoke (i.e. `object.archive, object.data`) on an object with the content type of `"audio/mpeg"`, then the audio stream shall be selected at an implementation specific time after the containing document becomes active. Any `<param>` elements included in such objects shall be ignored.

8.4.7.1.1 Relation to document events

In the case of non-actioned references, the following constraints shall be observed:

- The `DVBDOMStable` event shall be generated prior to playing the stream.
- The media should be rendered as soon as possible after the `DVBDOMStable` event.
- The `load` event shall only be generated after the stream is playing

8.4.7.2 Resources of definite duration

Referencing an audio file resource of finite length (e.g. carried in DSMCC carousel), that carries audio data as specified in clause 7.1.4 "Monomedia format for audio clips" on page 71: shall cause audio to be rendered according to the restrictions in clause G.2 "Audio" on page 546.

If the reference requires specific interaction to invoke (i.e: `a.href, area.href`) then the audio shall be rendered once in its entirety after the reference is actioned. An implementation may impose a short delay before audio is audible, but this shall not be so long as to make the audio appear unconnected to the user action.

If the reference does not require a specific reference to invoke (i.e. `object.archive, object.data`) on an object of type `"audio/mpeg"`, then by default the audio is rendered once at an implementation specific time after the containing document becomes active. The following `<param>` name, value pairs shall be implemented for audio of finite duration rendered in an object:

name	legal values	meaning
loop	(true | false)	When the audio data has been played in its entirety, then it should be played again from the beginning of its associated data, so as to cause a "seamless" continuous (infinite) audio playback until the document is unloaded.

8.4.7.2.1 Relation to document events

In the case of non-actioned references, the following constraints shall be observed:

- The `DVBDOMStable` event and the `load` event shall be generated prior to playing the audio.

8.4.8 MPEG Video

NOTE: MPEG video or images may only be displayable full- or quarter-screen: if authors ask an object to display it in a way the hardware doesn't support, the user agent should follow the usual fallback rules for unavailable resources in object. Authors may need to provide alternate content to cover this, probably also fixing the size to prevent layout differences. However, the `img` and `input` tags do not provide this fallback capability, so authors should be more careful in using them, to be sure that all target STBs will display the image as desired.

8.4.8.1 Video Resources of indefinite duration

Referencing an MPEG elementary stream of indefinite length carried in the broadcast as specified in clause 7.2.2 "Video" on page 71 shall cause the referenced video to be placed in the bounding rectangle of the element after styling is applied (see clause 8.6.4.2.1.3 "dvb-clip-video" on page 112). Access to the referenced video stream shall not cause tuning to occur, if this would cause the implementation to lose access to the service carrying the application.

DVB HTML defines only the case where the reference does not require user interaction to invoke (i.e. img.src, input.src, object.archive, object.data), if access to the stream requires tuning, the referenced video stream is tuned to at an implementation specific time after the containing document becomes active.

Video referenced by an `<object>`, `<img>` or `<input>` is considered to be referenced later than that in external style sheets, and thus takes precedence over the selected background video in the case that there are insufficient resources to display both the referenced video and the background video simultaneously (in accordance with clause 11.2.9 "Intra application media resource management" on page 263). In the case of multiple references within a document, it is implementation specific which is considered referenced later.

No `<param>` elements are defined in for objects of type `"mpeg/video"`.

8.4.8.1.1 Relation to document events

In the case of non-actioned references to video of indefinite length, the following constraints shall be observed:

- The `DVBDOMStable` event shall be generated prior to playing the video.
- The media should be rendered as soon as possible after the `DVBDOMStable` event.
- The `load` event shall only be generated after the stream is playing

8.4.8.1.1.1 Modification of the referencing attribute using the DOM

Alterations to the video source due to script (e.g changing styling or `src` attributes) are considered as later references than any declarative reference. The playing video is replaced with the newly referenced video source using the same rules as for the original value of the attribute.

8.4.8.2 Resources of definite duration

This version of the specification does not define referencing of video segments of finite duration.

8.4.9 DVB Services

Use of URLs with that reference a service in contexts that do not require user action (i.e `object.data`, `object.archive`) on objects of type "`multipart/dvb.service`" are defined only for the media aspects of a service (e.g. video, audio, subtitles) and shall not cause service selection, but the media components of that service shall be displayed according to (clause 8.4.7 and clause 8.4.8).

Links to DVB services in contexts that require user action (i.e. `a.href, area.href`) shall cause service selection to the referenced service if the application is authorized (see clause 8.13.1.9 "javax.tv.service.selection.ServiceContextPermission" on page 180). If authorization fails, then the link shall be treated as if referencing an unavailable resource.

Links to DVB services of the form "`dvb:`" referencing broadcast services, and other locators referencing stored services (see clause 9.6.2 "Stored services" on page 211) or services over the interaction channel shall be allowed (see clause 9.6.1 "Applications loaded from the interaction channel" on page 211).

NOTE: Selecting the new service can cause the selecting application to be terminated.

8.4.10 Graphics content

Graphics formats shall be supported as specified in clause 7.1 "Static formats" on page 69. Such graphics shall be displayed inline with the content in the box generated as a result of processing any CSS rules.

NOTE: Images of other types than the minimum requirements for the MHP may be referenced, but the implementation may not display them. Since the `img` and `input` tags do not provide fallback capability, authors should be careful in using them, to be sure that all target STBs will display the content as desired.

8.4.11 Script content

The referenced resource shall be in a plain text format admitted by the present document clause 7.1.5 "Monomedia format for text" on page 71. The content shall be ECMAScript source code as defined in ECMA-262 [95], and shall be handled as if it were inline.

8.4.12 Style sheet content

The referenced resource shall be in a plain text format admitted by the present document clause 7.1.5 "Monomedia format for text" on page 71. The content shall be CSS source code as defined in CSS 2 [101], and shall be handled as defined by the cascading rules therein.

8.4.13 HTTP(S) URLs

For `form.action` only HTTP(S) URLs are valid (as form submission relies on GET/POST). The the user agent is only required to handle the case where the content returned is a conformant top-level document.

8.4.14 CSS Properties

8.4.14.1 Sources of MIME media type use points

<uri>: The CSS 2 specification defines the value type `<uri>`. For the places where `<uri>` is a permitted value in CSS see CSS 2 [101].

8.4.14.2 MIME media type use restrictions

Behaviour when referencing the following MIME media types is not specified for any of the `<uri>` type in CSS (but may nevertheless be the MIME media types of some parts of a DVB-HTML application):

- text/xml.
- application/xml.
- text/css.
- audio/mpeg.
- text/dvb.subtitle.
- image/dvb.subtitle.
- application/dvbj.
- text/ecmascript.

The following table shows whether the resource identified by the URI value of each CSS attribute (vertical axis) has DVB defined semantics for each MIME media type (horizontal axis) in DVB-HTML; "X" = Yes, blank = No.

CSS Attribute		MIME media Type									
		text/plain	text/dvb.utf8	image/jpeg	image/png	image/gif	image/mpeg	video/mpeg	video/dvb.mpeg.drip	multipart/dvb.service	application/dvb.pfr
background-image				x[b]	x[b]	x[b]	x[b]	x[c]	x[c]		
content			x[a]								
list-style-image				x[b]	x[b]	x[b]	x[b]				
@font-face	src										x
@viewport	"background:"			x[b]	x[b]	x[b]	x[b]		x[c]		
	"background-video-n"							x[c]		x[d]	

a) See clause 8.4.15.

b) See clause 8.4.16.

c) See clause 8.4.17.

d) See clause 8.4.18.

8.4.15 Generated Content

The referenced resource shall be in a plain text format admitted by the present document clause 7.1.5 "Monomedia format for text" on page 71. The content shall be handled as if it were inline as defined in CSS 2 [101].

NOTE: Informative, authoring guideline, in CSS2 you cannot:
- Generate markup (only XML CDATA).
- Apply further style to generated content.
- Access generated content via DOM.

8.4.16 Graphics styling

Graphics formats shall be supported as specified in clause 7.1.1 "Bitmap image formats" on page 69. Such graphics shall be handled as defined in CSS 2 [101].

8.4.17 Video Styling

Video and video drips may be used as the `background-image style` property. The resource shall be handled as an image type as defined in CSS 2 [101]. Video is displayed as defined in clause 8.4.8.1 "Video Resources of indefinite duration" on page 95 as a reference that does not require user interaction.

NOTE: MPEG video or images may only be displayable full- or quarter-screen: if you ask an object to display it in a way the hardware doesn't support, the user agent should follow the usual fallback rules for unavailable resources in object.

Video may be used as the viewport `"background-video-n"` style property. The resource shall be used to select the referenced video stream into service context, and cause it to be displayed in the corresponding background video plane.

Video drips may be used as the viewport `"background:"` property. The resource shall be used to fill the corresponding background plane.

8.4.18 DVB Service styling

Use of URLs with that reference a service as background-video styling are defined only for the media aspects of a service (e.g. video, audio, subtitles) and shall not cause service selection, but the only the media components of that service shall be displayed see clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114.

8.5 Synchronization

8.5.1 Triggers Overview

Triggers provide a means by which the application provider can interact with an application running on an end user terminal. Although in principal this interaction could be delivered by any communication channel available to the MHP, the present document defines only a binding to DSM-CC stream events. Triggers are received by the user agent and used to raise events in a running DVB-HTML application.

Triggers are small messages sent in a broadcast separately from the main content, which may cause a change in the behaviour of applications that choose to register for them. Triggers can carry a time at which they should be delivered, plus a small amount of payload data which an application can register for.

Application authors can think in terms of traditional media time bases (e.g. SMPTE time codes) that are a simple frames/seconds offset from the beginning of the media. Triggers can signal that a point on the time base has been reached. The author has to "name" these events so that applications can subscribe to them. This name may be meaningful to the author as is illustrated in table 17:

Table 17

Event name	Event time
Start	00:00:00.00
End of introduction	00:00:30.00
End of recipe	00:05:00.00
End of recipe	00:08:00.00
Start or roll out	00:11:00.00
End	00:11:30.00

The behaviour following the event is implemented in the code of the application. It is possible that data is delivered with the event to modify the behaviour.

The following issues are described in more detail below:

- How triggers are transported (see clause 8.5.1.1).
- How an application registers for and receives triggers (see clause 8.5.1.2).

8.5.1.1 Transport of triggers

We consider here transport of triggers in:

- DSM-CC stream events.

8.5.1.2 Application registration and reception

In order to integrate with W3C event models, triggers are delivered to DVB-HTML applications as DOM events. Registration is through:

- Explicit registration using the DOM API

Delivery is by DOM event. Trigger DOM event interfaces inherit from the interface `Event` in DOM (see Document Object Model (DOM) Level 2 Events Specification [98]).

8.5.1.3 Binding to DSM-CC Stream events

A mechanism is provided in clause 8.5.3 "Binding the event factory file to the application" on page 106 that identifies the location of the DSMCC Stream Event message associated with any document entity of the DVB-HTML application that registers to a trigger event. However, it is possible to bypass this mechanism through a default location binding.

By default, a DVB-HTML application is bound to all DSMCC Stream Event messages which are located in the application root directory defined in the `physical_root` field in the `dvb_html_application_location` descriptor of the AIT. In that case, those DSMCC Stream Event messages list the events used in the context of the whole application. See clause on default trigger mechanism clause 8.5.4 "Default Trigger Mechanism" on page 108.

8.5.2 Trigger Events

8.5.2.1 Converting stream events into DOM events

DVB-HTML triggering contains a mechanism by which the stream events are converted into DOM events. This has several features.

a) A mechanism to override the default association between application and stream event message which provides a degree of abstraction between the transport mechanism of the stimulus aspect of the event and the author's behavioural view.

b) A mechanism which expands the media event into one or more DOM events, this includes mapping the media event name into a DOM type, and extracting any or all of the media event payload and converting it into properties of the DOM event.

The application document receives the DOM events and has its behaviour modified by them using the standard mechanism of DOM event delivery (see clause 98).

In order to describe the above, the application has associated with it an "event factory file" (See clause 8.5.2.2 "Event Factory File definition" on page 101). This file provides the information the user agent needs to locate stream event messages (if not the default) for the event name bindings, and determines which media event names to subscribe to. If not present, the default event factory file is assumed (See clause 8.5.2.4 "Default Event Factory File" on page 104). It can also determine which parts of the media event payload become properties of the resulting DOM event. Factory files are associated with resources of the DVB-HTML application using a "linkage file" (See clause 8.5.3 "Binding the event factory file to the application" on page 106)

On receipt of the stimulus associated with an event ID (e.g. the correct NPT time arrives) the user agent is able to "fire" the DOM event into the DVB-HTML application to be handled.

The entire process is summarized by the following data flow diagram:

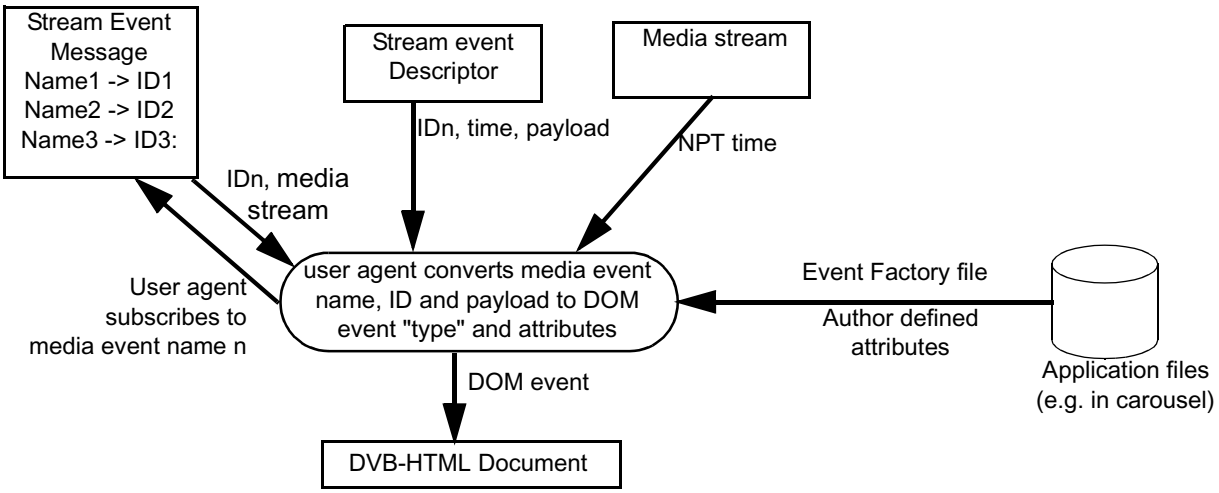


Figure 11: Overview of the authored event mechanism

The following text provides an informative description of the different steps involved when a DVB-HTML document subscribes to a trigger event delivered by DSM-CC stream events using a linkage file and factory file, an implementation may choose to perform some steps differently, however the overall result shall be equivalent:

On starting the application the user agent locates the linkage file. If no linkage file exists, then the default processing shall apply to this application (see clause 8.5.4 "Default Trigger Mechanism" on page 108).

On loading a document, the user agent locates any event factory files that apply to the document. If no factory files apply to this page, the default event factory file shall be applied (see clause 8.5.2.4 "Default Event Factory File" on page 104), the user agent collates all of the trigger-event elements in the event factory files.

If the DVB-HTML document, through an embedded Xlet or any attached script, implements an EventListener interface and subscribes to a trigger event of a type mentioned in any trigger-event element in the collated set, through a call to the DOM addEventListener() method on the element node of the document DOM. The user agent locates the DSMCC Stream Event message by following the URI specified by the stream attribute in the event element. The DSMCC Stream Event message provides the mapping between the event name in the trigger-event element and the event id and references the source of the stream event descriptors that the user agent needs to monitor. If the collated trigger-event elements do not mention a matching type then the default element shall be assumed (see clause 8.5.4 "Default Trigger Mechanism" on page 108).

On receipt of the stream event descriptor that provides the mapping between the event id and both the `eventNPT` and the associated payload, the user agent begins the synthesis of the DOM event, as defined by the event factory element. When the NPT of the referenced stream is equal to the eventNPT of the stream event descriptor plus any offset, or as soon as the stream event descriptor is received in case of 'do it now' events (see clause B.2.4.3 "DSM-CC Sections carrying Stream Descriptors" on page 498), the DOM event is injected in the DOM implementation at the node whose id matches the target attribute of the trigger-event element.

Payload of the stream event is parsed by the expression and placed in the synthesised DOM event using appropriate attribute names.

If following the DOM event propagation rules this event reaches the handler placed by the Xlet or script, the handler is activated and receives the synthesised DOM event.

8.5.2.2 Event Factory File definition

8.5.2.2.1 Syntax

The event factory file is an XML file with syntax defined by the following DTD.

```
<!-- ....................................................................... -->
<!--           DVB HTML Event Factory File DTD -->
<!-- ....................................................................... -->
<!-- file: htmleventfactoryfile-1-0.dtd-->
<!-- ....................................................................... -->

<!--
The following formal public identifier shall be used to identify this file:

   "-//DVB//DTD DVB HTML Event Factory 1.0//EN"

The following URL may be used to reference this file:

   http://www.dvb.org/mhp/dtd/htmleventfactoryfile-1-0.dtd

-->

<!ELEMENT htmleventfactoryfile (trigger-event|system-event|time-event)*>

<!ELEMENT trigger-event (event-attribute)*>
<!ATTLIST trigger-event
   stream                    CDATA               #IMPLIED
   event                     CDATA               #REQUIRED
   type                      CDATA               #IMPLIED
   target                    CDATA               #IMPLIED
   time                      CDATA               "+0"
   bubbles                   %Boolean;           "true"
   cancelable                %Boolean;           "true"
>

<!ELEMENT system-event (event-attribute)*>
<!ATTLIST system-event
   stream                    CDATA               #IMPLIED
   event                     CDATA               #REQUIRED
```

```
   system-event-type          CDATA               #REQUIRED
>

<!ELEMENT time-event (event-attribute)*>
<!ATTLIST time-event
   type                       CDATA               #IMPLIED
   target                     CDATA               #IMPLIED
   time                       CDATA               "+12"
   bubbles                    %Boolean;           "true"
   cancelable                 %Boolean;           "true"
>

<!ELEMENT event-attribute EMPTY>
<!ATTLIST event-attribute
   attribute-name             CDATA               #REQUIRED
   attribute-pattern          CDATA               #REQUIRED
>
```

8.5.2.2.2 Element semantics

The elements of the event factory file have the following semantics:

htmleventfactoryfile: This element serves as the root element for an event factory file.

trigger-event: This element specifies a relationship between:

- A media stream event.
- The DOM event interface to which it maps.
- The DOM event destination.

system-event: This element specifies a relationship between a media stream event and the system event to be generated. See clause 8.5.2.6 "System events" on page 105.

time-event: This element specifies a relationship between an absolute time and

- The DOM event interface to which it maps.
- The DOM event destination.

event-attribute: This element specifies the mapping of media event payloads into attributes of the trigger or system event.

The trigger-event and time-event element can contain zero or more event-attribute elements. These describe the construction of a derived interface from the DOM `Event` interface, which adds attributes.

The system-event element can contain zero or more event-attribute elements. These provide parameters to the system event.

Duplicate elements

Each trigger-event, time-event or system-event generates an event regardless of whether any are effectively duplicates.

8.5.2.2.3 Attributes semantics

The attributes of the event factory file have the following semantics:

stream: Names the stream event message, this shall be a "dvb:" URI and must resolve to a DSM-CC StreamEvent message. It may be relative to the application files or provide a full reference to the file system that carries the StreamEvent message. So, regardless of what file system carries the DVB-HTML application the implementation can locate the source of the events. If missing the default location is assumed.

event: The name of the media event in the stream event message which provides the stimulus for this event.

NOTE: Multiple broadcast-event records may reference the same media event, possibly with time offsets. This provides the names that the user agent must subscribe to.

type: The type of event which will be exposed to the DOM on triggering this event. If missing, the type will be the same as event.

system-event-type: The type of the system event which will be received by the user agent.

target: If this attribute is provided it specifies the ID of the target node in the HTML page. If the attribute is not provided then the target is the root of the DOM tree, also referred to as the document node. Any listeners on those event types should then be positioned on the document root node to be able to receive the event, or be positioned on the document node.

Example:

```
<?xml version="1.0"?>
<!DOCTYPE html PUBLIC "-//DVB//DTD XHTML DVB-HTML 1.0//EN"
   "http://www.dvb.org/mhp/dtd/dvbhtml-1-0.dtd">
<html xmlns="http://www.w3.org/1999/xhtml"
   xmlns:dvbhtml="http://www.dvb.org/mhp">
   <head>
      <script type="text/ecmascript">
         // event listener declaration
         function handleEvent(evt) { /* Handle the event */ }

         // the listener is positioned on the document root node,
         // i.e. the html node
         function setupEventListeners () {
            var htmlNode = document.documentElement;
            htmlNode.addEventListener("myTriggerEvent", handleEvent, true);
         }
      </script>
   </head>
   <body dvbhtml:onload="setupEventListeners()">
   </body>
</html>
```

offset: An optional offset time (in ms) which can be added to the NPT time of the stimulus to delay the firing of the event, this time is used to calculate a new NPT time for the delivery of the event.

time: The value of this parameter is detailed in clause 8.14.2 "Clock values" on page 185. Both Absolute and Offset times are allowed. If an offset form is given (A full, partial or timecode value with an initial '+' or '-' sign) then the event time is measured as an offset with respect to the UTC of the midday of the date attribute. Otherwise the value must lie in the range 0:0:0.0 to 23:59:59.99 (a value within one clock resolution of midnight), and specifies a clock time (in 24 hour format) on the day of the date attribute.

For example:

```
02:30:03    = 2 hours, 30 minutes and 3 seconds past midnight
+30:00:10.25 = 30 hours, 10 seconds and 250 milliseconds after the current midday
```

The MHP shall support offset referencing of at least +/- 12 hours.

date: The value of this parameter is detailed in clause 8.14.1 "Date Values" on page 185. It gives the date which on which the midday reference for the time attribute occurs. If not specified the value will be the date on which the application began executing.

bubbles: This attribute sets the DOM event attribute "bubbles" as defined in clause Document Object Model (DOM) Level 2 Events Specification [98].

cancelable: This attribute sets the DOM event attribute "cancelable" as defined in Document Object Model (DOM) Level 2 Events Specification [98].

attribute-name: The name which will be used for the DOM event attribute.

attribute-pattern: A regular expression which describes how to parse the data from the trigger payload in order to initialize the DOM event attribute. The attribute-pattern is of the form:

```
/pattern/flags:replacement
```

where pattern follows the grammar in 15.10.1 of ECMA-262 [95], and flags are at most one each of ("g", "i" or "m"). The replacement text is arbitrary text, but may contain '$' values which are substituted by elements collected by the pattern following the rules in 15.5.4.10 of ECMA-262 [95]

For example `"/(\d+)/g:$1$2$3"` would be a legal attribute-data value. And applied to the trigger payload:

```
"box 12 in 34 by 567 for 248"
```

would deliver the data:

```
"1234567"
```

8.5.2.3 Default Event Factory Element

Media events that are not defined in any event factory files associated with a DVB-HTML document and whose name "event-name" does not start with "dvb." are treated as if associated with a default event factory element which is defined with the following piece of syntax:

```
<trigger-event event = "event-name"
   type = "event-name"
   time = "0"
   bubbles = "true"
   cancelable = "true">
   <event-attribute
      attribute-name = "payload"
      attribute-pattern = "/.*/:$1"/>
</trigger-event>
```

NOTE: The event type and the media event name are identical in this case. It is indeed assumed here that every trigger event corresponds to a stream event with name value equals to the type of this trigger event. Since, the stream attribute is not present, the default location of the DSMCC StreamEvent messages is assumed. Also, since the target attribute is not present in this default event factory file, the target is the document root element (i.e. the html node).

Any listeners on those event types should then be positioned on the document root node to be able to receive the event, or to be positioned on the document node (see target attribute definition in clause 8.5.2.2 "Event Factory File definition" on page 101).

If the media event name value "event-name" starts with "dvb." then the media event is considered as being a system event, the default location of the DSMCC Stream Event message is assumed and the semantics of clause 8.5.2.6 "System events" on page 105 apply.

8.5.2.4 Default Event Factory File

In the absence of an event factory file associated with a DVB-HTML document, a default one is assumed. The default event factory file associated with a DVB-HTML document contains the definition of all the trigger events the document registers with. The aggregation of the default event factory elements constitutes the default event factory file for a DVB-HTML document.

8.5.2.5 Worked example

An applications event factory file contains the following text:

```
<trigger-event
   stream="dvb://233a..1234/goals"
   event="goal"
   type="score"
   cancelable="false">
```

```
   <event-attribute
      attribute-name="score"
      attribute-data="/\[s(core)?:(\d+)-(\d+)/$1-$2" />
</trigger-event>
```

This defines that the stream event message for this event is in the carousel location `"dvb://233a..1234/goals"` within this file will be a loop of event names, one of which should be `"goal"` this is the event that the user agent must subscribe to. The generated DOM event will be of type `"score"` to suit the naming convention of the author, and will not be cancelable. The media event will carry some payload data, and this should be placed in a DOM attribute called `"score"` in the resulting DOM event.

This will result in DOM events being delivered to the DVB-HTML application that have the following interface:

```
interface score : trigger-event {
   readonly attribute   DOMString score;
   void                 initScoreEvent(
                        in DOMString typeArg,
                        in boolean canBubbleArg,
                        in boolean cancelableArg,
                        in DOMString scoreArg );
};
```

Assume a stream event descriptor with the following payload bytes is received:

```
<http://xxx.yyy.com/fun.html>[score:1-2]
```

Then the resultant DOM event would be constructed using the following initialization

```
initScoreEvent(
      "score", true, false,"1-2"
)
```

The following DOM event properties will be filled in the base class as follows:

- DOMTimeStamp timeStamp - this will contain the ms count since the 1 Jan 1970.

8.5.2.6 System events

System events use the same transport and binding mechanisms as trigger-events, but instead of being converted into DOM events and being delivered to the DVB-HTML application they are entirely handled by the user agent. The mapping process from media event names to system event names is identical to that for trigger-events, that is the system-event element defines the stream (optionally) and event name to subscribe to. However, in this case the type attribute defines the kind of system event. The following values for type are defined:

- "dvb.start".
- "dvb.page".

NOTE: All event names that start with "dvb." are reserved for use by DVB to avoid name clashes with possible other name definers.

The attributes associated with system events are fixed, but use the same mechanism to pull the information from the payload bytes.

8.5.2.6.1 dvb.start event

- The dvb.start event causes a DVB-HTML application in the `ACTIVE` state to receive the AppStarting (see clause 8.9.2.2 "Lifecycle events" on page 136) event. No payload data is defined for the start event: any event-attribute elements associated with this shall be ignored.
- The dvb.start events are only defined in the context of the DVB-HTML application entry point document (identified by the application location descriptor): if the start event element is present in the event factory file of any other DVB-HTML document it shall be ignored.
- More than one dvb.start binding can be defined but only the first to fire shall cause an AppStarting event.

The resultant event time of the start event specifies the time at which the application entry point document is intended to be displayed to the user. Ideally the implementation should begin fetching data and formatting the new page off-screen, and then display it at the time specified. It is not possible in general to predict how long any page might take to render, so that no matter how long in advance of the desired display time the page message is delivered there is no fixed guarantee an MHP will have completed the rendering.

8.5.2.6.2 dvb.page event

The event-attribute element associated with the dvb.page system-event allows the broadcaster to direct the application at a specific page during execution. Referencing pages that are not reachable due to security or other restrictions (see clause 8.14.3 "Unrealizable locators" on page 186) shall cause the event to be ignored. After processing of the event completes the application shall have a single window containing the referenced document. Even if the referenced document is currently being displayed it shall still be reloaded and redisplayed.

In order for an application author to guarantee that page events operate globally in an application they will have to use the broadest possible regular expression ("*") in the linkage file to ensure that the event factory file that specifies the dvb.page event is bound to all DVB-HTML documents.

The following values for attribute-name are defined:

Table 18

attribute-name	number of occurrences
actuate	zero or one
href	one
title	zero or one

actuate: The results of the evaluation of the attribute-pattern should be one of the following:

- "onLoad"
- "onRequest"

the semantics of other values are not defined and shall be ignored. If this attribute is not present it is treated as if "onRequest".

If the result is "onLoad" then the user agent loads the page (as described above) given in the href attribute (as described below).

If the result is "onRequest", the user is informed that the document is available and chooses whether to switch to it. If the user accepts the behaviour is as if "onLoad". If the user declines the offer then the user presentation remains unchanged.

href: The results of the evaluation of the attribute-pattern yield a URI. The URI which the user agent should load.

title: The results of the evaluation of the attribute-pattern yields text that is intended to describe the target to the user in the "onRequest" interaction. The text encoding shall be compatible with clause 7.1.5 "Monomedia format for text" on page 71.

8.5.3 Binding the event factory file to the application

A DVB-HTML application is usually constructed of multiple DVB-HTML documents, each such file can have a different trigger event set to which it subscribes. Each file can be associated with zero or more event factory files. If no event factory file is associated with a DVB-HTML document then the default event factory file is assumed (See clause 8.5.2.4 "Default Event Factory File" on page 104). If no event element is associated with an event type in all the event factory files associated with a DVB-HTML document, then the default event factory element is assumed for this event (See clause 8.5.2.3 "Default Event Factory Element" on page 104).

If more than one event factory file is associated with a document then the behaviour is as if all of the elements were contained in a single file. The order of the files is not significant.

In order to define the mapping between DVB-HTML files and event factory files, each application is associated with zero or one "event linkage" file, this event linkage file defines the association between specific event factory files and the documents to which they relate. If there is no event linkage file then the default trigger mechanism is assumed (See clause 8.5.4 "Default Trigger Mechanism" on page 108).

Syntax of event linkage file

This file provides a list of zero or more event factory attribute files for each document in the application. The event linkage file is an XML file using the following DTD.

```
<!-- ..................................................................... -->
<!--           DVB HTML Event Linkage File DTD -->
<!-- ..................................................................... -->
<!-- file: htmleventlinkagefile-1-0.dtd-->
<!-- ..................................................................... -->

<!--
The following formal public identifier shall be used to identify this file:

   "-//DVB//DTD DVB HTML Event Linkage 1.0//EN"

The following URL may be used to reference this file:

   http://www.dvb.org/mhp/dtd/htmleventlinkagefile-1-0.dtd

-->

<!ELEMENT htmleventlinkagefile (linkage)*>

<!ELEMENT linkage (location)+>
<!ATTLIST linkage
   boundary          CDATA               #REQUIRED
>

<!ELEMENT location EMPTY>
<!ATTLIST location
   URI               CDATA               #REQUIRED
   language          CDATA               #IMPLIED
>
```

8.5.3.1 Semantics of event linkage file

htmleventlinkagefile: This element serves as the root element for an event linkage file.

linkage: This element specifies a set of DVB-HTML documents with which the event factory files identified by the location element are to be associated.

boundary: This is a regular expression identifying the set of documents. The encoding is identical to that used in the application boundary descriptor (see clause 10.10.3 "DVB-HTML application boundary descriptor" on page 247).

location: This element specifies the location of an associated event factory file using the URI.

URI: The URI.

language: This optional attribute identifies the user preference language required before the event factory file is interpretted. If this attribute is empty then event factory file applies regardless of user preference. If the user preference language does not match then the referenced event factory file does not apply. This matching is implementation defined.

The encoding of this attribute shall be ISO 639-2 [19].

8.5.3.2 Example

```
<?xml version="1.0"?>
<!DOCTYPE linkage "-//DVB//DTD DVB HTML Event Linkage 1.0//EN"
"http://www.dvb.org/mhp/dtd/htmleventlinkagefile-1-0.dtd">

<linkage boundary ="*">
   <location URI="./events/app_events.evt" />
</linkage>
<linkage boundary ="foo.htm">
   <location URI="http://www.xx.com/app/ev1.evt" />
   <location URI="http://www.xx.com/app/ev2.evt" />
</linkage>
<linkage boundary ="bar.htm">
   <location URI="http://www.xx.com/app/ev1.evt" />
   <location URI="lid://www.xx.com/app/ev3.evt" />
</linkage>
```

Where `"http://www.xx.com/app/ev1.evt"` etc. are the URIs of the behaviour files.

8.5.3.3 Name and location of linkage file

The event linkage file is located in the same directory as the application entry point document.

The file name of the linkage file is formed by replacing any file name extension with the string "lnk". So, for the application entry point document:

```
foo.html
```

the linkage file would be named:

```
foo.lnk
```

8.5.4 Default Trigger Mechanism

The default trigger mechanism is assumed when there is no linkage file associated with a DVB-HTML application. This default mode provides a simple event mechanism in the case where a DVB-HTML application is associated with system events or with trigger events with simple data payload. An overview is provided in figure 12 "Overview of the default trigger mechanism" on page 109.

In that case, any document of the DVB-HTML application that registers for trigger-events is associated with the default event factory file as defined in clause 8.5.2.4 "Default Event Factory File" on page 104. All stream events used in the context of the DVB-HTML application are defined in DSMCC Stream Event messages available in the default location (see clause 8.5.1.3 "Binding to DSM-CC Stream events" on page 99). It is assumed that the name values of the stream events are identical to the trigger event types. Stream events with name values different from trigger event types registered by a document or different from system event names shall be ignored.

In the default mode, all DSMCC Stream Event messages present in the default location will be bound to the application. An application that has registered on a given event name will thus receive several events if they are referenced in different DSMCC Stream Events with this exact value of event name. This may not reflect the original intent of the application author. It is thus recommended that application authors carefully choose the values of event type in their DVB-HTML application when they register on stream events that are originating from different media sources (e.g. by using prefixed names).

Event registration by a DVB-HTML document is performed as described in clause 8.5.1.2 "Application registration and reception" on page 99 except that the listeners need to positioned on the root element node of the DOM tree, since the target of the event will be this node. An example is provided in clause 8.5.2.3 "Default Event Factory Element" on page 104.

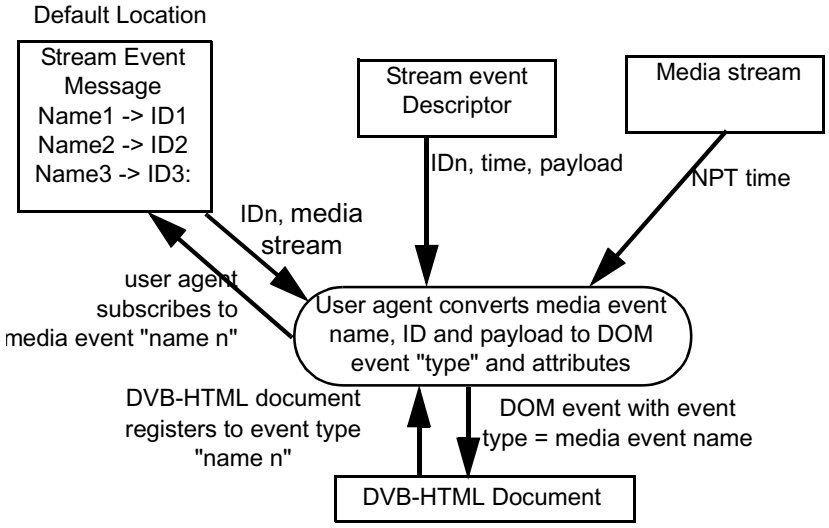


Figure 12: Overview of the default trigger mechanism

The following text provides an informative description of the different steps involved when a DVB-HTML document subscribes to a trigger event in the default mode:

a) The DVB-HTML document, through an embedded Xlet or any attached script, implements an EventListener interface and subscribes to the trigger event through a call to the DOM addEventListener() method on the root element node of the DOM tree with an appropriate event type.

The user agent locates the DSMCC Stream Event message in the default location that contains an event name equal to the registered event type.

The DSMCC Stream Event message provides the mapping between the event name and the event id and references the source of the stream event descriptors that the user agent needs to monitor.

b) On receipt of the stream event descriptor that provides the mapping between the event id and both the eventNPT and the associated payload, the user agent begins the synthesis of the DOM event, as corresponding to the default event factory element. When the NPT of the referenced stream is equal to the eventNPT of the stream event descriptor or as soon as the stream event descriptor is received in case of 'do-it-now' events, the DOM event is injected in the DOM implementation.

c) Payload of the stream event can be fully extracted from the synthesised DOM event through the default 'payload' attribute.

8.6 CSS

Cascading Style Sheets (CSS) are a method to attach a look to HTML or XML content.

8.6.1 Summary of CSS profiling for MHP

DVB-HTML shall support CSS2 as defined in CSS 2 [101] but amended by the profile statements in the following clauses:

- 8.6.2 "MHP profile of CSS data types" on page 110.
- 8.6.3 "MHP profile of CSS @ rules" on page 110.
- 8.6.4 "MHP profile of CSS media types" on page 111.
- 8.6.5 "Graphics and video integration" on page 112.
- 8.6.6 "Font selection" on page 124.
- 8.6.7 "Font specification" on page 125.

An MHP terminal must therefore observe the conformance clauses specified in CSS 2 [101].

8.6.2 MHP profile of CSS data types

The implementations shall support all of the data types defined in CSS 2 [101] except as amended by table 19.

Table 19: MHP profile of CSS data types

Data type	Profile
<alphavalue>	See clause 8.6.4.2.1.1 "opacity" on page 111 The results of opacity blending may be implementation specific, see clause 13.6.1 "Approximations in composition" on page 390.
<angle>	Not required (support for aural style sheets is not required).
<color>	Application authors should not make any assumption on the expected results when using system colours defined in CSS 2 [101]. In particular there is no guarantee that any two system colour names will have distinct appearances.
<frequency>	Not required (support for aural style sheets is not required).
<length>	See clause 8.6.5.2 "Coordinate spaces" on page 113
<shape>	In the present document the only valid <shape> value is: `rect (<top> <right> <bottom> <left>)` The parameters <top>, <bottom> <right>, and <left> specify offsets from the top and left of the box.
<time>	Not required (support for aural style sheets is not required).

8.6.3 MHP profile of CSS @ rules

The implementations shall support all of the @ rules defined in CSS 2 [101] except as amended by table 20.

Table 20: MHP profile of CSS @ rules

Rule	Profile
page	Not required.
viewport	Required, See clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114.

8.6.4 MHP profile of CSS media types

A DVB-HTML user agent is required to support the media types in this clause, support for other media types is optional.

8.6.4.1 "screen" media type

A DVB-HTML user agent shall support the `screen` media type

8.6.4.2 'dvb-tv' media type

A DVB-HTML user agent shall support the `dvb-tv` media type.

The `dvb-tv` media type is a new media type introduced to enable content authors to differentiate an MHP terminal with a predominantly TV like environment (low resolution, possible interlace, specific gamut color, limited-scrollability, small screens, sound available) from an MHP terminal with a more computer desktop like environment. The `dvb-tv` media type is a superset of properties as the `screen` media type as defined in CSS 2 [101]. `dvb-tv` is a member of the following media groups.

Table 21: Relationship between media groups and media types

MediaTypes	Media Groups			
	continuous/paged	visual/aural/tactile	grid/bitmap	interactive/static
dvb-tv	continuous	visual	bitmap	both

8.6.4.2.1 Additional Properties of "dvb-tv" media type

8.6.4.2.1.1 opacity

opacity: Objects may be rendered in a semi-transparent fashion in DVB-HTML using the `opacity` property defined in SVG [105]. Opacity can be thought of as a postprocessing operation. Conceptually, after an object or group of objects is rendered into an RGBA off-screen image, the opacity setting specifies how to blend the off-screen image into the graphics device.

Value: <alphavalue> | inherit

Initial: 1.0

Applies to: all elements

Inherited: no

Percentages: N/A

Media: visual

> **<alphavalue>:** The uniform opacity setting to be applied across an entire object. Any values outside the range 0,0 (fully transparent) to 1,0 (fully opaque) will be clamped to this range. If the object is a container element such as a , then the effect is as if the contents of the element were blended against the current background using a mask where the value of each pixel of the mask is <alphavalue>.

See alpha compositing in clause 13.3.4 "Composition" on page 382.

The CSS boxes are composed following the normal CSS model, however overlapping boxes that have semi opaque colours are composed using the Porter-Duff rules (see Porter-Duff). We define a new property:

8.6.4.2.1.2 dvb-compose-rule

dvb-compose-rule: The default rule used is the `src-over` rule.

CSS allows for a fully transparent background, and with the addition of the compose rule and semi opaque colours semi transparent effects can be achieved. The various approximations defined for compositing in clause 13.3.5 "Composition Rules" on page 383 also apply to the CSS compositing.

Value: clear | dst-in | dst-out | dst-over | src | src-in | src-out | src-over

Initial: src-over

Applies to: all elements

Inherited: no

Percentages: N/A

Media: visual

8.6.4.2.1.3 dvb-clip-video

See clause 8.6.5.8.1.1 "dvb-clip-video" on page 123.

8.6.4.2.1.4 focus traversal

See clause 8.6.5.10 "Focus traversal and short-cuts" on page 123

8.6.4.2.1.5 viewports

See clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114

8.6.4.2.2 Policy rules

When several media types are present in a DVB-HTML document, user agents shall apply the properties settings that are included in the most appropriate `@media` rule. In this case, the user agent shall ignore properties settings that are included in the other `@media` rules targeting other media types. An MHP terminal shall ignore all properties belonging to media types that it does not support or are not selected.

8.6.4.3 Clarifications on support of paged properties

The CSS2 specification CSS 2 [101] appendix F lists properties associated with the paged media group as being also associated with the visual media group, which creates a possible ambiguity with the definition of the `screen` and `dvb-tv` media types which do not support the `paged` media group. For clarification, DVB-MHP does not require the support of the properties where the "media group" column contains "`visual, paged`".

8.6.5 Graphics and video integration

8.6.5.1 General recap of the MHP graphics

The MHP defines three sets of planes, background, background video, and application. The DVB applications draw into the application layer, but may be transparent or translucent to the video planes beneath. Video objects can be placed in the application layer too, and these act as components (e.g. being clipped to the viewport).

MHP defines the following coordinate spaces which can be used in these planes,

8.6.5.1.1 Input video space

This considers post upsampling MPEG pixels.

8.6.5.1.2 Device space

Logical pixels in the various display devices.There may be different device spaces for the various device types (e.g.video and graphics).

8.6.5.1.3 Normalized space

Normalized coordinates relative to the screen.

8.6.5.1.4 Colour

MHP defines a 4 dimensional colour space coordinate system, which covers the sRGB gamut with semi opaque colours.

In DVB-HTML points in the three chroma dimensions are specified using the CSS rgb() or #rgb syntax, the `opacity` property is used to specify the fourth translucency component (see clause 8.6.4.2.1.1 "opacity" on page 111). Any translucency information in referenced images shall also be respected.

8.6.5.2 Coordinate spaces

DVB-HTML applications do not have to fill the entire graphic space, but can specify a rectangle in the screen space, to locate the initial viewport for the application. It can also specify and use a local pixel coordinate space in that viewport for placement of elements within the application.

DVB-HTML applications can also make use of locations in the video space so that elements can be positioned relative to them (e.g. placing captions in black bars).

The definition of `em` and `ex` shall be computed using the rules in clause D.3.4.2 "Horizontal resolution" on page 519, not based on the subtended angle at the eye as in CSS 2.

8.6.5.2.1 Screen coordinates

The screen space coordinates are normalized, and can therefore be expressed in CSS % units where it is defined for MHP that this means percent of screen real estate.

i.e. full screen is top:0 % left:0 % width:100 % height:100 %.

8.6.5.2.2 Pixel coordinates

Pixel coordinates use CSS `px` units, these describe logical pixels in the viewport (which in the same way as `HGraphicsDevice`, may not actually map to physical device pixels), and define the coordinate space of the viewport.

8.6.5.2.3 Video coordinates

To address positions based on the video coordinate space the *pel* numeric type is defined.

e.g. the style

```
#captions { position: fixed; top: 23pel; left: 43pel; width: 100pel; height: 60pel }
```

establishes a fixed box in the viewport, the rectangle of which is based on (43, 23, 100, 60) in the source video (see clause 8.6.5.6.2 "Definition of pel areas in the video" on page 122 for how this is computed into an actual box).

8.6.5.3 How to define the initial containing block

8.6.5.3.1 Problem

The rectangle on screen that is the logical equivalent of the `HScene` in DVB-J, is called the *viewport* in CSS. Since this does not have to fill the screen, it is required to be able to establish the coordinate space that this viewport has (if this is not specified by the application then the user agent can use the natural pixel resolution for the device). Within the viewport the user agent needs to establish the root containing block for the document to be laid out in - following the normal CSS rules, this is defined in the viewport pixel coordinate space and may not extend to the full size of the viewport.

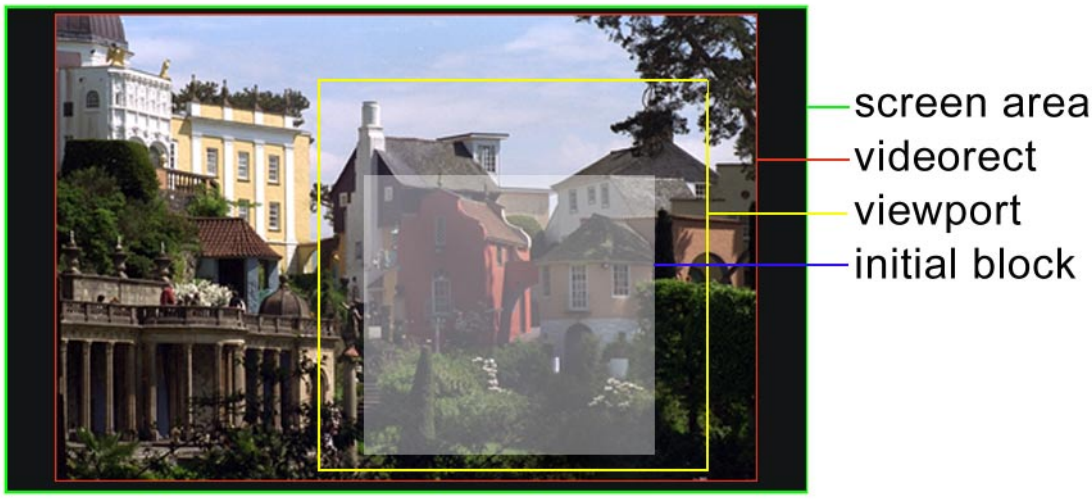


Figure 13: CSS Boxes

8.6.5.3.2 The @dvb-viewport rule

Viewport context: The `@dvb-viewport` rule is used to define the viewport for the application. This is roughly equivalent to the `@page` rule for printed output. The declarations that it contains are defined to be in the **viewport context**.

Only one viewport can be in effect at a time, and this is defined by the cascade referenced by the stylesheet of the root containing document (see clause 8.6.5.4 "Cascading" on page 120 and also clause 8.6.5.3.4 "Pseudo classes" on page 119) for example:

```
@dvb-viewport {
      scene: (25%, 25%, 50%, 50%);
      hres: 288px;
      vres: 360px;
      initial: (94px,130px,100px,100px)
}
```

Specifies that:

- the viewports scene is 1/4 screen and centred,
- that the desired coordinate resolution of the viewport is 288 x 360,
- and the initial containing block is a 100 x 100 square approximately centred within the viewport.

8.6.5.3.3 Establishing a viewport

8.6.5.3.3.1 Viewport properties

The following properties may be used inside a `@dvb-viewport` rule. DOM access to these properties is provided by clause 8.6.5.9 "DOM Access to CSS" on page 123. Implementations are not required to respect property requests in the `@dvb-viewport` rule that would require the implementation to exceed the minimum requirements defined in clause G.3 "Video" on page 546. By giving DOM write access to these properties the application can dynamically change the backgrounds. By giving DOM read access the actual values can be discovered to adapt to the current local conditions.

scene: The `scene` property specifies where the CSS viewport lies in terms of percentage of the `area` allocated to the application (this `area` is by default based on the video rectangle but may be changed, see clause 8.6.5.5.1 "The area property" on page 120).

Value: <shape>

Initial: rect(0%, 100%, 100%, 0%)

Applies to: Viewport context

Inherited: no

Percentages: area

Media: visual

<shape>: See table 19 "MHP profile of CSS data types" on page 110. In this context `<top>`, `<bottom>` `<right>`, and `<left>` specify <percentage>.

<percentage>: The offset is a percentage of the width (for `left` or `right`) or height (for `top` and `bottom`) of the `area` (see clause 8.6.5.5.1 "The area property" on page 120).

horizontal-resolution: Determines the number of logical pixels horizontally in the viewport and defines the grid to which `px` units in the stylesheet apply. NB the logical pixels do not have to match with the actual device pixels.

Value: <length>

Initial: 720px

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

vertical-resolution: Determine the number of logical pixels vertically in the viewport and defines the grid to which `px` units in the stylesheet apply. NB the logical pixels do not have to match with the actual device pixels.

Value: <length>

Initial: 576px

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

initial: This establishes the box for the root element of the layout. CSS allows that the initial containing block be larger than the viewport, and in this case it states the user agent should offer a mechanism for scrolling, since this may not be appropriate on an MHP it is advised that authors do not use initial blocks larger than the viewport. If they do then the user agent shall clip to the viewport, and may provide mechanisms to view the clipped regions.

Value: <shape>

Initial: rect(0%, 100%, 100%, 0%)

Applies to: Viewport context

Inherited: no

Percentages: Scene

Media: visual

<shape>: See table 19 "MHP profile of CSS data types" on page 110. In this context `<top>`, `<bottom>` `<right>`, and `<left>` specify `<length>` or `<percentage>`.

<length>: The offset is a fixed distance from the reference edge (`top` or `left`) in the logical pixels of the `scene`.

<percentage>: The offset is a percentage of the `width` (for `left` or `right`) or `height` (for `top` and `bottom`) of the viewport established by the `scene` property.

8.6.5.3.3.2 Other viewport properties

These properties will mostly be useful for interrogation of the video processing being performed so that a presentation can be tailored to fit, but they also allow the manipulation of the background devices.

These are used after the viewport is selected (see clause 8.6.5.3.4 "Pseudo classes" on page 119), and allow the application to override the presentation of the background properties.

type: The type defines whether the viewport should attempt to preserve graphic fidelity or video fidelity. It can also require that the pixel coordinate space be aligned with the video coordinate space.

Value: video | graphics | aligned | none

Initial: none

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

background-image-rectangle: This property of the viewport defines the shape of the image placed on the background device.

Value: <shape>

Initial: rect(0%, 100%, 100%, 0%)

Applies to: Viewport context

Inherited: no

Percentages: screen

Media: visual

<shape>: See table 19 "MHP profile of CSS data types" on page 110. In this context `<top>`, `<bottom>` `<right>`, and `<left>` specify `<percentage>`.

<percentage>: The offset is a percentage of the screen `width` (for `left` or `right`) or `height` (for `top` and `bottom`).

background: This property of the viewport defines the image or colour to be used in the background plane when the application has the focus.

Value: <uri> [, <colour>] | <colour>

Initial: black

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

If a `<uri>` is specified it should point to an image in an MHP supported format, other formats may be supported. If the resource is not found then the optional fallback colour or the initial value will be used

background-video-rectangle-n: This property of the viewport defines the output rectangle (in percent of the screen) of the background video device (see clause 8.6.5.3.3.3 "n planes" on page 119 for explanation of the "-n" notation). The default is full screen. The pel aspect ratio of this rectangle is the same as that of the screen. the resolution however is a subset of the screen resolution.

Value: <shape>

Initial: rect(0%, 100%, 100%, 0%)

Applies to: Viewport context

Inherited: no

Percentages: screen

Media: visual

> **<shape>:** See table 19 "MHP profile of CSS data types" on page 110. In this context `<top>`, `<bottom>` `<right>`, and `<left>` specify <percentage>.
>
> **<percentage>:** The offset is a percentage of the screen `width` (for `left` or `right`) or `height` (for `top` and `bottom`).

background-video-clip-n:
This property of the viewport defines the input (clipping) rectangle of the background video source (see clause 8.6.5.3.3.3 "n planes" on page 119 for explanation of the "-n" notation). The clipping maintains the pel aspect ratio of the screen. This clipping rectangle then induces a video transform, which should not be specified. The transform in this case may not be limited to one of the given constants (see "background-video-transform-n:" on page 118), but will usually be "DFC_PROCESSING_CCO" on page 118

Value: <shape>

Initial: rect(0%, 100%, 100%, 0%)

Applies to: Viewport context

Inherited: no

Percentages: input video

Media: visual

> **<shape>:** See table 19 "MHP profile of CSS data types" on page 110. In this context <top>, <bottom> <right>, and <left> specify <pels> or <percentage>.
>
> **<pels>:** The offset is specified in the pels of the input video.
>
> **<percentage>:** The offset is a percentage of the input video width (for "left" or "right") or height (for "top" and "bottom").

background-video-preserve-aspect-n: This property of the viewport defines how the input video source rectangle is transformed onto the display output rectangle (see clause 8.6.5.3.3.3 "n planes" on page 119 for explanation of the "-n" notation). If the value is false the video is transformed with no regard for the aspect ratio of the source or destination but simply scales the input grid to the output grid, if true (the default) the aspect ratio of the source is preserved onto the aspect ratio of the destination and scaled as much as possible (some of the output rectangle may be filled with black letterbox bars).

Value: true | false

Initial: true

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

background-video-n: This property of the viewport defines the locator of the video source or service (see clause 8.4.18 "DVB Service styling" on page 98) to be used in the background video plane when the application has the focus (see clause 8.6.5.3.3.3 "n planes" on page 119 for explanation of the "-n" notation). If not specified the MHP uses the media components of the currently playing service.

Value: <uri> (, <uri>)* | <color>

Initial: dvb.current

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

If a `<uri>` is specified it should point to a video component or service. If the resource is not found then the optional fallback `<uri>`s may be tried in order, if no resource is found the MHP uses the media components of the currently playing service.

background-video-transform-n: This property of the viewport defines the transform of the video to the output rectangle (see clause 8.6.5.3.3.3 "n planes" on page 119 for explanation of the "-n" notation). It has one of the symbolic constant values:

Value: <process>

Initial: DFC_PROCESSING_DEFAULT

Applies to: Viewport context

Inherited: no

Percentages: N/A

Media: visual

<process>: One of the following constant values:

DFC_PROCESSING_CCO: A central rectangle is cut out of the video input frame and transferred into the output video rectangle defined by the corresponding background-video-rect

DFC_PROCESSING_FULL: The full video input frame is transferred, part of the output may be black if the video input aspect is not the same as the output frame aspect.

DFC_PROCESSING_LB_14_9: The video input frame is transferred into a 14:9 letterbox in the output frame defined by the corresponding background-video-rect.

DFC_PROCESSING_LB_16_9: The video input frame is transferred into a 16:9 letterbox in the output frame defined by the corresponding background-video-rect.

DFC_PROCESSING_LB_2_21_1: The video input frame is transferred into a 2,21:1 letterbox in the output frame defined by the corresponding background-video-rect.

DFC_PROCESSING_DEFAULT: The default decoder format conversion is active.

DFC_PROCESSING_PAN_SCAN: An mxn part out of the video input frame is transferred into the output frame defined by the corresponding background-video-rect. The position of this part is determined by pan and scan vectors from the MPEG video stream.

DFC_PROCESSING_UNKNOWN: Constant representing an unknown format conversion being performed by the decoder. (e.g. if a manual transform is defined). This value cannot be set

8.6.5.3.3.3 n planes

The "n" is to be replaced by an integer number greater than or equal to zero defining the plane in the video layers, where 0 is the furthest plane from the viewer. The "-n" is optional with `background-video-rect` equivalent to `background-video-rect-0`.

8.6.5.3.4 Pseudo classes

Viewports can be labelled with pseudo-classes which allow the application to adapt to the physical structure of the MHP display or output system. For example:

```
@dvb-viewport :16x9 { ... }
@dvb-viewport :4x3 { ... }
```

The pseudo-class syntax is as follows:

```
display-pseudo-class = ":" [ aspect-ratio ] [ resolution ] [ scan ]
aspect-ratio = integer "x" integer
resolution = "R" integer "x" integer
scan = "P" | "I"
```

integer is an <`integer`> as defined in the CSS 2 specification

where the components of the pseudo-class have the following meanings:

aspect-ratio: specifies the physical display pixel aspect ratio

resolution: specifies the physical display pixel resolution

scan: specifies whether the display is progressive scan ("P") or interlaced ("I")

This allows most of the common formats to be defined.

A pseudo-class matches a display if each component of the pseudo-class either exactly matches the display or is not present.

`EXAMPLE 1: 16x9R720x576P`
Matches a progressive scan 16 x 9 display with 720 x 576 pixels.

`EXAMPLE 2: 4x3R1024x768`
Matches a 1 024 x 768 display with 4 x 3 pixel aspect ratio, either interlaced or progressive scan.

If the pseudo-class for more than one `@dvb-viewport` rule matches a display, one rule is chosen by applying the CSS 2 cascade algorithm (CSS 2 [101] section 6.4 "The cascade"). In addition to the description of specificity there, the relative specificities of several display pseudo-classes is determined by summing the number of components which are specified; for example, "P" has a specificity of 1, "16x9R720x576P" has a specificity of 3.

8.6.5.4 Cascading

The `@dvb-viewport` properties cascade in the normal manner. However, only those viewport properties that are defined in the context of the document of the DVB-HTML application displayed in a root window shall be used to determine the application's viewport. Any `@dvb-viewport` properties defined in the context of a document that is not displayed in the root window shall be ignored.

NOTE: Therefore applications running in sub frames cannot control the viewport or background video.

8.6.5.5 How to discover where the video is

In order to have good visual synchronization with video in the background plane, a DVB-HTML application will need to be able to determine the intersection of the viewport and the background video areas, both the active video and any additiona "bar" areas caused by letterboxing.

8.6.5.5.1 The area property

DVB-HTML defines an `@dvb-viewport` property *area* which defines the rectangle of which the viewport is a sub rectangle. This has the following logical values, which can be combined together.

screen: uses the screen as reference, not the background video, this cannot be combined with other values.

total-video-area-on-screen: defines the box on screen where the video is including any bars the MHP knows about

active-video-area-on-screen: defines the box on screen where the video is excluding bars

LV-bar: limits the area to the left hand vertical letterbox bar.

RV-bar: limits the area to the right hand vertical letterbox bar.

TH-bar: limits the area to the top horizontal letterbox bar.

BH-bar: limits the area to the bottom horizontal letterbox bar.

EXAMPLE 1: `area: totalVideoAreaOnScreen`

is the default, and would limit the viewport to exactly where the video is being placed (including letterbox bars)

Combinations must add up to a single rectangle.

EXAMPLE 2: `area: activeVideoAreaOnScreen & BHBar`

would be legal and would allow the use of the area in the lower letterbox bar but not the top bar

EXAMPLE 3: `area: LVBar & THBar`

would be illegal

EXAMPLE 4: `area: THBar & BHBar`

would be illegal

EXAMPLE 5: `area: THBar & BHBar & activeVideoAreaOnScreen`

would be legal and would allow the use of the area in the upper and lower letterbox bar and the active video area

The order of property evaluation is as follows:

- first the background video rectangle is established (see "background-video-rectangle-n" on page 117, the default is full screen). The viewport is established with respect to the furthest video plane from the viewer.
- then the `area` is determined, (the default is the total active video area). and finally the viewport and initial box are determined. These would all have to be recalculated if the background video rectangle were to change (either by the terminal or by DOM control)

8.6.5.6 Placing content in relation to video

The terminal defined starting cascade style sheet implicitly defines (see "Definition of boxes" on page 122) the following regions when the viewport contains them.

```
.active-video-area-on-screen
.total-video-area-on-screen
.LV-bar
.RV-bar
.TH-bar
.BH-bar
```

so that for example the document

```
<!DOCTYPE
   html PUBLIC "-//DVB//DTD XHTML DVB-HTML 1.0//EN"
   "http://www.dvb.org/mhp/dtd/dvbhtml-1-0.dtd"
>
<html>
<head>
   <title>css demo</title>
   <style type="text/css">
   <!--
   @dvb-viewport 16x9I{
      area: active-video-area-on-screen & BH-bar
   }
   -->
</style>
</head>
   </body>
      <div class="active-video-area-on-screen"> </div>
      <div class="BH-bar"> </div>
   </body>
</html>
```

Would use allow the placement of material in the lower black bar and over the video area.

8.6.5.6.1 Definition of boxes

The named regions are defined as the intersection of the viewport (shown in the illustration as the yellow rectangle) with the relevant area, therefore the regions could potentially be empty, in this case no content is displayed for that region. For example the `#TH-bar` shown in blue in the illustration below does not cover the whole of the letterbox bar, but only that which intersects the viewport. Similarly the `active-video-area-on-screen` region shown by the purple rectangle does not cover all the live video, but only that which intersects the viewport.

Figure 14: Example of named screen regions

8.6.5.6.2 Definition of pel areas in the video

Positions defined by using the pel type are defined to be the pixel location in the viewport where the corresponding video pel is translated to. In the case that the transformed pel covers more than one pixel, the top most left most pixel is used. This allows the placement of content in relation to elements within the video.

NOTE: the pixel may not be within the viewport, and so may get clipped. it could also change with pan and scan.

The video plane used to define the pel coordinate system shall be the backmost active video plane. If no video plane is active then the pel type is defined as equal to the px type.

8.6.5.7 Placing video within the presentation

8.6.5.8 Box Layout

8.6.5.8.1 Video Boxes

Video content may be placed in an `<object> or <img>` element. Using style rules the box for this can be positioned following the normal CSS rules anywhere within the viewport. This acts like a video component in DVB-J, and is entirely separate from video in the background plane.

When placing video inside an element, the video inside that element is positioned and scaled by any positioning and resizing of the element due to style, If the implementation does not support arbitrary scaling of video, then the resource shall be treated as not available and the fallback elements (if any) applied, otherwise the video shall be scaled as required. The video is always scaled to the full size of the element.

NOTE: Since the video is scaled to exactly fit the elements box, the `overflow` and `clip` attributes have no meaning for such elements.

Video element objects are treated as defined by the styling of the element. However, it is not required to support `opacity` style on such elements.

8.6.5.8.1.1 dvb-clip-video

The mapping to the source video is provided by the `dvb-clip-video` property which allows an arbitrary portion of the video to be placed within the element.

dvb-clip-video: The dvb-clip-video property defines the bounding box of the source rectangle in the source video allowing an arbitrary portion of the video to be placed within the element (as in figure 38 "Introducing video into the AWT component stack" on page 388). The coordinate space used to express the region is that of the decoded video after possibleTS 101 154 [9] up-sampling. This rectangular segment of the video is then used to fill the element to which the style property is applied

For example:

<object src="dvb://current" style="dvb-clip-video:rect (10pels, 50pels, 70pels, 90pels)"/>.

Value: <shape>

Initial: full video rectangle

Applies to: object, image

Inherited: no

Percentages: N/A

Media: visual

Media: visual

<shape>: See table 19 "MHP profile of CSS data types" on page 110. In this context <top>, <bottom> <right>, and <left> specify <pels>

<pels>: The offset is specified in the pels of the input video and indicates an offsets from the left or top edge of the video as appropriate.

8.6.5.9 DOM Access to CSS

In order to gain programmatic access to the `@dvb-viewport` rule the language specific binding for the DOM interface specified in clause 8.9.8.1.3 "DVBCSSViewportRule" on page 165 may be used.

8.6.5.10 Focus traversal and short-cuts

In MHP it is possible to determine the order of traversal of elements using the navigation keys, and to specify certain keys as short cuts.

The `dvb-tv` media type includes the following additional style properties:

Table 22: Navigation properties

Property	Meaning
nav-up	References the visual element to receive focus on receipt of the VK_UP event
nav-down	References the visual element to receive focus on receipt of the VK_DOWN event
nav-left	References the visual element to receive focus on receipt of the VK_LEFT event
nav-right	References the visual element to receive focus on receipt of the VK_RIGHT event
nav-index	Provides a navigation number for the element. This number must be unique on the page.
nav-first	An element with this style will be given focus on first presentation of the page.

The values of nav-up, nav-down.nav-left, and nav-right may be <integer>, in which case the referenced element is the element with the corresponding nav-index style, or they may be <string>. The <string> has the following syntax:

```
value:      '[outer]' | [frame-ref] '#' [elem-ref]
frame-ref:  frameid |
elem-ref:   '$'integer | elemid
```

where:

frameid: is the id of the frame containing the referenced item (the current frame is the default). The same rules shall apply as for the target attribute in HTML 4 [104], except that steps 3 and 4 of Annex B.8 therein shall not apply as DVB-HTML does not open new windows.

elemid: is the id of the referenced item. At least one of the frame-ref or elem-ref optional elements must be present if value is not [outer].

integer: is a positive integer, and represents the element with the corresponding nav-index style (the default is the element with the nav-first style).

e.g.

```
<style type="text/css">
   #foo nav-right:"frame1#bar"
</style>
```

Would indicate the style for the element with the id foo, would navigate the focus to the element with the id "bar" in the frame "frame1".

The following string is reserved and has special meaning:

[outer]: This string refers to the external application context in the case that the DVB-HTML application is an inner application. If this name is used in the case where the application is not an inner application it shall be ignored.

If the element to receive the navigation focus cannot be determined by these rules, then the user agents default focus processing should be applied.

NOTE: The navigation hints should be used with some care, as the user agent may have applied defaults based on the current layout. If an author overrides these defaults, then the layout may produce non intuitive results for the viewer.

8.6.6 Font selection

There are four possible font selection actions defined in CSS2: name matching, intelligent matching, synthesis, and download. A user agent shall support the font matching algorithm as defined in section 15.5 in CSS 2 [101]. The user agent is not required to support intelligent font matching algorithm and font synthesis or their associated descriptors as described in table 23 "Descriptor support in MHP" on page 124. The user agent shall support the CSS2 @font-face rule and shall ignore any font index file co-located with a DVB-HTML application.

Table 23: Descriptor support in MHP

Descriptor	Required
ascent	
baseline	
bbox	
cap-height	
centerline	
definition-src	
descent	
font-family	Yes

Descriptor	Required
font-size	Yes
font-stretch	Yes
font-style	Yes
font-variant	Yes
font-weight	Yes
mathline	
panose-1	
slope	
src	Yes
stemh	
stemv	
topline	
unicode-range	Yes
units-per-em	Yes
widths	
x-height	

8.6.6.1 Restrictions on "src" descriptor

The user agent shall fully support the descriptor for Referencing: `src` with the following restrictions:

- The only format type required to be supported for the font `src` descriptor is `"truedoc-pfr"`.
- The only string required to be supported for the <font-face-name> value for access to local fonts is `"Tiresias"`, see clause G.4.1 "The built-in font" on page 546.

8.6.7 Font specification

The user agent is required to support the following set of properties for selecting a font:

- `font-family`
- `font-style`
- `font-variant`
- `font-weight`
- `font-stretch`
- `font-size`
- `font-size-adjust`
- `font`

Setting `font-stretch` and `font-size-adjust` is not required to have any visual effect in a constrained graphics environment.

The text rendering model used by the user agent shall respect the text rendering model defined in clauses D.3.4, D.3.5, D.3.6.1 and D.3.6.2.

8.6.8 Default behaviour

In the absence of any other styling information for a page, the user agent shall render using the default stylesheet in annex AB "(normative): DVB HTML StyleSheet" on page 983

8.6.8.1 Default style sheet font rules

For DVB HTML user agents the style sheet referred to by CSS 2 (see UA default stylesheet in CSS 2 [101]) will consist of the stylesheet in annex AB. This stylesheet is not directly accessible to DVB HTML applications.

In addition to the style entries listed in the appendix, this stylesheet shall also provide `@font-face` rules for all installed fonts, which shall at least cover the minimum installed set of fonts (see clause G.4 "Resident fonts and text rendering" on page 546) and have rules for the CSS 2 generic families, `serif, sans-serif, cursive, fantasy` and `monospace`.

The minimum requirement of the additional font rules are:

- The implementation-specific stylesheet shall provide a font description with name "`Tiresias`".
- The implementation-specific stylesheet shall provide the normal weight.
- The implementation-specific stylesheet shall provide the normal stretch.
- The implementation-specific stylesheet shall provide at least the point sizes required (see table G.4 "Example font sizes and use cases" on page 546).
- The implementation-specific stylesheet shall provide a `src`: to locate the font data.
- The implementation-specific stylesheet shall not provide `font-style` or `font-variant` declarations unless the implementation also provides font data that would visually distinguish the rendered text.

For example a minimal implementation might use the following rule:

```
@font-face {
    font-family: "Tiresias", serif, sans-serif, cursive, fantasy, monospace;
    font-weight: normal;
    font-stretch: normal;
    font-size: 36pt, 31pt, 26pt, 24pt;
  }
```

8.6.8.1.1 Extending the simple rule

An implementation may additionally include `unicode-range`: data for the installed fonts, and other "Descriptors for Matching" (CSS 2 [101] spec Section 15.3.6), which might be used, e.g. for `font-size-adjust`.

8.6.8.1.2 Fallback for italic, small caps and font stretch

The rules above imply that the available fonts cover all variations of `italic`, `small-caps` and `font-stretch`. An implementation that only had the minimum installed fonts should present the same (plain) style glyphs for any combination of the styles required by CSS 2.

NOTE: This allows an author to use `font-style: italic, font-weight: bold` etc. in stylesheets without having text so styled appear as missing character glyphs when using Tiresias, but they should be aware that no extra styling information may be displayed.

8.7 Xlet integration

DVB-HTML defines an <object> element that may be used for embedded Xlets. For <object> elements used for embedded Xlets the type should be set to "application/dvbj", the <object> element may contain <param> elements containing run time arguments for the Xlet defined by the <object> element. The sequence of these arguments is mapped to XletContext.ARGS and shall be available to the Xlet, in the form of an array of Strings, by calling:

```
javax.tv.xlet.XletContext.getXletProperty(XletContext.ARGS)
```

If no valid arguments are defined, this method shall return an array of strings with zero elements.

By default the application identifier of Xlets contained in DVB-HTML are the same as that of the enclosing application.

Using the AppID attribute the embedding HTML context can supply a different AppID for the Xlet, thus giving it a different context (e.g for persistent file locations). The value given for the AppID attribute must be one of those given in the DVB-HTML application descriptor (see clause 10.10.1). An Xlet with an AppID assigned by the HTML application is still considered part of the single DVB HTML application, e.g. for inter application communication.

If an Xlet and an embedded Xlet have the same application identifier it is only possible for one to be running at any time. So, if the Xlet has already started then a DVB-HTML application shall not be able to start an embedded Xlet with the same application identifier. Conversely, if the embedded Xlet has already started the Xlet shall not start. Any lifecycle signalling associated with an Xlet with the same application identifier as an embedded Xlet shall not apply to the embedded Xlet. If DVB-HTML application attempts to start an embedded Xlet that has a an application identifier that conflicts with an already running application:

- the embedded Xlet shall not be started
- the already running application is not considered apart of the DVB-HTML application

8.7.1 Object element

When used to include an Xlet inner application the following object element attributes semantics shall apply:

declare: when present, makes the current object definition a declaration only. The object must be instantiated by a subsequent object definition referring to this declaration.

classid: specifies the location of the class that implements the interface javax.tv.xlet.Xlet. Exactly one instance of this Xlet class shall be created. The URI shall be evaluated as relative to the codebase attribute.

codebase: specifies the base URI for the Xlet. Xlet classes are loaded relative to the "directory" specified by this locator. If this attribute is not specified, then it defaults to the same base URI as for the DVB-HTML document carrying the object element. If the URI is not within the application containing the Xlet then the Xlet shall not be loaded.

codetype: specifies the content type of the data referenced by the classid and codebase attributes. In the case of Xlets it will be set to the MIME type for Xlets (application/javatv-xlet).

archive: This is ignored for embedded Xlets.

standby: specifies a message that a user agent may render while loading the objects implementation and data.

height, width: these attributes specify the size of the Xlet's visible representation. If either height or width is zero or negative, then the method javax.tv.graphics.TVContainer.getRootContainer() shall return null.

8.7.2 Param element

The param element is defined for embedding inner application Xlets as follows:

```
<!ELEMENT param EMPTY>
<!ATTLIST param
   id          ID               #IMPLIED
   name        CDATA            #REQUIRED
   value       CDATA            #IMPLIED
   valuetype   (data|ref|object) "data"
   type        CDATA            #IMPLIED
>
```

where the specified attributes are defined as follows:

id: is a unique identifier for the param element. The scope of uniqueness is the document carrying the param element.

name: should be set to either arg_n (case-insensitive), where n is a non negative integer, or, appid.

- Where the name is of the form arg_n this specifies that the value argument contains the value of run time argument number n for the Xlet. If the largest value for n among the param tags is x, then the ARGS array shall contain x+1 elements. If two param elements with the same name are given for an Xlet, the corresponding array element shall contain the value of one of them. Which one is chosen is not specified.

  These arguments are available to an Xlet through XletContex.getXletProprty(XletContext.ARGS) as defined in Java TV [51].

- The appid shall carry a 16 bit bit string (left bit first) encoded as follows:

  ```
  appid = "0x" 4*hex
  hex   = digit | "A" | "B" | "C" | "D" | "E" | "F" | "a" | "b" | "c" | "d" | "e" | "f"
  digit = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
  ```

  If more than one parameter tag with the name appid is provided or the value does not correspond to that of one of the application ids listed in the DVB-HTML application descriptor (see clause 10.10.1) the Xlet shall not be started.

value: is the string value of this run time argument.

valuetype: ignored. Xlet arguments can only be strings, so it doesn't make sense to provide values of any other type.

type: ignored. This follows from the treatment of valuetype.

8.7.3 Example

The following is an example of using object and param elements in order to include an Xlet inner application in a DVB-HTML document:

```
<object
   id = "slideShow"
   codetype = "application/dvbj"
   classid = "slideShow.class"
   codebase = "first_xlet/"
   height = "180"
   width = "320">
   <param name = "arg_0" value = "Everest"/>
   <param name = "arg_1" value = "Kilimanjaro"/>
   <param name = "appid" value = "0xbded"/>
</object>
```

8.8 Scripting

ECMAScript is a simple lightweight object-oriented scripting language for manipulating computational objects within a host environment. The present document requires ECMAScript as defined in ECMA-262 [95].

8.8.1 DOM 2 binding

The present document requires the DOM 2 binding libraries for the interfaces required in clause 8.9 "Document Object Model (DOM)" on page 135 as defined in the respective references.

8.8.2 Interface between ECMAScript and DVB-J

By allowing DVB-J to expose APIs to ECMAScript, applications may be created which are a hybrid of DVB-J and DVB-HTML/ECMAScript. For example, the core engine for a particular application could be implemented in DVB-J and the user interface and graphical content implemented in DVB-HTML/ECMAScript.

8.8.2.1 ECMAScript APIs for accessing DVB-J

Public DVB-J: packages, classes, methods and fields shall be visible in ECMAScript using a property of the global object called Packages. For example, RMI's Naming class would be accessed using Packages.java.rmi.Naming. The java.lang package is accessed using Packages.java.lang. In addition to DVB-J classes, class files located in the codebase as specified by the meta tag described below are also accessible.

Xlets may be accessed via the DOM or accessed via the inter application communication API, see clause 11.7.3 "Inter-Application and Inter-Xlet communication API" on page 292.

When ECMAScript uses the Packages object to reference a Java class that is not loaded, the codebase is searched for the class file. The codebase is specified using a meta element with a name "codebase" and the "content" specifying the classpath as a base URL, e.g.

```
<meta name="codebase" content="http://example.com/sports/">
```

If multiple codebase meta elements are present in the root document, each specified codebase is searched in its order of appearance. If the class is not found, a java.lang.ClassNotFound exception is thrown. Only meta elements on the root document of the DVB-HTML application may specify the codebase; others have no effect.

ECMAScript contexts within an application share a single classloader. This classloader is separate from that of any Xlets that are part of the DVB HTML application.

8.8.2.2 Inter-Xlet and Xlet-ECMAscript Communication via org.dvb.ixc

In MHP, Xlets are allowed to communicate with each other by exporting objects via the org.dvb.io.ixc APIs described in clause 11.7.3 "Inter-Application and Inter-Xlet communication API" on page 292 and annex Y "(normative): Inter-application and Inter-Xlet communication API" on page 962. When an Xlet wishes to export an object so that it is visible to other applications, it is exported under a name formed from a string that contains a unique application identifier, possibly with an arbitrary name appended.

With Xlets embedded in a DVB-HTML document, there is the possibility that there will be multiple active Xlets that are part of the same application. Each such Xlet will have its own classloader (see clause 8.8.2.1), and will not be able to directly share instances with other Xlets. The Xlets will be able to communicate with each other, using the inter-xlet communication mechanism, accessed through the org.dvb.io.ixc APIs.

The MHP naming convention for exported objects are preserved. The APIs provide two options for exporting objects: Exporting them so that they are only visible within the same application, or exporting them so that they are visible to other applications. In either case, it is possible for two Xlets to export an object under the same name. If this happens, the last object exported shall be the one that is visible; an export from one Xlet might therefore overwrite an export from another that occurred earlier in time.

NOTE: Xlets that are in the same DVB-HTML document (and part of the same application) are expected to be authored to work together, so it is the application author's responsibility to ensure that no harmful overwriting occurs.

8.8.2.3 Security

The DVB-J security model applies to the application as a whole, hence an Xlet embedded in an DVB-HTML document has the privileges of the overall DVB-HTML application. ECMAScript may directly invoke DVB-J with the same permissions as the overall application.

See also clause 8.12 "Security of DVB-HTML applications" on page 170.

NOTE: ECMAScript can pass both internal and external strings across the bridge to Java, but Java has no way to distinguish between them. Hence, Java code written for use across the bridge should treat such strings as it would any other strings from untrusted sources.

8.8.2.4 Implicit Method Selection

When more than one method signature matches the set of arguments, argument preference is compared for each argument starting with the first, until one signature has a preferred match. Preference is determined from the argument conversion tables in the following clause. In those tables, type conversions are listed in decreasing order of preference.

8.8.2.5 Explicit Method Selection

Methods may be selected explicitly by referring to a method as if it were an element of an ECMAScript associative array indexed by the signature, e.g.

```
new Packages["java.lang.String"]["(char[])"](c);
```

8.8.2.6 Static Method Invocation

Static methods of a Java class shall be invocable from ECMAScript either on the JavaClass object or on an instance of the class.

8.8.2.7 Method Signature Matching

Typically, methods invoked from ECMAScript are designed for that purpose and unambiguous. In most cases, it is probably sufficient to leave method selection up to the implementation, however the tables below define both the preferred order used for selecting signatures and the type conversion invoked when an argument is passed.

Method selection is performed similarly to DVB-J. The DVB-J method must:

- Be public.
- Be static or non-static depending on whether the ECMAScript invocation is on the class or on an object, respectively.
- Have the same number of arguments.
- Have arguments with types to which the ECMAScript arguments can be converted according to the tables below.

If these conditions are not met, the DVBException with the error code CONVERSION_TYPE_ERR is raised.

If there is only one DVB-J method matching these criteria, that method is invoked.

If more than one DVB-J method matches, then a method is preferred over another for invocation when the conversion of at least one of its arguments is preferred and the conversion of all other arguments is equivalent or preferred. In cases where no method is preferred over all others, results may be implementation dependent.

8.8.2.8 New ECMAScript Object Types

ECMAScript is a loosely typed language with few fundamental types (mainly: Number, Boolean, String, Object, Null and Undefined). In order to access DVB-J's richer type structure, three new ECMAScript object types are introduced to support values returned from calls to DVB-J.

Table 24: New ECMAScript Object Types

ECMAScript Object Type	Description
JavaArray	Wrapper for a DVB-J array. Behaves like an ECMAScript array including being indexed by an integer and having a length property
JavaObject	Wrapper for a DVB-J Object. Converting this wrapper to a string, calls the toString() method. Converting to a number calls the doubleValue() method. Converting to a boolean results in true, unless the object is null.
JavaClass	Wrapper for a DVB-J class

8.8.2.9 Type Conversion (ECMAScript to DVB-J)

In the following tables conversions are listed in decreasing order of preference (from top to bottom within the table and from left to right within each table row). Conversions that are not listed are not allowed.

When the ECMAScript parameter is a boolean, conversion is performed as follows:

Table 25: Conversion from ECMAScript boolean

DVB-J Parameter Type	Conversion from ECMAScript boolean
boolean	Direct conversion.
java.lang.Boolean java.lang.Object	Object of type java.lang.Boolean.
java.lang.String	Converted to "true" or "false".
double, float, long, int, short, char, byte	1, if true. 0, if false.

When the ECMAScript parameter is a number, conversion is performed as follows:

Table 26: Conversion from ECMAScript number

DVB-J Parameter Type	Conversion from ECMAScript Number
double	Direct conversion with full precision.
java.lang.Double	java.lang.Double created with full precision.
Float	Rounded to float precision. Values out of float range become +infinity or –infinity.
long, int, short, char, byte	Rounded to appropriate precision. Values out of range causes the DVBException with the error code CONVERSION_TYPE_ERR to be raised. Passing NaN causes the DVBException with the error code CONVERSION_TYPE_ERR to be raised.
java.lang.String	Conversion to a string using the ECMAScript toString function.
boolean	Passing NaN causes the DVBException with the error code CONVERSION_TYPE_ERR to be raised. 0 is false. Non-zero is true.
java.lang.Object	java.lang.Double created with full precision

When the ECMAScript parameter is a string, conversion is performed as follows:

Table 27: Conversion from ECMAScript string

DVB-J Parameter Type	Conversion from ECMAScript string
java.lang.String java.lang.Object	Object of type java.lang.String.
char	If string is a single character, conversion via the ECMAScript charCodeAt() function; otherwise the DVBException with the error code CONVERSION_TYPE_ERR is raised.

When the ECMAScript parameter is undefined, conversion is performed as follows:

Table 28: Conversion from ECMAScript undefined

DVB-J Parameter Type	Conversion from ECMAScript undefined
java.lang.String java.lang.Object	Object of type java.lang.String with a value of "undefined".
boolean	False
long, int, short, byte, char	Zero
double, float	Nan

When the ECMAScript parameter is null, conversion is performed as follows:

Table 29: Conversion from ECMAScript null

DVB-J Parameter Type	Conversion from ECMAScript null
Any object	Null
boolean	False
double, float, long, int, short, byte, char	Zero

When the ECMAScript parameter is JavaArray, JavaObject or JavaClass, conversion is performed as follows:

Table 30: Conversion from ECMAScript DVB-J objects

DVB-J Parameter Type	Conversion from ECMAScript DVB-J Objects
Most specific assignment compatible class.	Unwrap ECMAScript JavaObject to original DVB-J Object. ECMAScript JavaObject is of an incompatible class to the required class the DVBException with the error code CONVERSION_TYPE_ERR shall be raised
java.lang.String	Result of toString().
double, float, long, int, short, char, byte	Result of doubleValue() is taken and converted as a Number to the DVB-J type as above. If no doubleValue() method is defined, causes the DVBException with the error code CONVERSION_TYPE_ERR to be raised.

When the ECMAScript parameter is an ECMAScript Object, conversion is performed as follows:

Table 31: Conversion from ECMAScript Object

DVB-J Parameter Type	Conversion from ECMAScript Object
java.lang.Object (including subclasses) or interface	If ECMAScript object has all public fields and methods of the DVB-J parameter type, and has been generated as specified in Subclassing and Interface Instance Creation, then the generated DVB-J class is used. Otherwise the DVBException with the error code CONVERSION_TYPE_ERR shall be raised

ECMAScript Arrays are passed as parameters only to Java methods accepting an array as its corresponding argument. An ECMAScript array containing a single element type matches a Java array parameter based on the matching preference of the array element types. An ECMAScript array containing different element types is not convertible to and does not match any Java parameter type.

8.8.2.10 Subclassing and Interface Instance Creation

Instances of an instantiable Java class can be create by using the "new" operator on the Java class, e.g.

```
   new Packages.java.lang.String("astring");
```

The parameters are passed to the constructor using the type conversion rules above. This mechanism is extended to allow the creation of instances of classes that must be subclassed to produce an instantiable class. The SubType object is defined and used with a constructor function to allow ECMAScript to construct an instance of a subclass. The Subtype constructor takes a string naming the Java class to be subclassed as its argument, e.g. "java.awt.ActionListener" and an ECMAScript function which acts as a constructor to initialize any abstract elements. Invoking the Subtype constructor on a final Java class shall cause the DVBException with the error code SUBCLASS_NOT_ALLOWED_ERR to be raised. The object returned by the Subtype constructor is a function used to create instances. When this function is used as a constructor, its arguments are passed to the function specified in the Subtype constructor. The function is invoked with the current object being an ECMAScript handle to the JavaObject being instantiated.

Example:

```
function actDone(event) {
   /* My event handling method */
}

function MyListenerConstructor(arg1, arg2) {
   /* if ActionListener had a constructor it could be called here
   * e.g. this.ActionListener(arg2);
   */
   this.ActionPerformed = arg1;
}
MyListenerType = new Subtype("java.awt.ActionListener", MyListenerConstructor);
MyListener = new MyListenerType(actDone, 0);
```

NOTE: This mechanism may be used to create listeners from ECMAScript.

An example of constructing and setting a listener:

```
<script>
   function receiveEvent(x) {
      window.open("http://chat.tv.com/chatLogin?user="+x, _chatFrame);
   }
   function chatConstructor() {
      this.receiveUserPreferenceChangeEvent = receiveEvent;
   }
   chatListenerType = new Subtype("org.dvb.user.UserPreferenceChangeEvent", chatConstructor);
   chatListener = new chatListenerType();

   Packages.org.dvb.user.UserPreferences.addUserPreferenceChangeListener(chatListener);
</script>
```

8.8.2.11 Type Conversion (DVB-J to ECMAScript)

Type conversion of return values occurs as follows:

Table 32: Conversion from DVB-J types

DVB-J Return Value Type	Conversion to ECMAScript type
double, float, long, short, int, byte, char	Direct conversion to number
boolean	Direct conversion to boolean
array	JavaArray
java.lang.Class	JavaClass
Object wrapped around ECMAScript Object	Direct conversion (unwrapping)
Other objects (including java.lang.Double, java.lang.Integer and java.lang.String (note), java.lang.Exception)	JavaObject (an ECMAScript wrapper around the DVB-J Object providing the same methods and
NOTE: The explicit or implicit invocation of the ECMAScript toString() function on the ECMAScript handle to a java.lang.String shall return an external string.	

8.8.2.12 Catching DVB-J Exceptions in ECMAScript

DVB-J exceptions are thrown back into ECMAScript when the underlying DVB-J method throws an exception, or an exception is generated as part of the attempted type conversion from ECMAScript to DVB-J (see type conversions above). For example, the following ECMAScript:

```
try {
        Packages.java.lang.Class.forName("someClass");
} catch (e) {
        print("Exception: " + e);
}
```

would print out something like the following, if someClass does not exist.

Exception: java.lang.ClassNotFoundException: someClass.

8.9 Document Object Model (DOM)

DOM is a platform and language neutral interface that provides programmatic access to the content, structure and style of documents. Support for language bindings for the DOM for both Java language and ECMAScript is required.

Table 33: Supported DOM modules

DOM Module		Where specified	Required
Package	Feature String		
Level 2 Core	Core	Document Object Model (DOM) Level 2 Core Specification [96]	Yes
	XML		No
Level 2 Views	Views	Document Object Model (DOM) Level 2 Views Specification [100]	Yes
Level 2 Stylesheets	StyleSheets	Document Object Model (DOM) Level 2 Style Specification [99].	No
Level 2 CSS stylesheets	CSS	Document Object Model (DOM) Level 2 Style Specification [99].	No
	CSS2		Yes
Level 2 Events	Events	Document Object Model (DOM) Level 2 Events Specification [98].	Yes
	UIEvents		Yes
	MutationEvents		Yes
DVB-HTML	DVBHTML	See clause 8.9.4 "DVB-HTML DOM module" on page 142	Yes
DVB Events	DVBEvents	See clause 8.9.2 "DVB Events DOM module" on page 136	Yes
DVB Key Events	DVBKeyEvents	See clause 8.9.3 "DVB Key events DOM module" on page 140	Yes
DVB CSS	DVBCSS	See clause 8.9.8.1 "DVB CSS DOM module" on page 164	Yes
DVB Environment	DVBEnvironment	See clause 8.9.7 "DVB Environment object module" on page 159	Yes

8.9.1 DOM Level 2 Events

8.9.1.1 Fundamental interfaces

DVB-HTML shall support the events module as defined in Document Object Model (DOM) Level 2 Events Specification [98] (which includes the following interfaces: EventTarget, EventListener, DocumentEvent, Event and EventException).

8.9.1.2 Event interfaces

The following event sets from Document Object Model (DOM) Level 2 Events Specification [98] shall be supported:

- UIEvent.
- MutationEvent.

It is not required to support the following event sets:

- HTML events.

NOTE: Equivalents to the Load and Unload events are provided, see clause 9.3.4 "Application activity events" on page 207.

- MouseEvent.

  It is recommended that implementations providing support for mouse like devices provide the MouseEvent event set.

8.9.2 DVB Events DOM module

A DOM application can use the hasFeature method of the DOM implementation interface to determine that this module is supported. The feature string for all interfaces listed in this module is "DVBEvents" and the version "2.0".

8.9.2.1 Key events

DVB-HTML will provide the W3C event bindings for keyboard and remote control events in a later release of the present document when the W3C Dom level 3 events specification is finalized. Until such time, scripting will have access to key events as specified in an additional DVB DOM module specified in clause 8.9.3 "DVB Key events DOM module" on page 140.

in the following DVB-HTML specific manner:

8.9.2.2 Lifecycle events

This clause provides the mapping of DVB-HTML life cycle events to the DOM event model.

8.9.2.2.1 Interface DVBLifecycleEvent

The DVBLifecycleEvent interface provides specific contextual information to a DVB-HTML application associated with its lifecycle.

All lifecycle events are delivered to the root element of the document in the root frame of an application and follow the normal event delivery rules in Document Object Model (DOM) Level 2 Events Specification [98]. For clarification, sub-frames which contain the root of separate applications (as described in clause 8.12.3 "Inter application security" on page 178) also have DVB lifecycle events delivered to the corresponding document root. The different types of such events that can occur are detailed under clause 8.9.2.2.2 "Event definitions" on page 137.

8.9.2.2.1.1 IDL Definition

```
// Introduced in DVB-HTML:
interface DVBLifecycleEvent : Event {
   readonly attribute DOMString eventinfo;
   void initDVBLifecycle Event(in DOMString typeArg,
      in boolean canBubbleArg,
      in boolean cancelableArg,
      in long detailArg);
};
```

8.9.2.2.1.2 Attributes

eventinfo: This attribute specifies additional information about the event the meaning of which depends on the type of the event.

8.9.2.2.1.3 Methods

Table 34: DVB Lifecycle Event Method

Method	Name	Description		
	initDVBLifecycle Event	This method is used to initialize the value of a lifecycle event created through the DocumentEvent interface. This method may only be called before the lifecycle event has been dispatched via the `dispatchEvent` method, though it may be called multiple times during that phase if necessary. If called multiple times, the final invocation takes precedence.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	typeArg	DOMString		Specifies the event type. The string is identical to the name of the event (e.g. the AppStarting event is specified with the string "AppStarting").
	canBubbleArg	Boolean		Specifies whether or not the event can bubble.
	cancelableArg			Specifies whether or not the event's default action can be prevented.
	detailArg	Number		Specifies the Event's detail.
Return value	**Type**	**Description**		
No Return Value.				
Exceptions				
No Exceptions.				

8.9.2.2.2 Event definitions

8.9.2.2.2.1 AppStarting

This event is given to the DVB-HTML application whilst in the Active state if and only if it is signalled as PREFETCH. The user agent sends this event when it receives the dvb.start event. After receiving the dvb.start event and prior to sending this event the user agent begins displaying the DVB-HTML application.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.2.2.2 AppActive

This event is given to the DVB-HTML application on transitioning from the Loading state to the Active state.

- Bubbles: No.
- Cancelable: No.
- Context Info: eventinfo.

The values of eventinfo are those defined in table 79 "DVB-HTML application control code values" on page 229 with the following semantics:

- PREFETCH means that the DVB-HTML application will not be presented by the user agent until the user agent has sent an AppStarting event.
- All other values imply that the DVB-HTML application will not receive an AppStarting event and can assume that presentation has begun.

8.9.2.2.2.3 AppPause

This event is given to the DVB-HTML application on transitioning to the Paused state.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.2.2.4 AppResume

This event is given to the DVB-HTML application on transitioning out of the Paused state to the Active state.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.2.2.5 AppDestroyed

This event is given to the DVB-HTML application on transitioning to the Destroyed state.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.2.2.6 AppKilled

This event is given to the DVB-HTML application on transitioning to the Killed state.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.2.2.7 AppTerminating

This event is given to a DVB-HTML application when an application within a subframe terminates.

- Bubbles: No.
- Cancelable: No.
- Context Info: eventinfo.

The value of eventinfo is the name of the frame where the terminating application was hosted:

8.9.2.2.3 State transition summary

The following table summarizes the allowed transitions in the lifecycle model (see clause 9.3.3 "The State Model" on page 203).

State transition	Loading	Active	Paused	Destroyed	Killed
Loading to	no	yes 1	no	yes 2	yes 3
Active to	no	no	yes 4	yes 5	yes 6
Paused to	no	yes 7	no	yes 8	yes 9
Destroyed to	no	no	no	no	yes 10
Killed to	no	no	no	no	no

The following table describes the events delivered to the application following these transitions.

NOTE: In 8 and 9 no AppResume event be received.

cross reference	transition	event delivered
1	Loading to Active	event AppActive on entry to Active state
2	Loading to Destroyed	event AppDestroyed on entry to Destroyed state
3	Loading to Killed	event AppKilled on entry to Killed state
4	Active to Paused	event AppPause on exit from Active state
5	Active to Destroyed	event AppDestroyed on entry to Destroyed state
6	Active to Killed	event AppKilled on entry to Killed state
7	Paused to Active	event AppResume on entry to Active state
8	Paused to Destroyed	event AppDestroyed on entry to Destroyed state
9	Paused to Killed	event AppKilled on entry to Killed state
10	Destroyed to Killed	event AppKilled on entry to Killed state

8.9.2.3 Additional DVB Events

8.9.2.3.1 Trigger events

See clause 8.5 "Synchronization" on page 99.

8.9.2.3.2 DVBDOMStable event

This event signals the completion of the current document DOM construction. After the receipt of this event the DOM structure of the document will be complete, however the DOM structure in sub-frames or in-line frames may not be complete and resources such as the contents of images may not have finished loading. Prior to the generating the event implementations are free to have an incomplete DOM structure referenced by the document variable.

This event uses the base Event interface to pass contextual information. The following type is allowed:

DVBDOMStable: This event occurs when the DOM implementation is fully constructed, but is not required to wait until all of the associated frames in a `<frameset>`, content in `<image>` or `<object>` elements loads. This event is valid for `<body>` and `<frame>` elements.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.2.3.3 DVB-HTML events

These events use the base Event interface to pass contextual information. The following types are allowed:

load: The load event occurs when the DOM implementation finishes loading all content within a document, all frames within a `<frame>`, or an `<object>` element.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

unload: The unload event occurs when the DOM implementation removes a document from a window or frame. This event is valid for `<body>` and `<frame>` elements.

- Bubbles: No.
- Cancelable: No.
- Context Info: None.

8.9.3 DVB Key events DOM module

A DOM application may use the hasFeature(feature, version) method of the DOMImplementation interface with parameter values "DVBKeyEvents" and "2.0" (respectively) to determine whether or not the event module is supported by the implementation. The feature string is also used with the createEvent method. It is implementation dependent how a MHP gets the set of supported keys.

Key events generated by a real or virtual keyboard or from a remote control device shall be generated by the user agent and can be registered for by applications through the DOM. Registering for events using the type string "HKeyEvent" or "HRcEvent" can place a listener that shall receive an object that implements the DVBKeyEvent interface. All Key events are initially targeted at the element with focus, or the body element if no element has focus

e.g.

```
function myListener(evt) { ... }
node.addEventListener("HRcEvent", myListener, false )
```

8.9.3.1 Interface DVBKeyEvent

The DVBKeyEvent interface provides specific contextual information associated with Remote Control and Keyboard Events. The interface is able to describe the representation of a key event as a string, color or symbol (such as a triangle, ">", for "play"). This allows an application to describe a button on an input device correctly for a given platform.

The keyChar attribute describes the representation of a key event as a string. All available events shall have a text representation. Other representations may be available

NOTE: The DVBKeyEvent interface is designed to be compatible with the W3C level 3 DOM key events albeit with some redundancy, and in future versions of the specification it is envisaged that objects will also support the W3C defined interface.

8.9.3.1.1 IDL Definition

// Introduced in MHP 1.1:

```
interface DVBKeyEvent : UIEvent {
readonly attribute unsigned long when;
readonly attribute unsigned long modifiers;
readonly attribute unsigned long keyCode;
readonly attribute DOMString keyChar;
readonly attribute DOMString color;
readonly attribute DOMString symbol;
   void initDVBKeyEvent(in DOMString type,
      in boolean canBubbleArg,
      in boolean cancelableArg,
      in unsigned long modifiers,
      in unsigned long keycode,
);
};
```

8.9.3.1.2 Attributes

Table 35: Key event attributes

Name	Readonly	Type	Description
when	yes	unsigned long	The timestamp for the event
modifiers	yes	unsigned long	Indication of any modification keys active for the event
keyCode	yes	unsigned long	The key code of the key associates with this event.
keyChar	yes	unsigned long	The character representation of the key associated with this event
color	yes	DOMString	The six coloured key events (VK_COLORED_KEY_0, …, VK_COLORED_KEY_5), if implemented, must also be represented by a color. For all other key events this value should be null. The format of the color is specified in CSS 2 [101] section 4.3.6 Colors.
symbol	yes	DOMString	The URL to an image provided by a MHP to describe the symbol associated with a certain key. The recommended symbols for some Key events are described in HAVi [50]. The value of this attribute can be NULL.

8.9.3.1.3 Methods

Table 36: Key Event Method

Method	Name	Description		
	initDVBKeyEvent	This method is used to initialize the value of a keyboard event. This method may only be called before the key event has been dispatched via the dispatchEvent method, though it may be called multiple times during that phase if necessary. If called multiple times, the final invocation takes precedence.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	type	DOMString	-	Either "HRcEvent" or "HKeyEvent"
	canBubbleArg	boolean		Specifies whether or not the event can bubble.
	cancelableArg	boolean		Specifies whether or not the event's default action can be prevented
	modifiers	unsigned long		The modifiers to be applied to the event
	keycode	unsigned long	-	The Keycode of the event to be generated
Return value	**Type**	**Description**		
	-	Initializes the event, all of the attributes shall be set as if this event were generated by the system.		

8.9.4 DVB-HTML DOM module

8.9.4.1 Conformance

A DVB-HTML user agent shall be considered as being an HTML-only DOM implementation as defined in the W3C Document Object Model (DOM) Level 2 Core Specification [96], so that conformance statements in DOM Level 2 applying to those kinds of implementation will apply also to a DVB-HTML user agent. E.g. a DVB-HTML DOM implementation is not required to implement the `createDocument()` method in the `DOMImplementation` interface from the DOM Level 2 Core.

8.9.4.2 Differences from W3C DOM Level 1 HTML interfaces

The W3C DOM 1 HTML interfaces were designed in order to provide convenience functions to manipulate HTML 4.0 documents and also to create documents from scratch. The DOM DVB-HTML module has been defined with the objective to manipulate DVB-HTML documents without any intention to create them. In general, the DOM DVB-HTML module follows the design of the W3C DOM1 HTML interfaces, however the following differences can be observed:

- Some attributes have been made immutable in the DOM DVB-HTML module. These modifications have been indicated in the present document.
- Some attributes and interfaces have not been included in the DOM DVB-HTML module.
- For the length attribute in all interfaces, the type has been homogenized to unsigned long.
- Some semantics have been added to clarify user agent behaviour (e.g. on modification of the disabled attribute).
- Some semantics have been altered to take into account the DVB-HTML DTD (e.g.since the `name` attribute is not supported for identification purposes some attribute semantics had to be modified accordingly).

8.9.4.3 Extensions

8.9.4.3.1 Enumerations

In DVB-HTML, some element attributes can be set to a limited number of values. In order to be as much as possible in line with the IDL defined in the W3C DOM 1 HTML, the present document does not use the IDL `enum`. For attributes that take a limited set of values (i.e. an enumeration) the following semantics shall apply:

- If a mutable attribute is set with a value outside of the possible values the DOMException with the error code SYNTAX_ERR is raised and the original value shall be kept.

The bindings reflect this choice, see annexes AC "(normative): ECMAScript Binding" on page 986 and AD "(normative): Support for DVB-HTML" on page 999.

8.9.4.3.2 Initial and current values of form controls

Form controls that accept a user input, e.g. text area, option, text, password, checkbox, radio button, have both an initial value and a current value. The names and the types of these values depend on the type of the control. When a control is created, the means by which the initial value is set depends on the control. See the corresponding interface definition clause 8.9.4.6.6 "DVBHTMLFormElement Interface" on page 149.

When a control is created, the current value is set to the initial value.

The initial value can only be modified by a script. The current value can be modified either by a user interaction or a scripting instruction. If the current value is modified, the display shall be updated to reflect the value changed.

When a form is reset, either by user interaction or by scripting instruction, for each of the controls accepting user input and contained in the form, the current value shall be set to the initial value. The initial value may have been modified between the creation of the control and the reset of the form. As such, the initial value used shall be the value at the time of the reset.

Form controls that do not accept user input, e.g. hidden controls, submit buttons, reset buttons, buttons, submit images, have only one value, a current value. When a control is created, the means by which the current value is set depends on the control. See clause 8.9.4.6.6 "DVBHTMLFormElement Interface" on page 149. The current value can only be modified by a scripting instruction. In such a case, it is not required to affect the display.

The file input control has a different behaviour from those described above. It accepts a user input but only has a current value. The semantics of the current value of form controls that do not accept user input applies.

8.9.4.4 System aspects

8.9.4.4.1 Access to the document

8.9.4.4.1.1 Java

The DVB DOM Implementation shall implement the org.dvb.dom API as defined in clause 11.13.1 "Document object model APIs" on page 313. This will provide applications a handle to the DVB-HTML document object model.

8.9.4.4.1.2 ECMAScript

The DVB DOM implementation shall provide to applications a `document` object that represents the current DVB-HTML document.

8.9.4.4.2 DOM DVB-HTML module

A DOM application can use the `hasFeature` method of the `DOMImplementation` interface to determine whether this module is supported or not. The feature string for all the interfaces listed in this module is "DVBHTML" and the version is ".0".

8.9.4.4.3 DOM modification

8.9.4.4.3.1 DOM access

Any DOM call from the DOM DVB-HTML module shall be synchronous. As such, any subsequent calls can assume that they can operate on a DOM structure updated accordingly to the previous call.

8.9.4.4.3.2 Synchronization with renderer actions.

Wherever applicable, any required impact on the visual rendering following a DOM call has been described. However, the present document is voluntarily silent on the nature of the relationships between a DOM modification and the renderer, in particular on the synchronization aspects.

8.9.4.4.3.3 Modifications from the DOM Core

A NO_MODIFICATION_ALLOWED_ERR exception shall be raised when attempting to modify an attribute from the DOM Core which equivalent attribute in the DOM DVB-HTML module is defined to be readonly, e.g. this exception shall be raised when modifying the `type` attribute in the `button` element through the DOM Core.

8.9.4.5 Miscellaneous interfaces

This clause describes various utility interfaces of the DOM DVB-HTML module.

8.9.4.5.1 DVB-HTMLCollection Interface

A `DVBHTMLCollection` is a list of DVB-HTML elements. An individual element may be accessed by either ordinal index or the element's `id` attribute.

NOTE: Collections in the DVB-HTML DOM are assumed to be dynamic meaning that they are automatically updated when the underlying document is modified.

8.9.4.5.1.1 IDL Definition

```
interface DVBHTMLCollection {
   readonly attribute unsigned long length;
   Node namedItem(in DOMString name);
   Node item(in unsigned long index);
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLCollection` interface defined in Document Object Model (DOM) Level 1 Specification [97].

8.9.4.5.2 DVBHTMLDocument Interface

A `DVBHTMLDocument` is the root of the DVB-HTML document hierarchy and holds the entire content. Besides providing access to the hierarchy, it also provides some convenience methods for accessing certain sets of information from the document.

8.9.4.5.2.1 IDL Definition

```
interface DVBHTMLDocument : Document {
   readonly attribute DVBHTMLCollectionanchors;// DVB-HTML Type coherence
   attribute DVBHTMLElementbody;// DVB-HTML Type coherence
   attribute DOMString cookie;
   readonly attribute DOMString domain;
   readonly attribute DVBHTMLCollection forms; // DVB-HTML Type coherence
   readonly attribute DVBHTMLCollection images; // DVB-HTML Type coherence
   readonly attribute DVBHTMLCollection links; // DVB-HTML Type coherence
   readonly attribute DOMString referrer;
   attribute DOMString title;
   readonly attribute DOMString URL;

   void open();
   void close();
   void write(in DOMString text);
```

```
   void writeln(in DOMString text);
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLDocument` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.5.2.2.

8.9.4.5.2.2 Attributes

Table 37: DVBHTMLDocument attributes

Name	Readonly	Type	Description
anchors	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
body	no	DVBHTMLElement	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
domain	yes	DOMString	See domain in 8.14.6 "Domain" on page 189.
forms	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
images	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
links	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
title	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. In addition, if the user agent makes this visible, then it shall update the rendering upon modification. This attribute is linked to the <title> element changes to one shall be reflected in the other.

8.9.4.5.2.3 Methods

Table 38: DVBHTMLDocument open method

Method	Name	Description		
	open()	As defined in Document Object Model (DOM) Level 1 Specification [97] opens the document for writing. This creates a new empty document in the target to which subsequent writes are made. The transition and the rendering of the new document shall not be performed until a call to the close() method. The ECMAScript context which opened the new document cannot be destroyed until it calls document.close(). (note)		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
Return value	**Type**	**Description**		
	-	This method does not return a value.		
NOTE: document.open() shall not change the URL of the document.				

Table 39: DVBHTMLDocument close method

Method	Name	Description		
	close()	As defined in Document Object Model (DOM) Level 1 Specification [97]. Rendering of the document is performed as if a link had been followed with that document as a target.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**

Table 39: DVBHTMLDocument close method

Return value	Type	Description
	-	This method does not return a value.

Table 40: DVBHTMLDocument write method

Method	Name	Description		
	write()	As defined in Document Object Model (DOM) Level 1 Specification [97]. An inline non-deferred script performing document.write() feeds additional strings to the parser. The text is parsed into the document's structure model. These strings are sent to the parser sequenced immediately after the closing script tag of the inline script. See also ("Implicit document.open()" on page 146).		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
Return value	**Type**	**Description**		
	-	This method does not return a value.		

Table 41: DVBHTMLDocument writeln method

Method	Name	Description		
	writeln()	As defined in Document Object Model (DOM) Level 1 Specification [97]. An inline non-deferred script performing document.writeln() feeds additional strings to the parser. The text is parsed into the document's structure model. These strings are sent to the parser sequenced immediately after the closing script tag of the inline script. See also ("Implicit document.open()" on page 146).		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
Return value	**Type**	**Description**		
	-	This method does not return a value.		

Implicit document.open()
If document.write() is called from a deferred script context and the document has not been explicitly opened for writing, the first write() performs an implicit open of the containing document.

Implicit document.close()
If the deferred inline script context which performed an open (explicit or implicit) exits without calling close on the document, the document is closed implicitly.

When a document is trying to access the value of the `forms`, `anchors`, `links` or `images` attributes before the parsing of the document is complete, the returned value shall be the collection of matching elements at the time of the call.

8.9.4.6 DVB-HTML element related interfaces

8.9.4.6.1 DVBHTMLElement Interface

All DVB-HTML element interfaces derive from this class.

8.9.4.6.1.1 IDL Definition

```
interface DVBHTMLElement : Element {
```

```
   attribute DOMString className;
   attribute DOMString dir;
   attribute DOMString id;
   attribute DOMString lang;
   attribute DOMString title;
};
```

8.9.4.6.1.2 Attributes

The semantics of the attributes associated with this interface are the same as the semantics associated with the HTMLElement interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in table 42.

Table 42

Name	Readonly	Type	Description
dir	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. Trying to set this attribute to a value other than the values allowed in HTML 4 [104] shall cause the DOMException with the error code SYNTAX_ERR to be raised.
lang	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. Trying to set this attribute to a value other than the values allowed in HTML 4 [104] shall cause the DOMException with the error code SYNTAX_ERR to be raised.

8.9.4.6.2 DVBHTMLAnchorElement Interface

This interface models the anchor element, corresponding to the DVB-HTML `<a>` tag. It represents a source anchor, the `<A>` tag with the `href` attribute, or a destination anchor, the `<a>` tag with the `id` attribute.

8.9.4.6.2.1 IDL Definition

```
interface DVBHTMLAnchorElement : DVBHTMLElement {
   attribute DOMString accessKey;
   attribute DOMString charset;
   attribute DOMString href;
   attribute DOMString hreflang;
   attribute DOMString target; // Diverge from W3C DOM HTML
   attribute DOMString type;

   void blur();
   void focus();
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLAnchorElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.2.2.

8.9.4.6.2.2 Attributes

Table 43

Name	Readonly	Type	Description
target	no	DOMString	The id of the frame to render the resource designated by the URI in. The semantics of the target attribute in HTML 4 [104] apply with the following modification: all references to the name attribute shall be seen as being references to the id attribute.

8.9.4.6.3 DVBHTMLMapElement Interface

This interface models a client-side image map. See the MAP element definition in HTML 4 [104].

8.9.4.6.3.1 IDL definition

```
interface DVBHTMLMapElement : DVBHTMLElement {
   readonly attribute DVBHTMLCollection areas; // DVB-HTML Type coherence
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLMapElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.3.2.

8.9.4.6.3.2 Attributes

Table 44

Name	Readonly	Type	Description
areas	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Its type has been changed to DVBHTMLCollection.

NOTE: The `name` attribute in the map element is deprecated in DVB-HTML. As such, the map is identified only through the `id` attribute.

When a document is trying to access the value of the `areas` attribute before the parsing of the contents of the `map` element is complete, the returned value shall be the collection of matching elements at the time of the call.

8.9.4.6.4 DVBHTMLAreaElement Interface

This interface models an image map area which can triggers an action when the user clicks on it.

8.9.4.6.4.1 IDL Definition

```
interface DVBHTMLAreaElement : DVBHTMLElement {
   attribute DOMString accessKey;
   attribute DOMString alt;
   attribute DOMString href;
   attribute boolean nohref;
   attribute DOMString target; // Diverge from W3C DOM HTML
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLAreaElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.4.2.

8.9.4.6.4.2 Attributes

Table 45

Name	Readonly	Type	Description
target	no	DOMString	The id of the frame to render the resource designated by the URI in. The semantics of the target attribute in HTML 4 [104] apply with the following modification : all references to the name attribute shall be seen as being references to the id attribute.

8.9.4.6.5 DVBHTMLButtonElement Interface

`DVBHTMLButtonElement` represents the DVB-HTML `<button>` tag.

8.9.4.6.5.1 IDL Definition

```
interface DVBHTMLButtonElement : DVBHTMLElement {
   attribute DOMString accessKey;
   attribute boolean disabled;
```

```
   readonly attribute DVBHTMLFormElement form; // DVB-HTML Type coherence
   attribute DOMString name;
   readonly attribute DOMString type;
   attribute DOMString value;

   void blur(); // Introduced in DVB-HTML DOM
   void focus(); // Introduced in DVB-HTML DOM
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLButtonElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clauses 8.9.4.6.5.2, 8.9.4.6.5.3.

8.9.4.6.5.2 Attributes

Table 46

Name	Readonly	Type	Description
form	yes	DVBHTMLFormElement	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs.
value	no	DOMString	The button's current value. It corresponds to the value attribute of the DVB-HTML `<button>` tag but shall be interpreted as a current value (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143).

8.9.4.6.5.3 Methods

Table 47

Method	Name	Description		
	blur	Removes focus from this element.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	-	-	-	-
Return value	**Type**	**Description**		
	-	-		

Table 48

Method	Name	Description		
	focus	Gives focus to this element.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	-	-	-	-
Return value	**Type**	**Description**		
	-	-		

8.9.4.6.6 DVBHTMLFormElement Interface

The `DVBHTMLFORMElement` encompasses behaviour similar to a collection and an element. It provides direct access to the contained input elements as well as the attributes of the form element. See the `FORMElement` definition in HTML 4 [104].

8.9.4.6.6.1 IDL Definition

```
interface DVBHTMLFormElement : DVBHTMLElement {
   attribute DOMString action;
   attribute DOMString acceptCharset;
```

```
   attribute DOMString enctype;
   readonly attribute DVBHTMLCollection elements; // DVB-HTML Type coherence
   readonly attribute unsigned longlength; // Lengths type coherence
   attribute DOMString method;
   attribute DOMString target; // Diverge from W3C DOM HTML

   void reset();
   void submit();
}
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLFormElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.6.2.

8.9.4.6.6.2 Attributes

Table 49

Name	Readonly	Type	Description
elements	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the type differs
length	yes	unsigned long	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the type differs
method	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. Trying to set this attribute to a value other than the values allowed in HTML 4 [104] shall cause the DOMException with the error code SYNTAX_ERR to be raised.
target	no	DOMString	The id of the frame to render the resource designated by the URI in. The semantics of the target attribute in HTML 4.01 apply with the following modification: all references to the name attribute shall be seen as being references to the id attribute.

When a document is trying to access the value of the `elements` attribute before the parsing of the contents of the `form` element is complete, the returned value shall be the collection of matching elements at the time of the call.

8.9.4.6.7 DVBHTMLFrameElement Interface

8.9.4.6.7.1 IDL Definition

```
interface DVBHTMLFrameElement : DVBHTMLElement {

   readonly attribute Document contentDocument;
   readonly attribute DOMString frameBorder; // Diverge from W3C DOM HTML
   attribute DOMString longDesc;
   readonly attribute DOMString marginHeight // Diverge from W3C DOM HTML
   readonly attribute DOMString marginWidth; // Diverge from W3C DOM HTML
   readonly  attribute DOMString scrolling; // Diverge from W3C DOM HTML
   attribute DOMString src;
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLFrameElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.7.2.

8.9.4.6.7.2 Attributes

Table 50

Name	Readonly	Type	Description
frame Border	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.
margin Height	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.

Table 50

margin Width	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.
scrolling	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.

8.9.4.6.8 DVBHTMLFrameSetElement Interface

8.9.4.6.8.1 IDL Definition

```
interface DVBHTMLFrameSetElement : DVBHTMLElement {
   readonly attribute DOMString cols; // Diverge from W3C DOM HTML
   readonly attribute DOMString rows; // Diverge from W3C DOM HTML
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLFrameSetElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.8.2.

8.9.4.6.8.2 Attributes

Table 51

Name	Readonly	Type	Description
cols	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.
rows	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.

8.9.4.6.9 DVBHTMLIFrameElement Interface

8.9.4.6.9.1 IDL Definition

```
interface DVBHTMLIFrameElement : DVBHTMLElement {
attribute DOMString frameBorder;
attribute DOMString longDesc;
attribute DOMString scrolling;
attribute DOMString src;
attribute DVBHTMLDocument contentDocument;
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLIFrameElement` interface defined in Document Object Model (DOM) Level 1 Specification [97]Attributes

Table 52: IFrame element attributes

Name	Readonly	Type	Description
content Document	no	DVBHTMLDocument	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the type differs

8.9.4.6.10 DVBHTMLImageElement Interface

8.9.4.6.10.1 IDL Definition

```
interface DVBHTMLImageElement : DVBHTMLElement {
   attribute DOMString alt;
   attribute DOMString height; // Extension to W3C DOM HTML
   attribute DOMString longDesc;
   attribute DOMString lowSrc;
   attribute DOMString src;
   readonly attribute DOMString useMap; // Diverge from W3C DOM HTML
   attribute DOMString width;
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLImageElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.10.2.

8.9.4.6.10.2 Attributes

Table 53

Name	Readonly	Type	Description
longdesc	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97], A DVB-HTML User Agent may optionally make use of this resource in device specific ways (e.g for accessibility). The externally referenced resource will not form part of the document model.
useMap	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly. The attribute value shall be the id value and not the name value of the associated map element (since the name attribute in the map element is not supported in DVB-HTML)

8.9.4.6.11 DVBHTMLObjectElement Interface

8.9.4.6.11.1 IDL Definition

```
interface DVBHTMLObjectElement : DVBHTMLElement {
attribute DOMString archive;
attribute DOMString code;
attribute DOMString codeBase;
attribute DOMString codeType;
readonly attribute DVBHTMLDocument contentDocument; // Introduced in DVB-HTML:
attribute DOMString data;
attribute boolean declare;
readonly attribute DVBHTMLFormElement form;
attribute DOMString height;
attribute DOMString name;
attribute DOMString standby;
attribute DOMString type;
readonly attribute DOMString useMap;
attribute DOMString width;
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the HTMLObjectElement interface defined in Document Object Model (DOM) Level 1 Specification [97], with the addition of the contentDocument attribute defined in clause 8.9.4.6.11.2.

8.9.4.6.11.2 Attributes

Table 54

Name	Readonly	Type	Description
contentDocument	yes	DOMString	The document this object contains, if there is any and it is available, or null otherwise.

8.9.4.6.12 DVBHTMLInputElement Interface

8.9.4.6.12.1 IDL Definition

```
interface DVBHTMLInputElement : DVBHTMLElement {

   attribute DOMString accept;
   attribute DOMString accessKey;
   attribute DOMString alt;
   attribute boolean checked; // Extension to W3C DOM HTML
   attribute DOMString defaultValue; // Extension to W3C DOM HTML
   attribute boolean defaultChecked; // Extension to W3C DOM HTML
   attribute boolean disabled; // Extension to W3C DOM HTML
   readonly attribute DVBHTMLFormElement form; // DVB-HTML Type coherence
   attribute long maxLength;
   attribute DOMString name;
   attribute boolean readOnly; // Extension to W3C DOM HTML
   attribute DOMString size;
   attribute DOMString src;
   readonly attribute DOMString type; // Diverge from W3C DOM HTML
   readonly attribute DOMString useMap; // Diverge from W3C DOM HTML
   attribute DOMString value; // Extension to W3C DOM HTML

   void blur();
   void click();
   void focus();
   void select();
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLInputElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.12.2.

8.9.4.6.12.2 Attributes

Table 55

Name	Readonly	Type	Description
checked	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]; this attribute corresponds to the current value of controls (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143) with attribute type equals to checkbox or radio. It shall be ignored for the other types of control.
default Checked	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]; this attribute corresponds to the initial value of controls (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143) with attribute type equals to checkbox or radio. It is initialized by the checked attribute of the <input> tag. It shall be ignored for the other types of control.
default Value	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]; this attribute corresponds to the initial value of controls (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143) with attribute type equals to text or password. It is initialized by the value attribute of the <input> element.
disabled	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. If set to true, the effects are the following : Input does not receive the focus. Input is not included in the tabbing navigation. Input is not successful. Since the readOnly state is less restrictive than the disabled state, if the disabled attribute is set to true, the control evolves to the disabled state, independently of the readOnly attribute value. If the disabled attribute is set to false, the control will evolve to the readOnly state depending on the value of the readOnly attribute. By default, the attribute value is FALSE.
form	yes	DVBHTMLFormElement	As defined in Document Object Model (DOM) Level 1 Specification [97], only the return type differs.
readOnly	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. When set to true and textarea is not in the disabled state, the effects are the following : Input receives the focus but cannot be modified by the user. Input is included in the tabbing navigation. Input is successful. Since the readOnly state is less restrictive than the disabled state, if the readOnly attribute is set to true when the disabled attribute is equal to true, the control remains in the disabled state. By default, the attribute value is `FALSE`.
type	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.

Table 55

Name	Readonly	Type	Description
useMap	yes	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly. The attribute value shall be the id value and not the name value of the associated map element (since the name attribute in the map element is not supported in DVB-HTML)
value	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute corresponds to the current value of controls (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143 with attribute type equals to text, password, hidden, submit, reset, button, image, or file. For all the controls, it represents the value of the name/value pair sent to the server when the form containing this control is submitted. This attribute is initialized by the value attribute of the <input> tag.

8.9.4.6.13 DVBHTMLOptionElement Interface

This interface models the `<option>` element.

8.9.4.6.13.1 IDL Definition

```
interface DVBHTMLOptionElement : DVBHTMLElement {
   attribute boolean defaultSelected; // Extension to W3C DOM HTML
   attribute boolean disabled;
   readonly attribute DVBHTMLFormElement form; // DVB-HTML Type coherence
   readonly attribute long index;
   attribute DOMString label;
   attribute boolean selected; // Extension to W3C DOM HTML
   readonly attribute DOMString text;
   attribute DOMString value;
};
```

The semantics of the attributes associated with this interface are the same as the semantics associated with the `HTMLOptionElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.13.2.

8.9.4.6.13.2 Attributes

Table 56

Name	Readonly	Type	Description
default Selected	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. The initial value is as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143. If the option is included in a single choice select, it is initialized to true if the attribute checked is present in the option tag and if this option is the latest option between those contained in the select with the attribute checked set. Its value is false otherwise. If the option is included in a multiple choice select, it is initialized to true if the attribute checked is present in the option tag, false otherwise.
form	yes	DVBHTMLFormElement	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
selected	yes	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. The current value is as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143.

8.9.4.6.14 DVBHTMLSelectElement Interface

This interface represents the `<select>` control which allows the selection of one or multiple options among a list. Some graphical user agents represent single and multiple selection with different types of widgets. Options can be grouped inside an option group, for presentational reasons, or directly inserted in the selection. Option groups can't be nested.

8.9.4.6.14.1 IDL Definition

```
interface DVBHTMLSelectElement : DVBHTMLElement {
   attribute boolean disabled;
   readonly attribute DVBHTMLFormElement form; // DVB-HTML Type coherence
   readonly attribute unsigned long length; // Lengths type coherence
   readonly attribute boolean multiple; // Diverge from W3C DOM HTML
   attribute DOMString name;
   readonly attribute DVBHTMLCollection options; // DVB-HTML Type coherence
   attribute long selectedIndex;
               // Extension to W3C DOM HTML
   attribute unsigned long size; // Size type coherence
   readonly attribute DOMString type;
   attribute DOMString value;

   void add(in DVBHTMLElement element, in DVBHTMLElement before) raises(DOMException);
   void blur();
   void focus();
   void remove(in long index);
};
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLSelectElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.14.2.

8.9.4.6.14.2 Attributes

Table 57

Name	Readonly	Type	Description
form	yes	DVBHTMLFormElement	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
length	yes	unsigned long	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs
multiple	yes	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. This attribute has been moved to readonly.
options	yes	DVBHTMLCollection	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs.
selected Index	no	long	The ordinal index of the selected option, starting from 0. The value -1 is returned if no element is selected. If multiple options are selected, the index of the first selected option is returned. Upon modification, the display shall be affected.
size	no	unsigned long	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs.

When a document is trying to access the value of the `options` attribute before the parsing of the contents of the `select` element is complete, the returned value shall be the collection of matching elements at the time of the call.

8.9.4.6.15 DVBHTMLTextAreaElement Interface

This interface represents a multiline text area. It refers to the `<textarea>` DVB-HTML tag.

8.9.4.6.15.1 IDL Definition

```
interface DVBHTMLTextArea : DVBHTMLElement {
   attribute DOMString accessKey;
   readonly attribute unsigned long cols; // Diverge from W3C DOM HTML
   attribute DOMString defaultValue;
               // Extension to W3C DOM HTML
   attribute boolean disabled; // Extension to W3C DOM HTML
   readonly attribute DVBHTMLFormElement form; // DVB-HTML Type coherence
   attribute DOMString name;
   attribute boolean readOnly // Extension to W3C DOM HTML
   readonly attribute unsigned long rows; // Diverge from W3C DOM HTML
   readonly attribute DOMString type;
   attribute DOMString value; // Extension to W3C DOM HTML

   void blur();
   void focus();
   void select();
}
```

The semantics of the attributes and methods associated with this interface are the same as the semantics associated with the `HTMLTextAreaElement` interface defined in Document Object Model (DOM) Level 1 Specification [97], with the extensions, restrictions or amendments defined in clause 8.9.4.6.15.2.

8.9.4.6.15.2 Attributes

Table 58

Name	Readonly	Type	Description
cols	yes	unsigned long	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs and it has been moved to readonly.
default Value	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. The initial value (as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143) is initialized by the text inserted between the start and end tags of the element.
disabled	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. If set to true, the effects are the following : - Textarea does not receive the focus. - Textarea is not included in the tabbing navigation. - Textarea is not successful. Since the readOnly state is less restrictive than the disabled state, if the disabled attribute is set to true, the control evolves to the disabled state, independently of the readOnly attribute value. If the disabled attribute is set to false, the control will evolve to the readOnly state depending on the value of the readOnly attribute. By default, the attribute value is FALSE.
form	yes	DVBHTMLFormElement	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs.
read Only	no	boolean	As defined in Document Object Model (DOM) Level 1 Specification [97]. If set to true and textarea is not in the disabled state, the effects are the following : - Textarea receives the focus but cannot be modified by the user. - Textarea is included in the tabbing navigation. - Textarea is successful. Since the readOnly state is less restrictive than the disabled state, if the readOnly attribute is set to true when the disabled attribute is equal to true, the control remains in the disabled state. By default, the attribute value is `FALSE`.
rows	yes	unsigned long	As defined in Document Object Model (DOM) Level 1 Specification [97]. Only the return type differs and it has been moved to readonly.
value	no	DOMString	As defined in Document Object Model (DOM) Level 1 Specification [97]. The current value is as defined in clause 8.9.4.3.2 "Initial and current values of form controls" on page 143.

8.9.5 DVB Exceptions

DOM operations may raise exceptions in "exceptional" circumstances. In general, DVB-HTML will raise exceptions defined by Document Object Model (DOM) Level 2 Core Specification [96], however certain methods in DVB-HTML raise other exceptions under other circumstances.

In DVB-HTML the `DVBException` is defined, this is in addition to the DOMException of DOM 2 and defines additional error codes.

NOTE: The error codes defined for DVBException are defined so as not to clash with those defined for DOMException, however the W3C retains the right to define additional codes for DOMException which may conflict with DVBException in the future. To avoid conflicts the programmer may use typeof: the DVBException, as a host object, has a defined type different to that of DOMException.

8.9.5.1 DVBException

The value returned by the **typeof** operator for DVBException shall be "**dvbexception**".

8.9.5.1.1 IDL Definition

```
exception DVBException {
unsigned short code;
};


// ExceptionCode
// Introduced in DVB-HTML:
const unsigned short NON_CONFORMANT_ERR = 601;
const unsigned short SECURITY_VIOLATION_ERR = 602;
const unsigned short WINDOW_NOT_FOUND_ERR = 603;
const unsigned short SUBCLASS_NOT_ALLOWED_ERR = 604;
const unsigned short CONVERSION_TYPE_ERR = 605;
```

ExceptionCode: An integer indicating the type of error generated.

Other numeric codes are reserved by DVB for possible future use.

8.9.5.1.2 Defined Constants

NON_CONFORMANT_ERR: An operation attempted to alter the DOM in such a way as would make the document non conformant.

SECURITY_VIOLATION_ERR: An operation failed because the application did not have sufficient permission to perform it.

WINDOW_NOT_FOUND_ERR: The application attempted to open a window which was not part of the application.

SUBCLASS_NOT_ALLOWED_ERR: The application attempted to subclass a final class.

CONVERSION_TYPE_ERR: The application attempted to subclass a final class.

8.9.6 Language bindings

8.9.6.1 ECMAScript Binding

See annex AC "(normative): ECMAScript Binding" on page 986.

8.9.6.2 Java Binding

See annex AD "(normative): Support for DVB-HTML" on page 999.

8.9.7 DVB Environment object module

A DOM application can use the hasFeature method of the DOM implementation interface to determine that this module is supported. The feature string for all interfaces listed in this module is "DVBEnvironment" and the version "2.0".

8.9.7.1 Free variables

DVB-HTML shall support ECMAScript access to certain APIs is through a number of variables, which get bound in each page context:

- document
- navigator
- window

Each DVB-HTML application shall see different Navigator, Document and Window objects, Only one Navigator object is created per application lifetime (therefore properties may be set on the Navigator object which persist for the lifetime of the application). The navigator variable is bound to this object in each page context.

Windows and Document are initialized on an as needed basis, Document is valid during and after parsing of the document and is bound to the variable document.

Each window is associated with a single document, there may be more than one extant window object per DVB-HTML application, however multiple window support is included only for frames. There shall be at most one top level window per DVB-HTML application (see CSS 2 [101]).

The window variable is initialized to the immediately containing window for a document.

8.9.7.2 Environmental host objects

8.9.7.2.1 Navigator Object

Represents the browser itself, the navigator free variable is of this type. This is supported in DVB-HTML with the following attributes and methods.

8.9.7.2.1.1 IDL Definition

```
interface Navigator {
   readonly attribute String appCodeName;
   readonly attribute String appName;
   readonly attribute String appVersion;
   readonly attribute String userAgent;
};
```

8.9.7.2.1.2 Attributes

Table 59: Navigator Object Attributes

appCodeName	Readonly	Specifies the code name of the browser with the value specified in the BNF in clause 8.11.1 "User agent strings" on page 169
appName	Readonly	Specifies the name of the browser, the value shall be "DVB-HTML".
appVersion	Readonly	Specifies version information for the Navigator with the value specified in the BNF in clause 8.11.1 "User agent strings" on page 169
userAgent	Readonly	Specifies the user agent header see clause 8.11.1 "User agent strings" on page 169

8.9.7.2.2 Window object

Represents a top-level browser window or a frame. There is only one top-level window per DVB-HTML application, (i.e. whose parent is NULL). Other window objects in an application represent frames in a frameset.

The top level Window object of an application is created in the CSS initial containing block for the application. The viewport and containing block of the application are controlled by the stylesheet associated with the current document held by the top level Window object. Other Window objects are shaped by the frameset rules.

Window is supported in DVB-HTML with the following attributes and methods.

8.9.7.2.2.1 IDL Definition

```
interface Window {
   readonly attribute DVBHTMLDocument document;
   readonly attribute DOMImplementation implementation;
   readonly attribute DVBHTMLCollection frames;
   readonly attribute unsigned long length;
   attribute Location location;
   readonly attribute String name;
   readonly attribute Navigator navigator;
   readonly attribute Window parent;
   readonly attribute Window window;
   readonly attribute Window self;
   attribute String status;
   attribute String defaultStatus;
   readonly attribute Window top;
   void clearTimeout(in unsigned long timerId);
   Window open(in String url, in String name, in String features);
   unsigned long setTimeout(in String statement, in unsigned long delay);
}
```

8.9.7.2.2.2 Attributes

The following attributes are supported:

Table 60: Window Object Attributes

Attribute	Modifier	Semantics
closed	Readonly	Specifies whether a window has been closed.
document	Readonly	Contains information on the current document. Returns an object of type DVBHTMLDocument.
implementation	Readonly	Supplies the method to bootstrap into the DOM interfaces.
frames	Readonly	An array reflecting all the frames in a window containing documents from the current application. Frames that belong to another application shall not appear in the collection.
location	Readwrite	Contains information on the URL used to request the current document. Setting the value of window.location sets the href value of the window's associated location object, and causes the window to navigate to the URL. NOTE: The **requested** URL is stored in window.location and this may be different than the **actual** URL of the delivered document, which is stored in document.URL. If a string is used to set the location field, then it is converted to a Location. If the string is not a well formed URL, or the user agent is unable to navigate to it the location is unchanged. Setting this string to the "exit:" locator (see 8.14.5.2 "Exit locator" on page 188) shall cause termination as defined in 9.3.3.5 "Killed" on page 206.
name	Readwrite	A unique name used to refer to this window.
length	Readonly	the length of the frames collection
parent	Readonly	Returns the Window whose frameset contains the current frame or NULL if the window is the outer most window. A frame may return NULL for this attribute for security reasons (see 8.12.3 "Inter application security" on page 178)

Attribute	Modifier	Semantics
status	Readwrite	Specifies a priority or transient message in the window's status bar. NOTE: It is not required this actually be displayed anywhere – but calling it must cause no harm)
defaultStatus	Readwrite	The default message for the status bar NOTE It is not required this actually be displayed anywhere – but calling it must cause no harm.
top	Readonly	A synonym for the topmost browser window. The value of this attribute shall be NULL if the referenced frame is not available for security.
self	Readonly	Returns the current Window
document	Readonly	Returns the document instance the window is displaying. If the document is inaccessible due to security reasons (see 8.12.3 "Inter application security" on page 178) then shall return NULL.
navigator	Readonly	Returns the Navigator object for the application

8.9.7.2.2.3 Methods

The following methods are supported:

Table 61: Window open method

Method	Name	Description		
	open	Sets the document of the specified window to a new resource		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	url	String	in	The location of the document to display in the new window.
	name	String	in	The target frame within the frameset or the top level window.
	features	String	in	unused
Return value	**Type**	**Description**		
	Window	This method returns the Window object in which the document has been opened.		

:

Table 62: Window setTimeout method

Method	Name	Description		
	setTimeout	Evaluates an expression or calls a function once after a specified number of milliseconds has elapsed. When the document is replaced then all timeouts on the window are cleared.		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	statement	String	in	The piece of ECMAScript to be evaluated.

Table 62 (continued): Window setTimeout method

	delay	unsigned long	in	The length of time to wait before executing the statement in milliseconds.
Return value	**Type**	**Description**		
	unsigned long	This method returns a timerId that uniquely identifies the timer.		

Table 63: Window clearTimeout method

Method	**Name**	**Description**		
	clearTimeout	Cancels a timeout that was set with the setTimeout method. When the document is replaced then all timeouts on the window are cleared		
Parameters	**Name**	**Type**	**Qualifier**	**Description**
	timerId	unsigned long	in	The id of the timer to clear as returned by setTimount.
Return value	**Type**	**Description**		
	none	This method does not return a value.		

8.9.7.2.3 Location object.

A convenience element that parses URIs. Is used in the location field of the window object.

8.9.7.2.3.1 IDL Definition

```
interface Location {
attribute DOMString hash;
attribute DOMString host;
attribute DOMString hostname;
attribute DOMString href;
attribute DOMString pathname;
attribute DOMString port;
attribute DOMString protocol;
attribute DOMString search;

};
```

8.9.7.2.3.2 Attributes

Table 64: Location Object Attributes

Attribute	Modifier	Semantics
hash	Readwrite	The portion of the URI after and including the '#' symbol
host	Readwrite	The hostname and port of the URI
hostname	Readwrite	The hostname (without the port) of the URI.
href	Readwrite	The complete URI.
pathname	Readwrite	The pathname portion of the URI.
port	Readwrite	The port of the URI.
protocol	Readwrite	The protocol portion of the URI.
search	Readwrite	The portion of the URI after and including the '?' symbol, not including the hash portion.

8.9.8 CSS Support

8.9.8.1 DVB CSS DOM module

DVB-HTML does not require support for the DOM-2 CSS modules, however it does require support of the this simpler CSS module. A DOM application can use the hasFeature method of the DOM implementation interface to determine that this module is supported. The feature string for all interfaces listed in this module is "DVBCSS" and the version "2.0".

8.9.8.1.1 DVBCSSInlineStyle

DVBInlineStyle: This interface shall be implemented by objects that implement the Element interface (see Document Object Model (DOM) Level 2 Core Specification [96]), and which represent elements that support the style attribute.

A DVB-HTML user agent may support the DOM-2 CSS module, in which case this interface shall be replaced by ElementCSSInlineStyle, however in such a case the CSS2Properties interface shall also be implemented, and the object returned by the style attribute on ElementCSSInlineStyle shall also implement the CSS2Properties interface

8.9.8.1.1.1 IDL Definition

```
// Introduced in MHP1.1:
interface DVBCSSInlineStyle {
readonly attribute CSS2Properties style;
};
```

8.9.8.1.1.2 Attributes

Style of type CSS2Properties as defined in section 2.3 of Document Object Model (DOM) Level 2 Style Specification [99].

8.9.8.1.2 DVBCSSStyle

DVBCSSStyle: This interface shall be implemented by objects that implement the Element interface (see Document Object Model (DOM) Level 2 Core Specification [96]), that represent the root element of a document.

8.9.8.1.2.1 IDL Definition

```
// Introduced in MHP1.1:
interface DVBCSSStyle {
readonly attribute DVBCSSViewportRule viewport;
};
```

8.9.8.1.2.2 Attributes

viewport of type DVBCSSViewportRule, If the document containing the element is not in a root window this attribute shall be NULL, if it is in the root window then this attribute shall return an object that implements the DVBCSSViewportRule interface.

8.9.8.1.3 DVBCSSViewportRule

DVBCSSViewportRule: The DVBCSSviewportRule interface represents a @viewport rule within a CSS style sheet. The @viewport rule is used to specify the on screen regions and relationship to video of an DVB-HTML application.

8.9.8.1.3.1 IDL Definition

```
// Introduced in MHP 1.1:
interface DVBCSSViewportRule : CSSRule {
   readonly attribute DVBCSSViewportProperties style;
};
```

8.9.8.1.3.2 Attributes

style: of type DVBCSSViewportProperties, readonly. An object that represents all the properties of the active viewport.

8.9.8.1.4 DVBCSSViewportProperties

DVBCSSViewportProperties: The DVBCSSViewportProperties interface represents a mechanism for retrieving and setting properties within a viewport. The attributes of this interface correspond to all the properties specified in 8.6.5.3.2 "The @dvb-viewport rule" on page 114.

8.9.8.1.4.1 IDL Definition

```
// Introduced in MHP1.1:
interface DVBCSSViewportRule {
readonly attribute DOMSting pseudoClass;
attribute DOMString area;
attribute DOMString[] backgroundVideoTransform;
attribute DOMString[] backgroundVideo;
attribute DOMString[] backgroundVideoPreserveAspect;
attribute DOMString[] backgroundVideoClip;
attribute DOMString[] backgroundVideoRectangle;
attribute DOMString background;
attribute DOMString backgroundImageRectangle;
attribute DOMString initial;
attribute Number verticalResolution;
attribute Number horizontalResolution;
attribute DOMString scene;
};
```

8.9.8.1.4.2 Attributes

Table 65: Location Object Attributes

Attribute	Modifier	Semantics
pseudoClass	Readonly	See the pseudoClass property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: NO_MODIFICATION_ ALLOWED_ERR: Raised on any attempt to set this property.
area	Readwrite	See the area property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable.
backgroundVideo Transform	Readwrite	See the backgroundVideoTransform property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ ERR: Raised if the new value has a syntax error and is unparsable. (note)
backgroundVideo	Readwrite	See the backgroundVideo property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable. (note)
backgroundVideo PreserveAspect	Readwrite	See the backgroundVideoPreserveAspect property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ ERR: Raised if the new value has a syntax error and is unparsable. (note)
backgroundVideoClip	Readwrite	See the backgroundVideoClip property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable. (note)
backgroundVideo Rectangle	Readwrite	See the backgroundVideoRectangle property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ ERR: Raised if the new value has a syntax error and is unparsable. (note)
background	Readwrite	See the background property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable. (note)
backgroundImage Rectangle	Readwrite	See the backgroundImageRectangle property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ ERR: Raised if the new value has a syntax error and is unparsable. (note)
initial	Readwrite	See the initial property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable.
verticalResolution	Readwrite	See the verticalResolution property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable.
horizontalResolution	Readwrite	See the horizontalResolution property definition in clause 8.6.5.3.2 "The @dvb-viewport rule" on page 114. Exception: SYNTAX_ERR: Raised if the new value has a syntax error and is unparsable.
NOTE: This attribute is an array of values, one for each defined background plane		

8.10 Cookie support

8.10.1 DOM Cookie Interface

The cookie attribute of the document (see clause 8.9.4.5.2 "DVBHTMLDocument Interface" on page 144) provides an interface to the set of attribute-value pairs described in RFC 2109 [110].

The cookie attribute of document is a read/write string with the following behaviour:

a) The attribute may be assigned a string value `set-cookie` obeying the following BNF, where ALPHA and DIGIT are as specified in RFC 2616 [40]:

```
set-cookie= cookie
cookie= av-pair
         ["; expires=" [ rfc1123-date ] ]
         ["; path=" [ path ] ]
         ["; domain=" [ domain] ]
         ["; secure" ]
         ["; dvb-scope=" [ dvb-scope ]]
av-pair= attr ["=" value ]
attr  = 1*(ALPHA | DIGIT | aspecials)
aspecials= ( "!" | "#" | "$" | "&" | "'" | "*" | "+" | "-"
              | "." | "_" | "`" | "|" | "~" | "%" )

value = 1*(ALPHA | DIGIT | special | vspecials)
vspecials = "(" | ")" | "<" | ">" | "@" | "," | ":" | "\" | <"> | "/"
             | "[" | "]" | "?" | "=" | "{" | "}" | SP  | HT

path   = 1*(ALPHA | DIGIT | aspecials)
domain = 1*(ALPHA | DIGIT | aspecials)
dvb-scope = "App" | "Org" | "All"
```

rfc1123-date is the subset of the RFC 1123 [111] date format as specified in RFC 2616 [40] (HTTP 1.1).

```
rfc1123-date = wkday ", " SP date1 SP time " GMT"
wkday       = "Mon" | "Tue" | "Wed" | "Thu" | "Fri" | "Sat" | "Sun"
date1       = 2DIGIT SP month SP 4DIGIT
time        =  2DIGIT ":" 2DIGIT ":" 2DIGIT
month       =    "Jan" | "Feb" | "Mar" | "Apr"| "May" | "Jun"
               | "Jul" | "Aug" | "Sep" | "Oct"| "Nov" | "Dec"
```

b) If an expiration is not specified, the lifetime of the cookie is that of the DVB-HTML application.

c) When read the attribute returns a string `get-cookie` consisting of the av-pairs for all cookies that have not expired and are within the scope of the current document.

```
get-cookie  =  av-pair *(";" av-pair)
```

NOTE 1: If the same attribute is specified for multiple paths that apply to the current document, the attribute appears in multiple av-pairs.

NOTE 2: "%" is a legal character in values. As defined in RFC 2109 [110] characters not allowed in values may be escaped using "% HEX HEX", there is no special handling of this escaping by the ECMAScript API.

8.10.2 Cookie Storage and Lifetime

8.10.2.1 Cookie Storage Limits

An implementation should attempt to meet the minimum implementation limits of RFC 2109 [110] including (although not necessarily simultaneously) at least 20 cookies of 4 096 bytes. The size is the total required for the cookies and all attributes stored as strings.

8.10.2.2 Cookie Persistence

If the application requests permission for access to persistent storage, this is granted and persistent storage is available, an implementation should attempt to store cookies until they expire. If the application does not have permission for persistent storage or the storage is not available then cookies shall persist only for the lifetime of the DVB-HTML application.

8.10.2.3 Privacy Considerations

Notwithstanding any other requirements in this clause, an implementation may provide mechanisms for controlling the extent of cookie support, including which, if any, cookies are stored, temporarily or persistently.

8.10.3 Cookie Scoping

8.10.3.1 General Rules

All cookies are scoped by dvb-scope. The dvb-scope limits cookies to being accessible by pages in applications of a particular organization (dvb-scope=Org), by pages with a particular Application Identifier (dvb-scope=App) or by pages within all applications (dvb-scope=All). When not specified, the dvb-scope defaults to App. Cookies of unsigned applications are always scoped to App. Cookies with different scoping are stored separately and reported separately both through the DOM and when transmitted to a server. Setting a cookie with the same scoping as an existing one causes the replacement of the existing one.

8.10.3.2 Documents delivered via DSM-CC Object Carousel

Cookies set via the DOM on pages delivered by DSM-CC carousel transport are never sent back to a server, even when http: URLs are within the application boundary. The domain, path and secure attributes are ignored for such cookies.

8.10.3.3 Documents delivered via HTTP transport

Cookies associated with pages delivered by http: shall be scoped by domain and path in addition to scoping by their dvb-scope. If the domain is specified, the cookie is only accessible to pages delivered from hosts within that domain. The default domain is the host name of the http server which delivered the page.

If the path is specified, the associated cookie is only accessible to pages in directories under that path.

Domain and path matching are performed per RFC 2109 [110] with the exception that a host match is generated if either the domain string or the domain string with a period prepended to it would generate a match with the basic algorithm.

NOTE: the modified matching algorithm provides both domain compatibility with cookies whose domain is set from the DOM or from HTTP 1.0 or 1.1 servers that only support the protocol in clause 8.10.1 "DOM Cookie Interface" on page 167. In both cases, leading dots are frequently left off.

Setting a cookie with a domain or path for which the current page is out of scope has no effect and the cookie is discarded.

Cookies with the secure attribute specified shall only be sent over secure, HTTPS connections.

8.10.4 HTTP Cookie Support

8.10.4.1 Background

The MHP profile of HTTP 1.0 profile allows both HTTP 1.0 and HTTP 1.1 transport (see clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63). In order for cookie transport to work with existing HTTP 1.0 servers, support for "Netscape" cookie receipt is required. Cookie transmission can always be done with RFC 2109 [110] format since most servers will consider the $Version and $Path attributes as unknown cookies and ignore them.

8.10.4.2 Sending Cookies

The client shall send cookies per RFC 2109 [110] and for compatibility with older servers, DVB-HTML implementations should use semi-colons to separate cookies rather than commas (both are allowed by RFC 2109 [110]). Only cookies in the scope of the document, including any dvb-scope restrictions, are sent.

The client shall accept cookies via a Set-Cookie header in the HTTP response. The format of the contents of that header may be either in RFC 2109 [110] format or in that specified by the set-cookie BNF from the DOM description above (see clause 8.10.1 "DOM Cookie Interface" on page 167).

8.10.4.3 Receiving Cookies

The client shall accept cookies via a Set-Cookie header in the HTTP response. The format of the contents of that header may be either in RFC 2109 [110] format or in "Netscape" cookie format, where Netscape format is that specified by the set-cookie BNF from the DOM description above.

8.11 HTTP User Agent String Support

Requests from the DVB-HTML user agent shall include an HTTP header of the form:

User-Agent: <user-agent>

where <user-agent> is the DVB-HTML user agent string.

8.11.1 User agent strings

8.11.1.1 Current user agent-related strings

Current examples (from the internet) of the user agent string are shown in the following table.

Table 66: Internet user agent string examples

Field	Netscape Navigator	Internet Explorer on Win2K
userAgent	Mozilla/4.7 [en] (WinNT; U)	Mozilla/4.0 (compatible; MSIE 5.01; Windows NT 5.0)
appCodeName	Mozilla	Mozilla
appVersion	4.7 [en] (WinNT; U)	4.0 (compatible; MSIE 5.01; Windows NT)
appName	Netscape	Internet Explorer

The last three of these appear as properties on the navigator object. The properties `appCodeName` and `appVersion` are derived from the user agent string as reflected in the BNF. The user agent string generally has the BNF format. The `appName` is independent of the user agent string and its value shall always be "DVB-HTML" (see clause 8.9.7.2.1 "Navigator Object" on page 160).

8.11.1.2 User agent string BNF

Adopting "Mozilla" as the appCodeName provides no interoperability benefit, and in fact would be incorrect as the DVB HTML user agent is not required to be Mozilla compliant. In general, the user agent string is best kept short, since it is sent with every HTTP request, hence it is reasonable to use abbreviations where appropriate.

The following BNF illustrates the user agent string that should be used:

```
userAgent ::= appCodeName "/" appVersion
appCodeName::= "DVB-HTML"
appVersion ::= appVersionNumber " (" identifiers ")"
appVersionNumber::= major "." minor "." micro
major::= [0-9]+
minor::= [0-9]+
micro::= [0-9]+
identifiers::= [ profileIdentifier ]+ [ "; " mhpIdentifier ]*
profileIdentifier ::= profileName " " major "." minor "." micro
profileName::= "eb" | "ib" | "ia"
mhpIdentifier::= [^;()]+
```

The syntax for the `major`, `minor` and `micro` elements are equal to the properties with the same names defined in clause 11.9.3 "Profile and version properties" on page 298. The values for these properties are specified in clause 16.1 "System constants" on page 409. mhpIdentifiers may be used to indicate optional features in the MHP implementation.

For example:

```
DVB-HTML/1.1.0 (eb 1.1.0; ipm)
```

Indicates an enhanced broadcast profile, with optional ip multicast support.

8.12 Security of DVB-HTML applications

8.12.1 Authentication of DVB-HTML files

DVB-HTML is subject to the same security model as DVB-J applications, that is a permissions file is associated with authenticated applications; unauthenticated applications operate within a sandbox environment, which means certain forms of locators will not operate, and certain APIs will not be available to ECMAScript.

Authenticated applications may be granted permission to use the restricted locators and APIs.

User Agents shall interpreting signed applications shall only make available the following file types to that application if they are signed by the same leaf certificate:

- DVB-HTML
- ECMAScript
- CSS
- Inner application files (for DVB-J class files see clause 11.2.3 "Class Loading" on page 262).

Locators that are disabled due to security restrictions will behave as if the resource pointed to is unavailable.

ECMAScript API calls that fail due to security restrictions will generate the DVBException with the error code SECURITY_VIOLATION_ERR.

8.12.2 Runtime code extension

8.12.2.1 Security principles

In order to address the security issues that arise with runtime code extension:

a) ECMAScript platforms shall permit the use of any of the ECMAScript runtime code extension techniques listed below for unauthenticated applications or authenticated applications running in the sandbox.

b) ECMAScript platforms shall permit the restricted use of runtime code extension techniques for authenticated applications running outside of the sandbox, where by restricted use is meant that the input to runtime code extension derives only from an appropriately authenticated source (see "Extensions to ECMAScript for trusted executable code" on page 171).

c) ECMAScript platforms shall not permit the removal of pre-defined properties of host objects.

d) ECMAScript platforms shall not permit the replacement of a pre-defined function property of a host object.

8.12.2.1.1 Uses of runtime code extension in ECMAScript

The ECMAScript language supports runtime code extension by means of the following separate mechanisms:

- The `eval()` function property of the global object.
- The `Function` object.

In addition, the following mechanisms support runtime code extension through the following host object (platform) facilities:

- The `write()` function property of the DVB-HTML Document host object.
- The setTimeout(in String statement, in unsigned long delay) function property of the Window object.

The rules covering runtime code extension are detailed in clause 8.12.2.4 "Use of strings in RCEs" on page 177

8.12.2.2 Extensions to ECMAScript for trusted executable code

This clause details DVB specific mechanisms to allow Runtime Code Extension (RCE) features specified by the ECMAScript language specification and the allowed DOM APIs to be used without compromising security. In DVB-HTML additional mechanisms that keep track of the origin of strings in the system and disallow the potentially dangerous use in RCEs by privileged applications of strings from unverified external sources.

8.12.2.2.1 Propagation of Internal (safe) vs. External (unsafe) strings

This approach to providing security for the use of ECMAScript maintains application compatibility by distinguishing between value of an internal string type, a string value coming from within the ECMAScript language or literal strings within the application, and an external string type, a string value coming from (suspect) host-based objects. Both string values appear to content as ordinary ECMAScript string values to improve compatibility with the behaviour of DVB-HTML content in standard Internet browsers. This is accomplished by modifying the ECMAScript language specification to split the string type into two internal subtypes: *internal-string* and *external-string*. The difference between these subtypes is not visible to the application programmer, except in so far as a security exception may be thrown as a result of the use of some strings in an RCE.

This approach has the advantage of maintaining content compatibility with ECMAScript content written for existing browsers and to the W3C and ECMA specifications. In particular,

a) It allows DVB-HTML to conform to the W3C specified DOM APIs by allowing them to return values of type String rather than of type String Object.

b) It minimizes any increase in the runtime data footprint of ECMAScript applications by allowing the continued use of the much more compact String type, rather than String Object.

c) It minimizes any implementation change for DOM bindings between a W3C-complaint version and a DVB-HTML compliant version, since both can return String types.

d) It eliminates compatibility problems that would otherwise require changing core ECMAScript behaviour if String Objects were used (e.g. that two different instances of an object never test true for equality).

e) It allows finer-grained propagation of unsafe typing, since every string entity in the ECMAScript runtime would be tagged as safe (internal) or unsafe (external).

8.12.2.2.2 Modifying ECMA-262 to support Internal and External strings

This clause normatively specifies modifications to ECMA-262 [95] to differentiate the two kinds of string values.

The present document uses the editing convention that additions to ECMA-262 [95]are given in *italics*. Text that is removed is presented as ~~strike-out~~. When a change is made, the old text is given as ~~strike-out~~ and the new version in *italics*. The bold and bold-italics font faces are preserved from the ECMAScript standard document.

Change the last sentence of the second paragraph of section 4.2 to read:

> A primitive value is a member of one of the following built-in types: **Undefined, Null, Boolean, Number,** ~~and String~~ *Internal-String, and External-String*; an object is a member of the remaining built-in type **Object**; and a method is a function associated with an object via a property. *The term String type is used when either of the types Internal-String or External-String is acceptable. The term String value is used when a value of either of the types Internal-String or External-String is acceptable.*

Change the first sentence of the first paragraph of section 4.3.2 to read:

> A ***primitive value*** is a member of one of the types **Undefined**, **Null**, **Boolean**, **Number**, ~~and **String**~~ *Internal-String, and External-String.*

Change sections 4.3.16 through 4.3.18 to read:

> **4.3.16 ~~String Value~~***String, Internal-String, and External-String Values*
>
> *4.3.16.1 String Value*

A ***string value*** is ~~a member of the type **String** and~~ either a member of the type Internal-String or a member of the type External-String. It is a finite ordered sequence of zero or more 16-bit unsigned integer values.

NOTE: Although each value usually represents a single 16-bit unit of UTF-16 text, the language does not place any restrictions or requirements on the values other than that they be 16-bit unsigned integers.

4.3.16.2 Internal-String Value

An internal-string value is a member of the type Internal-String. See section 4.3.16.1 for details.

4.3.16.3 External-String Value

An external-string value is a member of the type External-String. See section 4.3.16.1 for details.

4.3.17 ~~String Type~~ String, Internal-String, and External-String Types

4.3.17.1 String Type

The type **String** is the set of all string values.

4.3.17.2 Internal-String Type

The type Internal-String is the set of all internal-string values.

4.3.17.3 External-String Type

The type External-String is the set of all external-string values.

In section 4.8.4, change the second paragraph after the BNF to read:

A string literal stands for a value of the ~~String~~ *Internal-String* type. The ~~string~~ *internal-string* value (SV) of the literal is described in terms of the character values (CV) contributed by the various parts of the string literal. As part of this process, some characters within the string literal are interpreted as having a mathematical value (MV), as described below or in section 7.8.3.

Change the first line of Section 8.4 to read:

8.4 The ~~String Type~~ *Internal-String and External-String Types*

Insert the following immediately before section 8.5:

8.4.1 The Internal-String Type

The Internal-String type is used for strings that originate purely from string literals within an ECMAScript program, from conversions of non-external-string types to a string type, and from the methods of built-in objects other than String object. The methods of the String object will return either Internal-String or External-String values, depending on the type of the string used to initialize the String object.

8.4.2 The External-String Type

The External-String type is used for strings that are returned from host objects.

In section 9.1, change the table row for Input Type String into the following two table rows:

~~String~~*Internal-String*	The result equals the input argument (no conversion)
External-String	The result equals the input argument (no conversion)

In section 9.2, change the table row for Input Type String into the following two table rows:

~~String~~*Internal-String*	The result is **false** if the argument is the empty string (its length is zero); otherwise the result is **true**.
External-String	The result is false if the argument is the empty string (its length is zero); otherwise the result is true.

In section 9.3, change the table row for Input Type String into the following two table rows:

~~String~~*Internal-String*	See grammar and note below.
External-String	See grammar and note below.

Change the first line of section 9.3.1 to read:

9.3.1 ToNumber Applied to the ~~String Type~~ Internal-String and External-String Types

In section 9.8, change the table to read:

Input Type	Result
Undefined	*the Internal-String value* **"undefined"**
Null	*The Internal-String value* **"null"**
Boolean	If the argument is **true**, then the result is *the Internal-String value* **"true"**. If the argument is **false**, then the result is *the Internal-String value* **"false"**
Number	See note below
~~String~~*Internal-String*	Return the input argument (no conversion)
External-String	Return the input argument (no conversion)
Object	Apply the following steps: Call ToPrimitive(input argument, hint String). Call ToString(Result(1)). Return Result(2).

Change the first paragraph under section 9.8.1 to read:

The operator ToString converts a number m to ~~string format~~ *an internal-string value* as follows:

Immediately before section 10, insert:

9.10 ToInternalString

The operator ToInternalString converts its argument to a value of type Internal-String according to the following table:

Input Type	Result
Undefined	the Internal-String value "undefined"
Null	The Internal-String value "null"
Boolean	If the argument is true, then the result is the Internal-String value "true". If the argument is false, then the result is the Internal-String value "false"
Number	See note in section 9.8

Internal-String	Return the input argument (no conversion)
External-String	if CanConvertToInternal(argument) returns true, then the result is an internal string with the same sequence of (16-bit) character values. Otherwise, throw SecurityError.
Object	Apply the following steps: Call ToPrimitive(input argument, hint String). Call ToString(Result(1)). If CanConvertToInternal(Result(2)) returns true, return Result(2). Otherwise, throw SecurityError.

The operator CanConvertToInternal is implemented so as to return false if the ECMAScript is being executed in a trusted context and no permissions have been granted to the context to convert external strings to internal strings. In all other cases, the operator CanConvertToInternal will return true.

Change section 10.1.2 to read:

There are three types of ECMAScript executable code:

• Global code is source text that is treated as an ECMAScript Program. The global code of a particular Program does not include any source text that is parsed as part of a FunctionBody.

• Eval code is the source text supplied to the built-in **eval** function. More precisely, if the parameter to the built-in **eval** function is ~~a string~~ *an internal-string*, it is treated as an ECMAScript Program. The eval code for a particular invocation of **eval** is the global code portion of the ~~string~~ *internal-string* parameter.

• Function code is source text that is parsed as part of a FunctionBody. The function code of a particular FunctionBody does not include any source text that is parsed as part of a nested FunctionBody. Function code also denotes the source text supplied when using the built-in **Function** object as a constructor. More precisely, the last parameter provided to the **Function** constructor is converted to ~~a string~~ *an internal-string* and treated as the FunctionBody. If more than one parameter is provided to the **Function** constructor, all parameters except the last one are converted to strings and concatenated together, separated by commas. The resulting string is interpreted as the FormalParameterList for the FunctionBody defined by the last parameter. The function code for a particular instantiation of a **Function** does not include any source text that is parsed as part of a nested FunctionBody.

In section 11.4.3, change the single table row for Type String into the following two table rows:

~~String~~ *Internal-String*	"string"
External-String	"string"

In section 11.6.1, change steps 14 and 15 to read:

~~14. Concatenate Result(12) followed by Result(13).~~
~~15. Result Result(14)~~
14. If Result(12) is of type internal-string and Result(13) is of type external-string, use a string value with the same sequence of characters as Result(12) but of type external-string. Otherwise use Result(12).
15. If Result(12) is of type external-string and Result(13) is of type internal-string, use a string value with the same sequence of characters as Result(13) but of type external-string. Otherwise use Result(13).
16. Concatenate Result(14) followed by Result(15). The string type is the same as that of Result(14).
17. Return Result(16).

Append the following paragraph at the end of Section 12.6.4:

> Property names are maintained as internal-strings or external-strings depending on the source of the property name. Property names are returned as internal-strings unless the property name was set from an external string, in which case it is returned as an external string.

Change step 1 under section 15.1.2.1 to read:

> 1. If x is not a string value, return x. *If x is an external-string value and CanConvertToInternal(x) returns false, throw the exception SecurityError.*

In section 15.1.3, change step 4 in the procedure for the hidden function Encode to read:

> 4. If k equals Result(1), return ~~R~~ *a string with the same sequences of characters as R and the same (internal-string vs external-string) type as the input string.*

In section 15.1.3, change step 4 in the procedure for the hidden function Decode to read:

> 4. If k equals Result(1), return ~~R~~ *a string with the same sequences of characters as R and the same (internal-string vs external-string) type as the input string.*

In section 15.2.4.2, change step 2 to read:

> 2. Compute ~~a string~~ *an internal-string* value by concatenating the three strings **"[object "**, Result(1), and **"]"**.

In section 15.3.2.1, change step 13 to read:

> 13. Call ~~ToString~~ *ToInternalString*(body)

In section 15.4.4.3, change step 14 to read:

> Let R be a string value produced by concatenating S and Result(13). *The type of R is external-string if the type of either S or Result(13) is external-string. Otherwise, the type of R is internal-string.*

In section 15.4.4.5, change step 11 to read:

> Let S be a string value produced by concatenating R and Result(4). *The type of S is external-string if the type of either R or Result(4) is external-string. Otherwise, the type of S is internal-string.*

In section 15.4.4.5, change step 14 to read:

> Let R be a string value produced by concatenating S and Result(13). *The type of R is external-string if the type of either S or Result(13) is external-string. Otherwise, the type of R is internal-string.*

Change the first sentence of section 15.5.3.2 to read:

> Return ~~a string~~ *an external-string* value containing as many characters as the number of arguments.

Add the following sentence to the end of the first paragraph in section 15.5.4.2 and to the first paragraph in section 15.5.4.3:

> *Return the value as an external-string if the String object was constructed with a value that converted to an external-string. Return the value as an internal-string if the String object was constructed with a value that converted to an internal-string.*

Add the following sentence after the first paragraph of section 15.5.4.4 to read:

> *Returns an external-string, if the type of the result of ToString is external-string. Otherwise, the returned string is an internal-string.*

Change step 5 in section 15.5.4.6 to read:

> Let R be the string value consisting of the characters in the previous value of R followed by the characters Result(4). *If either the previous value of R or Result(4) is of type external-string, give R type external-string. Otherwise give R type internal-string.*

Insert the following paragraph just before the NOTE in section 15.5.4.1:

> *If either the result of converting this to a string is of type external-string or the replaceValue converted to a string is of type external-string or the function replaceValue returns a value of type external-string, then the newstring has type external-string. In all other cases, the newstring has type internal-string.*

In section 15.5.4.13 to read, change step 8 to read:

> 8. Return a string containing Result(7) consecutive characters from Result(1) beginning with the character at position Result(5). *The type of the returned string is external-string if the type of Result(1) is external-string. The type of the returned string is internal-string if the type of Result(1) is internal-string.*

In section 15.5.4.14, change step 16 to read:

> 16. Let T be a string value equal to the substring of S consisting of the characters at positions p (inclusive) through q (exclusive). *Let the type of T (internal-string versus external-string) be the same as the type of S.*

In section 15.5.4.14, change step 28 to read:

> 28. Let T be a string value equal to the substring of S consisting of the characters at positions p (inclusive) through q (exclusive). *Let the type of T (internal-string versus external-string) be the same as the type of S.*

In section 15.5.4.15, append the following to the end of step 9:

> *Let the type of the returned string (internal-string versus external-string) be the same as that of Result(1).*

In section 15.5.4.16, insert the following paragraph before NOTE1:

> The result string's type (internal-string vs external-string) is the same as that of the string computed by converting the object to a string.

In sections 15.9.5.2 through 15.9.5.7, change the first sentence of the first paragraph in each section to read:

> This function returns ~~a string~~ *an internal-string* value.

In section 15.10.6.2, append the following at the end section::

> *The type of the resulting string (internal-string vs external-string) is the same as that of the string argument.*

In section 15.10.6.4, append the following at the end of the second paragraph:

> The returned string is of type internal-string if source is an internal-string. The returned string is of type external-string if source is an external-string.

Insert the following immediately after Section 15.1.6.6:

> 15.1.6.7 SecurityError
>
> Indicates that an authorized attempt was made to convert an external-string into an internal-string within the context of trusted ECMAScript.

8.12.2.3 Sources of Unsafe (external) strings

8.12.2.3.1 Sources within ECMAScript

As specified in the previous section the following sources of unsafe strings within the language itself shall be typed as external strings:

a) Strings resulting from operations on external-strings

b) String.fromCharCode, which converts a character code into a string.

8.12.2.3.2 Sources from Host Objects

All strings returned by Host Object APIs defined as part of the present document shall be typed as external strings.

All strings returned by the Bridge shall be typed as external strings.

Any Host Object APIs provided by a platform beyond those required in the present document should return external strings unless the result is known to be secure.

8.12.2.4 Use of strings in RCEs

An attempt to use an external string or a String Object containing an external string in a runtime code extension shall cause the DVBException with the error code SECURITY_VIOLATION_ERR to be raised.

An attempt to use an internal string or a String Object containing an internal string in a runtime code extension shall not cause the DVBException with the error code SECURITY_VIOLATION_ERR to be raised.

If the permission request file requests the permission to do privileged runtime code extension and this is granted for external strings then use of an external string or a String Object containing an external string in a runtime code extension shall be considered use of an internal string or a String Object containing an internal string.

If no permission to do privileged runtime code extension is granted then any attempt to use an internal or external string or a String Object containing an internal or external string in a runtime code extension shall be considered use of an external string.

If the permission request file requests the permission to do privileged runtime code extension and this is granted for internal strings only then use of external and internal strings retain their type.

The following uses of a string shall be considered runtime code extensions:

A string:

a) Passed to eval().

b) Passed to the constructor of a Function() object.

c) Passed to document.write().

d) Used to set an event handler.

   The exception occurs when an external-string is associated with the event handler either by setting a handler attribute of an element in the document or by parenting.

e) Used as the code in a script element.

   The setting of a <script> element text or src attribute in a displayed document shall not cause the new text to e incorporated into the ECMAScript context for the document. Therefore this is not strictly runtime code exception. However modification of script nodes is disallowed in the present document. The exception occurs when the external-string is associated with the script element either by parenting to a script element a node containing an external-string (e.g. by Node::insertBefore(), Node::appendChild(), Node::replaceChild()) or by setting the nodeValue of a TextNode or a CDATASection child of a script element to an external string.

f) Used in window.setTimeout().

8.12.2.5 Mutation of Host Objects

Any attempt to remove or replace the pre-defined properties of a host object shall cause the DVBException with the error code SECURITY_VIOLATION_ERR to be raised.

Any attempt to remove or replace the pre-defined function property of a host object shall cause the DVBException with the error code SECURITY_VIOLATION_ERR to be raised.

8.12.3 Inter application security

8.12.3.1 Restrictions on DOM elements introduced for security

No access is provided to documents from other applications.

The property accessor on the window and document host objects shall restrict access to properties and functions of those objects when the document context in which the access is executed is from a different DVB-HTML application or from a different domain than the document in the window:

- For such contexts, the window accessor shall only allow the assignment of a string to the location property: setting any other window property or getting any window property shall throw an exception.
- For such contexts, the document accessor shall not allow any access: setting or getting any document property shall throw an exception.

The exception that is thrown shall be the appropriate exception as if an attempt to access a resource for which the caller did not have permission were made:

- In the Java binding (see clause AD.1 "Java bindings to DVB extensions" on page 999) a SecurityException shall be thrown.
- In the ECMAScript binding (see annex AC "(normative): ECMAScript Binding" on page 986) when a security exception is raised, the DVBException with the error code SECURITY_VIOLATION_ERR is raised.

If a new application is started in a frame, then a new Window object is created to represent the frame. The parent of this window is the window that represents the frame from the calling applications perspective. This parent property however is not visible to the application within the frame. Therefore both applications have a window object that controls the frame, but no communication is possible between them. Access to properties, methods, and variables involving Window objects are restricted to windows that are displaying documents from the same application and from the same domain (see clause 8.14.6 "Domain" on page 189).

Where an application within a frame terminates prior to the application which contains the frameset that hosts the frame for that application, then the latter application shall receive the DVB lifecycle event "AppTerminating" (see clause 8.9.2.2 "Lifecycle events" on page 136).

The user agent shall set the content of the frame that contained the terminating application to a blank document. and the URL and Location property shall be set to the null string prior to sending the "AppTerminating" event.

Where an outer application terminates with a frameset which contains one or more embedded applications in frames, then the applications in those frames shall also be terminated. This shall apply even in the case where the application within the sub frame would survive service selection but the outer application will not.

8.13 DVB-HTML permissions

This section explains how the permissions that define the sandbox and are available to unsigned applications and the permissions that can be requested in the permission request file are mapped to the DVB-HTML application model. ADVB-HTML application has the following ways of accessing beyond the sandbox.

a) Following embedded links in the page can cause the loading of new resources.

b) Script may access APIs over the Java Bridge.

c) Properties in the host objects available to script may access resources.

The location attribute of the Window object.

The open() Function attribute of the Window object.

d) url() references in CSS attributes.

In case c) setting of attributes via the DOM interfaces is handled only when the attribute is used, and in this case the restrictions of case a) are applied.

In some cases a permission is only relevant to APIs reached via the Java Bridge.

8.13.1 Permissions for unsigned applications

The MHP security policy includes a set of resources that are always guaranteed to be granted to applications, if the application is executed. Unsigned applications have access to only these resources.

This section defines the mapping of those resources to DVB-HTML applications. DVB-HTML applications shall always be granted the necessary Permission.

8.13.1.1 java.awt.AWTPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.1 "java.awt.AWTPermission" on page 300.

8.13.1.2 java.net.SocketPermission:

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.2 "java.net.SocketPermission:" on page 301.

8.13.1.3 java.util.PropertyPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.3 "java.util.PropertyPermission" on page 301.

8.13.1.4 java.lang.RuntimePermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.4 "java.lang.RuntimePermission" on page 301.

8.13.1.5 java.io.SerializablePermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.5 "java.io.SerializablePermission" on page 301.

8.13.1.6 java.io.FilePermission

Permission to read resources for the sub-tree under which the implementation mounts the object carousels shall be granted. For APIs accessed via the, the same rights are granted as for DVB-J applications, see clause 11.10.1.6 "java.io.FilePermission" on page 301.

The location attribute of the Window object may be set to a resource in the sub-tree under which the implementation mounts the object carousels using a URL with the "dvb:" protocol.

The open() Function attribute of the Window object may be called with reference to a resource in the sub-tree under which the implementation mounts the object carousels using a URL with the "dvb:" protocol.

DVB HTML can read resources for the sub-tree under which the implementation mounts the object carousels using the dvb: protocol in a URL in the following element attributes:

- a.href
- area.href
- base.href
- blockquote.cite
- frame.longdesc
- frame.src
- iframe.longdesc
- iframe.src
- img.src
- img.longdesc
- img.usemap
- input.src
- input.usemap
- link.href
- object.archive
- object.classid
- object.codebase
- object.data
- object.usemap
- q.cite
- script.src
- Using the CSS url() value.

Using a "dvb:" locator that references a resource in the Carousel on other element attributes is undefined.

8.13.1.7 javax.tv.media.MediaSelectPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.7 "javax.tv.media.MediaSelectPermission" on page 301.

8.13.1.8 javax.tv.service.ReadPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.8 "javax.tv.service.ReadPermission" on page 301.

8.13.1.9 javax.tv.service.selection.ServiceContextPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.9 "javax.tv.service.selection.ServiceContextPermission" on page 301.

8.13.1.10 java.util.Locale.setDefault

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.1.10 "java.util.Locale.setDefault" on page 301.

8.13.1.11 org.dvb.security.PrivilegedRCEPermission

Unsigned applications are granted PrivilegedRCEPermission("external"), see clause 8.12.2.4 "Use of strings in RCEs" on page 177.

8.13.2 Additional Permissions for signed applications

Signed applications can additionally request to get more permissions. These permissions are requested using the permission request file (clause 12.6 "Security policy for applications" on page 330). This section defines the mapping from the items in the permission request file to the permissions that may be granted by the MHP terminal in response to the request. And how this affects the DVB-HTML application

In the case of org.dvb.security.PrivilegedRCEPermission only, signed applications with a permission request file can request permission that is more restrictive than that granted to applications without a permission request file.

8.13.2.1 java.util.PropertyPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.1 "java.util.PropertyPermission" on page 302.

8.13.2.2 java.io.FilePermission

A signed application has the rights of an unsigned application, in addition when the permission request file requests the permission to access persistent storage and this is granted, read and write access to the persistent storage directory sub-tree is allowed.

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.2 "java.io.FilePermission" on page 302.

If the permission is granted, the location attribute of the Window object may be set to a resource in the persistent file store using a URL with the "file:" protocol. If the permission is not granted then attempting to set this attribute with such a locator will cause a SecurityException to be thrown.

f the permission is granted, the open() Function attribute of the Window object may be called with reference to a resource in the persistent file store using a URL with the "file:" protocol. If the permission is not granted then calling open() with such a locator will cause a SecurityException to be thrown.

DVB HTML can read the persistent file store using the file: protocol in a URL in the following element attributes:

- a.href
- area.href
- base.href
- blockquote.cite
- frame.longdesc
- frame.src
- iframe.longdesc
- iframe.src
- img.src
- img.longdesc
- img.usemap
- input.src
- input.usemap
- link.href
- object.archive
- object.classid
- object.codebase
- object.data
- object.usemap
- q.cite
- script.src
- Using the CSS url() value.

If the file permission is not granted, all "file:" references shall fail as if the referenced resource was not available.

Using a "file:" locator that references a resource in the persistent store on other element attributes is undefined.

When there is a persistent file credential in the permission request file and this is granted, other files are made available as follows:

- file path = root directory of the persistent storage + filename from the credential.
- action = string containing "read" and/or "write" as indicated in the credential.

8.13.2.3 org.dvb.net.ca.CAPermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.3 "org.dvb.net.ca.CAPermission" on page 303.

8.13.2.4 org.dvb.application.AppsControlPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.4 "org.dvb.application.AppsControlPermission" on page 303.

If the permission is granted, the location attribute of the Window object may be set to launch a DVB-HTML application in a sub-window by using a locator which references another DVB-HTML application. If the permission is not granted or the locator points to an application of a type which is not embeddable in a frame then attempting to set this attribute with such a locator will cause a SecurityException to be thrown.

If the permission is granted, the open() Function attribute of the Window object may be called with reference to a resource that launches a DVB-HTML application in a sub-window by using a locator which references another DVB-HTML application. If the permission is not granted or the locator points to an application of a type which is not embeddable in a frame then calling the open() with such a locator will cause a SecurityException to be thrown.

DVB-HTML applications can, if granted this permission, launch applications using locators that reference other applications (see clause 9.3.1.4 "Application boundary" on page 201 and clause 9.2.1 "Starting DVB-J Applications" on page 195) using the attributes on elements below:

- a.href
- area.href

If the application is not granted the permission then these links will fail as if the resource was not available.

Using a locator that references an application on other element attributes is not required to be supported.

8.13.2.5 org.dvb.net.rc.RCPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.5 "org.dvb.net.rc.RCPermission" on page 303.

If the permission is granted for the default ISP, setting the location attribute of the Window object using locators that would require creating a return channel link may establish the link required to access the resource. If the permission is not granted then attempting to set this attribute with such a locator will cause a SecurityException to be thrown.

If the permission is granted for the default ISP, using the open() Function attribute of the Window object using locators that would require creating a return channel link may establish the link required to access the resource If the permission is not granted then calling open() with such a locator will cause a SecurityException to be thrown.

DVB-HTML applications can, if granted this permission for the default ISP establish the link required to reference resources in any element attribute that allows references when using locators that would require creating a return channel link.

If the permission is not granted, the link will not be established and the link will fail as if the resource did not exist.

8.13.2.6 org.dvb.net.tuning.TunerPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.6 "org.dvb.net.tuning.TunerPermission" on page 303.

Setting the location attribute of the Window object using locators that reference an audio or video stream will cause a SecurityException to be thrown.

Calling the open() Function attribute of the Window object using locators that reference an audio or video stream will cause a SecurityException to be thrown.

DVB-HTML applications can, if granted this permission, reference audio and video resources that require tuning using dvb: locators on the following element attributes:

- img.src
- input.src
- object.data
- Using the CSS url() value.

If the permission is not granted, no tuning will occur and the link will fail as if the resource did not exist.

Using a "dvb:" locator that references an audio or video resources on other element attributes is not required to be supported.

8.13.2.7 javax.tv.service.selection.SelectPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.7 "javax.tv.service.selection.SelectPermission" on page 303.

Setting the location attribute of the Window object using locators that references a DVB service will cause a SecurityException to be thrown.

Calling the open() Function attribute of the Window object using locators that references a DVB service will cause a SecurityException to be thrown.

Applications can, if granted this permission, select away from the current service to a new service using dvb: locators that reference a DVB service on the following element attributes:

- a.href
- area.href

If the permission is not granted, no service selection will occur and the link will fail as if the resource did not exist.

Using a "dvb:" locator that references a DVB service on other element attributes is not required to be supported.

8.13.2.8 org.dvb.user.UserPreferencePermission

This Permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.8 "org.dvb.user.UserPreferencePermission" on page 303.

8.13.2.9 java.net.SocketPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.9 "java.net.SocketPermission" on page 303.

If the permission is granted (and if necessary the rc permission), the location attribute of the Window object may be set to a locator that references a resource on the host named in the permission file. If the permission is not granted then attempting to set this attribute with such a locator will cause a SecurityException to be thrown.

If the permission is granted (and if necessary the rc permission), the open() Function attribute of the Window object may be called with locator that references a resource on the host named in the permission file. If the permission is not granted then calling open() with such a locator will cause a SecurityException to be thrown.

DVB-HTML applications can, if granted this permission (and if necessary the rc permission), reference resources in any element attribute that allows such references using locators to resources on the host named in the permission file.

If the permission is not granted the link will fail as if the resource did not exist.

8.13.2.10 org.dvb.media.DripFeedPermission

This Permission is relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.10 "org.dvb.media.DripFeedPermission" on page 304.

Setting the location attribute of the Window object using locators that reference a dripfeed resource will cause a SecurityException to be thrown.

Calling the open() Function attribute of the Window object using locators that reference dripfeed resources will cause a SecurityException to be thrown.

DVB-HTML applications can, if granted this permission, reference dripfeed resources using dripfeed: locators on the following element attributes:

- img.src
- input.src
- object.data
- Using the CSS url() value.

If the permission is not granted, the link will fail as if the resource did not exist.

Using a "dripfeed:" locator on other element attributes is not required to be supported.

8.13.2.11 org.dvb.security.PrivilegedRCEPermission

When the permission request file requests the permission to do privileged runtime code extension on internal strings and this is granted, a PrivilegedRCEPermission with the name "internal" is created.

When the permission request file requests the permission to do privileged runtime code extension on external strings, but it is granted only for internal strings, a PrivilegedRCEPermission with the name "internal" is created.

When the permission request file requests the permission to do privileged runtime code extension on external strings and this is granted, a PrivilegedRCEPermission with the name "external" is created.

For behaviour, see clause 8.12.2.4 "Use of strings in RCEs" on page 177.

See clause 11.10.2.12 "javax.microedition.apdu.APDUPermission" on page 304

8.13.2.12 org.dvb.application.storage.ApplicationStoragePermission

This permission is only relevant to API use over the bridge, the same rights are granted as for DVB-J applications, see clause 11.10.2.11 "org.dvb.application.storage.ApplicationStoragePermission" on page 304.

8.13.2.13 javax.microedition.apdu.APDUPermission

This permission is relevant only to API use over the bridge. The same rights are granted as for DVB-J applications, see clause 11.10.2.12 "javax.microedition.apdu.APDUPermission" on page 304.

8.14 Miscellaneous

8.14.1 Date Values

8.14.1.1 Syntax

Absolute Date values have the following syntax:

8.14.2 Clock values

8.14.2.1 Syntax

Absolute Clock values have the following syntax:

```
Clock-val         ::= ( Full-clock-val | Partial-clock-val | Timecount-val )
Full-clock-val    ::= Hours ":" Minutes ":" Seconds ("." Fraction)?
Partial-clock-val ::= Minutes ":" Seconds ("." Fraction)?
Timecount-val     ::= Timecount ("." Fraction)? (Metric)?
Metric            ::= "h" | "min" | "s" | "ms"
Hours             ::= DIGIT+; any positive number
Minutes           ::= 2DIGIT; range from 00 to 59
Seconds           ::= 2DIGIT; range from 00 to 59
Fraction  ::= DIGIT+
Timecount         ::= DIGIT+
2DIGIT  ::= DIGIT DIGIT
```

```
DIGIT   ::= [0-9]
```

The default metric suffix is "s" (for seconds). No embedded white space is allowed in clock values, although leading and trailing white space characters will be ignored.

The following are examples of legal clock values:

Full clock values:

```
02:30:03    = 2 hours, 30 minutes and 3 seconds
50:00:10.25 = 50 hours, 10 seconds and 250 milliseconds
```

Partial clock value:

```
02:33   = 2 minutes and 33 seconds
00:10.5 = 10.5 seconds = 10 seconds and 500 milliseconds
```

Timecount values:

```
3.2h    = 3.2 hours = 3 hours and 12 minutes
45min   = 45 minutes
30s     = 30 seconds
5ms     = 5 milliseconds
12.467  = 12 seconds and 467 milliseconds
```

Fractional values are just (base 10) floating point definitions of seconds. The number of digits allowed is unlimited (although actual precision may vary among implementations).

For example:

```
00.5s = 500 milliseconds
00:00.005 = 5 milliseconds
```

8.14.2.2 Offset values

Offset values are used to specify when an element should begin or end relative to another time.

An offset value has the following syntax:

offset-value ::= "+" (Clock-value)

An offset value includes a sign on a clock value, and is used to indicate a positive offset. The offset is measured from the implicit start time:

8.14.3 Unrealizable locators

Locators may not be realizable for several reasons:

- The locator requires tuning for which permission or resources are not available.
- The locator requires network or interaction channel access for which permission is not available.
- The locator requires access to data that is denied by Conditional Access mechanisms.
- The locator requires access to a authenticated file for which authentication fails.
- The locator requires mounting a file system that cannot be mounted at the same time as the currently mounted file systems.

8.14.3.0.1 Presentation of Locators in DVB HTML.

It is implementation specific how the user agent indicates the presence of links to resources when rendering DVB-HTML. Where the user agent can determine a priori that a given link will fail, it is implementation dependent whether the user agent renders this as a link. It is also implementation dependent if and how a user agent presents failure to locate a resource due to insufficient permission being granted.

NOTE: HTML 4 [104] section 12.2.4 recommends that the user agent alerts the user when a referenced file is not available. To avoid computer-like dialogs and accessibility issues it is recommended that authors follow the guidelines in Accessibility e.g. providing text equivalents using the `alt` attribute.

8.14.4 Relation to HTTP and HTTPS

The user agent string (see clause 8.11.1 "User agent strings" on page 169) is sent in a header as part of all HTTP and HTTPS requests (see clause 6.3.7 "Hypertext Transfer Protocol (HTTP)" on page 63).

8.14.5 DVB-HTML specific locators

DVB-HTML has two specific formats of locators which have defined semantics only in the context of DVB-HTML:

- The extended form of the DVB locator (see clause 8.14.5.1 "Extended DVB locator" on page 187).
- The exit locator used for application self termination (see clause 8.14.5.2 "Exit locator" on page 188).

8.14.5.1 Extended DVB locator

8.14.5.1.1 Extended DVB locator syntax

The formal specification of the URL form expressed in BNF is given in the following extension to the dvb: locators defined in table 142 "DVB URL syntax" on page 393.

Table 67: Extended DVB URL syntax

```
dvbhtml_url                = dvb_url | dvb_scheme ":" dvbhtml_hierpart
dvbhtml_hierpart           = dvbhtml_net_path
dvbhtml_net_path           = "//" dvbhtml_entity
dvbhtml_entity             = dvb_service_contextual | dvb_service_component_contextual | ait_
specifier
dvb_service_contextual     = "current" | "original"
dvb_service_component_contextual = "current.audio" | "current.video" | "current.av"
ait_specifier              = ait_filter "." "ait" ait_abs_path
ait_filter                 = "current"
ait_abs_path               = "/" ait_entity
ait_entity                 = ait_root_directory | ait_application
ait_root_directory         = "app_root"
ait_application            = org_id_part "." app_id_part [ "?" ait_params ]
ait_params                 = "arg_" 1*digit "=" *uric ["&" ait_params ]
```

(for `digit` & `uric` see RFC 2396 [41])

(for `org_id_part` and `app_id_part` see clause 14.5 "Text encoding of application identifiers" on page 398)

The semantics of launching applications via such a locator are specified in clause 8.3.3.1.3 "Hypertext" on page 85.

8.14.5.1.2 TV locators

A locator for a DVB service or service component can be a full dvb: locator, as defined in clause 14.1 "Namespace mapping (DVB Locator)" on page 393, or one of the following specific forms.

Table 68

Locator	Meaning
`dvb://current`	The service currently selected by the application.
`dvb://current.av`	The Audio and Video being presented on the background video device (see 11.6.2)
`dvb://current.audio`	The Audio being presented in association with the background video device
`dvb://current.video`	The Video being presented on the background video device
`dvb://original`	Originating service for this application (place of birth)
NOTE: Content authors who, in other systems, use the "tv:" locator, as defined in RFC 2838 [46], may use the equivalent "dvb://current.av" locator to reference the default audio and video component within the service.	

8.14.5.1.3 Application locator

See clause 14.1.7 "Application locator" on page 394.

8.14.5.1.4 AIT locators

Locators for the root directory or the icon representation of the current application can be identified by the following specific forms.

Table 69

Locator	Meaning
`dvb://current.ait/app_root`	The root directory path as found in the dvb html application location descriptor for the application. (note)
`dvb://current.ait/app_icon`	The Icon found in the application icons descriptor for the application. (note)
NOTE: Shall mount file systems if referenced objects are in unmounted file systems and the link is followed.	

8.14.5.2 Exit locator

In the context of a DVB-HTML application, actioning a link in the defined element, attribute context (see table 16 "MIME media type usage" on page 92) with the following form of locator shall cause an application to terminate.

```
exit:
```

The formal specification of the URL is given in the following BNF.

Table 70: Exit URL syntax

```
exit_url                    = exit_scheme ":" *uric
exit_scheme     = "exit"
```

Activating such a link shall request that the application manager move the current application into the Killed state. Any possible characters following the ":" shall be ignored in this version of the specification (see RFC 2396 [41]).

8.14.6 Domain

One of:

- The domain name of the server that served the document if it can be identified.
- An empty string ("") for a page with a dvb: locator.

NOTE: Such pages cannot therefore be in the same domain as any page delivered via http.

- Null otherwise.

9 Application model

9.1 Broadcast MHP applications

9.1.1 Basic lifecycle control

The basic control of the lifecycle of broadcast MHP applications is through the selection of broadcast services. Selection of a broadcast service can be initiated by the user of the MHP terminal using the Navigator as well as by MHP applications offering EPG functionality. Host Control tune requests from a CI module cause service selections. Host Control replace / clear_replace has an equivalent effect to using `javax.tv.media.MediaSelectControl`.

The unit for the presentation and execution of content in the MHP specification is the service. A service in MHP represents a group of pieces of content which are intended to be presented together to the end-user. A service may consist of the contents of a broadcast DVB service, including audio/video streams, data streams and all the service information, applications and application signalling that is being broadcast. Other forms of service are possible, such as a stored service (see clause 9.6.2 "Stored services" on page 211).

Every service that gets presented by an MHP platform is presented within a service context. These form one of the foundations for the runtime environment and the execution model. A service context is an "environment" in which a service gets presented. It defines the boundaries of the service (letting the platform and applications identify which of the pieces of content that are being presented make up a given service). It also enables that service to be addressed and controlled as a single entity.

- In a DVB-J application, a service context is represented by an instance of the ServiceContext class. Where multiple DVB-J applications are being presented in the same service context, the number of ServiceContext objects representing a service context is implementation dependant, but each application sees only one such instance. Changes made by one application to the ServiceContext object that it has are visible to the ServiceContext objects representing the same service context in other applications. DVB-J applications may obtain a reference to the service context within which they are executing through using the method `getServiceContext(XletContext)` on the ServiceContextFactory class.
- In a DVB-HTML application, a service context is represented by a JavaObject object returned by the Bridge API, having the methods and attributes corresponding to the ServiceContext class. Where multiple DVB-HTML applications are being presented in the same service context, the number of JavaObject objects representing a service context is implementation dependant, but each application sees only one such instance. Changes made by one application to the JavaObject object that it has are visible to JavaObject objects representing the same service context in other applications. DVB-HTML applications may obtain a reference to the service context within which they are executing through the Bridge API to access the `getServiceContext(XletContext)` on the ServiceContextFactory class.

The means by which the navigator of an MHP terminal supports selection of services is implementation dependent. However, where an MHP application is using the numeric keys of the remote control, the navigator shall not respond to the user pressing these keys by causing service selection. Hence the user pressing the numeric keys to enter his pincode does not cause service selection.

A service context can present only one service at any one time. Selecting a service to be presented in a service context causes any previous service being presented in that service context to stop being presented. Any content part of the previous service which is not part of the new service shall stop being presented. MHP terminals may limit on the number of broadcast service contexts which can be presented simultaneously.

- In a DVB-J application, selecting a service corresponds to calling the `select()` method an instance of `javax.tv.service.selection.ServiceContext`.
- In an internet access application, selecting a service corresponds to activating a link to a dvb: locator representing a service.
- In a DVB-HTML, selecting a service either corresponds to activating a link to a dvb: locator representing a service, or by calling the select() method on a the JavaObject representing a service context.

9.1.2 Starting applications

When a broadcast service is selected, applications which are listed in the AIT of the service and identified as auto-start shall be launched as described in clause 10.6 "Control of application life cycle" on page 228 without explicit intervention of the user. Applications which are started after the selection of a service will be controlled by signalling associated with that service. The MHP terminal shall monitor that signalling for changes made by the broadcaster. These changes may include the termination of particular applications as well as the addition of new auto-start applications.

Applications which are not identified as auto-start in the AIT shall not be automatically launched by the MHP terminal, but require explicit launching. This explicit launching can be done by the resident Navigator on the MHP terminal or by an MHP application. For example, the user can launch such applications after they have been offered a choice of applications through some user interface. Since the resident navigator is not required to provide a mechanism for this explicit launching, broadcast services wishing to have applications started must provide an application which is identified as auto-start.

Where the currently selected service in a service context includes multiple MHP applications, any running applications may be able to launch other applications from that set. The launched applications shall be presented inside that same service context.

- A DVB-J application is able to achieve this using the application listing and launching API.
- A DVB-HTML application is able to achieve this either by activating a link using a locator referencing an application, or by using the Bridge APIs.

9.1.3 Support for execution of multiple simultaneous applications

The set of applications that are signalled within a service can be presented and executed concurrently.

MHP terminals shall be able to support applications from that set (using the same screen) at least as defined in the minimum platform capabilities clause of the present document. MHP terminals are required to support execution of the set of such applications for each broadcast service which they permit to be presented simultaneously.

Broadcasters should ensure that simultaneous running of the set of applications for a service is comprehensible to the user and does not yield perceptible interference problems.

9.1.4 Stopping applications

MHP applications may stop themselves voluntarily using the MHP APIs or may be stopped by the MHP terminal in a number of situations. Examples of situations where this shall be allowed include:

9.1.4.1 A new service being selected replacing a previously selected one

When a new service is selected and replaces a previously selected one, applications from the former service shall only continue to execute where they are signalled in the new service. If an application is not signalled in that signalling then it will be stopped by the MHP terminal. Where an application is known to be bound to a single service, the broadcaster can identify that application as service bound using the service_bound_flag in the application descriptor. Such applications shall be stopped as soon as possible by the MHP terminal and without needing the AIT for the new service to be available. This allows the autostart application(s) of the new service to be started earlier than would otherwise be the case.

9.1.4.2 The stopping of an application by another application

Subject to the security policy of an MHP terminal, one application may request to stop another application. In such a case, the resident Application Manager, after a successful security check, kills the application otherwise that application shall continue running, without interruption.

9.1.4.3 Changes in the application signalling to request a particular application be stopped

The broadcaster may request an MHP terminal to stop an application using the control codes in the AIT. The precise semantics of these are dependent on the application format.

9.1.4.4 Stopping by the MHP terminal due to a shortage of resources

Where an MHP terminal has insufficient resources (e.g. memory, CPU and resources managed by the resource management API) to continue the execution of one of the running applications, the MHP terminal is allowed to decide to stop an MHP application without user intervention.

NOTE: The precise resources of an MHP terminal are implementation dependant.

9.1.5 Persistence of Applications Across Service Boundaries

Where a running application is signalled in both the new service and the former service, and is not signalled as service bound in the former service, it shall continue to run and shall not be restarted. In this case, the running application shall become controlled by the application signalling of the new service where it is signalled and not the signalling of the former service. Hence the MHP terminal shall monitor the AIT of the new service and shall stop responding to the AIT of the former service.

If the application is signalled as service bound in the former service then it is terminated in the normal way as the new service is selected. If it is signalled as auto-start in the new service it will restart with no volatile context from the previous instantiation.

If an application survives a service selection operation, it will not automatically gain access to any new broadcast file system on the new service. It remains logically attached to any broadcast file systems it has already attached to, although it may be temporarily disconnected from the broadcast carousels feeding those file systems. The behaviour of the broadcast file system under these circumstances is defined in clause 6.2.5.3 "Loss of Carousel Behaviour" on page 61.

If temporarily disconnected, the broadcast carousel shall be reconnected upon selection of a service where an identical carousel is available. This includes both the original service from which the application was downloaded (assuming the carousel is still present in that service) and other services containing an identical carousel as defined by clause B.2.10. To determine carousel availability, the MHP shall use the PMT information obtained for the PMT of the currently selected service.

9.1.6 Management of autostarting

The receiver shall launch autostart applications under the following conditions:

- The signalling indicates that the application can be supported by the receiver, as defined by the application profile and versioning information contained in the application descriptor.
- Only a single application with a given Application identification is allowed to run at any time in a single service context.
- The application is a newly introduced autostart application or has newly been given autostart status.

So:

- When a service is selected the receiver shall launch at most one instance of each autostart application that it can support.
- If after service selection an autostart application that the receiver can support is introduced or a previously listed supportable application gains autostart status then the application shall be launched subject to normal resource limitations, etc.

However, if an autostart application terminates itself, it shall not be restarted unless it again becomes a new autostart application. An application becomes a new autostart application in the following cases:

- The receiver navigates away from the service and then selects a service where the application is autostart.
- The application is removed from the AIT and then is re-introduced.
- The autostart status of the application is reset then set again.

NOTE 1: In summary the autostart status of an application is in effect an edge trigger rather than level trigger signal.

NOTE 2: These semantics for the autostart behaviour address "de-bouncing" the case where an autostart application terminates voluntarily. They do not address the case where the receiver terminates the application.

In this case the platform may attempt to re-start the application however this is implementation dependent.

NOTE 3: The present document does not describe in detail the timing required for the broadcast signalling to renew the autostart status of an application.

9.1.7 When tuning is not service selection!

MHP applications may cause tuning to another transport stream by mechanisms other than service selection. Usage of these mechanisms does not constitute service selection and therefore no applications from the target transport stream or service shall be started either by the MHP terminal or by MHP applications. The MHP terminal shall continue monitoring the AIT of the logically selected service where this is available on the target transport stream. Where the AIT of the selected service is not available, the application shall continue executing as described in clause 10.4.4 "Visibility of AIT" on page 223. The service being presented in the service context shall not be changed by an application using these mechanisms:

- DVB-J tuning APIs.
- DVB-HTML accessing a media or service reference (e.g in an <object> or <img> element), or by accessing the tuning API through the Bridge.

9.1.8 MHP Applications and Service Selection

MHP applications may select services using the service selection API. The service selection API includes a class `ServiceContext` to represent environments in which services may be presented. Calling the select method on a `ServiceContext` causes a new service to be presented in that context and any former service being presented in that context will be stopped.

Where one MHP application uses the application listing and launching API to successfully start a second MHP application, the second MHP application shall be considered as executing inside the service context of the first MHP application. The number of `ServiceContext` objects representing a service context is implementation dependant, but each application sees only one such instance. Changes made by one application to the `ServiceContext` object that it has are visible to the `ServiceContext` objects representing the same service context in other applications.

MHP applications started in response to a service selection operation are considered to be executing "inside" a service context. They may obtain a reference to the service context within which they are executing through using the method `getServiceContext(XletContext)` on `javax.tv.service.selection.ServiceContextFactory`.

9.1.9 Cached applications

When an application is signalled in the AIT of a broadcast service in the usual way, and that AIT entry also contains an `application_storage_descriptor`, the terminal may use files that have been stored on the terminal to accelerate the loading of that application. These files may have been stored on the terminal by any way allowed by clause 9.9 "Stored and cached applications" on page 215, including proactive caching, or an explicit request to store or cache the application.

Stored broadcast related applications shall take the lifecycle model of broadcast applications. For example:

- The application can only be started when it is listed in the AIT of the currently selected service.
- Following a service change, the application behaviour will depend on the AIT signalling in the newly selected broadcast service.

In summary, the behaviour is that of a broadcast application, except that the loading is possibly accelerated due to the file system cache provided by the storage.

When a cached application (other than one with launchable_completely_from_cache set to "1") executes, it shall see the same filesystem as if it was being run directly from broadcast. The set of files stored in response to being listed in the application description file (see clause 9.6.1 "Applications loaded from the interaction channel" on page 211) shall always override the same files from the broadcast.

Broadcasters should not remove a file listed in the ADF from the broadcast without amending the ADF and incrementing the application version number. If a cached file is removed from the broadcast, but is cached by the terminal, it shall still be readable. File.list() shall always return the current contents of the broadcast, so will not show such files.

When starting an application which has launchable_completely_from_cache set to "1", the behaviour depends on whether or not all critical files are cached. If they are not, the application will be started as described in the previous paragraph (or, if "not_launchable_from_broadcast" is "1", the application will not be started at all). If all critical files are cached, the application will be started without mounting the carousel. Only the files stored in the cache shall be available. Note that, in this case, if the permission request file is not listed in the application description file (or does not have a priority of critical and has not been cached), the permission request file is missing and hence no additional permissions are requested.

NOTE: The application provider is responsible for managing any dependencies between those files which can be stored and those files which are not required to be stored.

9.1.9.1 Version management

If the application has not_launchable_from_broadcast set to '0' then the broadcast version shall be used regardless of the value of is_launchable_with_older_version. If the application has not_launchable_from_broadcast set to '1' and:

- is_launchable_with_older_version is set to '0', it shall not be launched at all.
- is_launchable_with_older_version is set to '1', the cached/stored version shall start.

Applications that use the application caching API are responsible for updating the cached version of an application when a new version is released. If not_launchable_from_broadcast is set to '1' and:

- is_launchable_with_older_version set to '0', a launchable application must be provided to manage the update (although an MHP terminal may perform the update autonomously).
- is_launchable_with_older_version set to '1', the cached/stored application is responsible to manage the update.

Terminals shall allow different versions of an application to be cached/stored simultaneously. (For example, if two broadcasters use the same application, they may not upgrade to the latest version at the same time.) Where multiple versions of an application are stored and one of them is to be started, the one started shall be the one whose version number is less than the version number of the transmitted application by the smallest amount.

NOTE: MHP terminals may refuse to update, or keep stored, applications where the version numbers change too frequently. Broadcasters should ensure that frequently changing files are not listed in the "Application description file". The meaning of "too frequently" is terminal-specific. However, an application version changing twice a day shall not be considered too frequently.

When running a cached application where multiple versions of that application are cached, the terminal shall only return files from the cache that were stored in response to an application description file signalled with the same organisation ID, application ID, and version number as the version of the application that is being run.

9.1.9.2 Proactive caching

If a storable application is signalled, terminals are allowed to proactively store any files that are indicated in the ADF. Terminals do not have to honour the requested priority when proactively caching files.

In particular, note that proactive caching is not required to store all files with critical priority (but in this case the application shall not be reported as cached by the MHP APIs, and shall not be started if it is signalled with not_launchable_from_broadcast set to "1").

Terminals are responsible for handling version updates to applications that were proactively cached.

9.2 DVB-J Model

9.2.1 Starting DVB-J Applications

DVB-J applications may be started by any of the means defined for general MHP applications. The application listing and launching API defined in annex S "(normative): Application Listing and Launching" on page 846 allows one MHP application to start another MHP application subject to security policy. The `start()` method of the `AppProxy` interface will then cause the Application Manager to start the new MHP application subject to normal resource limitations.

The Xlet interface is defined in the `javax.tv.xlet.Xlet` interface Java TV [51]. DVB-J applications provide a class implementing this interface and reference that class in the DVB-J application location descriptor. In order to start a DVB-J application, the application manager shall call the constructor of this class, the `initXlet()` and the `startXlet()` methods of this interface.

9.2.2 Stopping a DVB-J Application

DVB-J applications may stop for any of the reasons listed for general MHP applications. An application shall be able to notify that it is stopped by finishing its execution and informing the Application Manager through the `notifyDestroyed()` method on the `javax.tv.xlet.XletContext` interface. This interface also includes other methods to allow a DVB-J application to request or notify changes in its state.

The application listing and launching API allows an application to indirectly control the lifecycle of another application subject to security policy. This control is indirect because an application cannot invoke an Xlet state method directly, but goes through this API. This ensures that the resident Application Manager can always keep track of all the application that are running.

When a DVB-J application is stopped by an MHP terminal, the `destroyXlet` method of the signalled Java class implementing the Xlet interface, i.e. the initial class of the application, shall be called by the application manager. In the case of the application being stopped due to a service selection operation, the stopping of the application shall be unconditional. This method call gives applications their last opportunity to save state before their execution stops. Applications which wish to survive the user of the MHP terminal zapping away from their service (e.g. during an advertising break) must save their state and reload that state when they are re-started if the user returns to that service later.

9.2.3 DVB-J Application Lifecycle

9.2.3.1 Introduction

This clause describes the Xlet lifecycle model for the DVB-J API. This describes the capabilities of the Xlet in each state and the methods by which the application manager influences the life cycle state.This clause is not directly related to other aspects of a system, such as graphics or shared resource allocation/management.

NOTE: The traditional Java platforms define a number of application models that have their own lifecycles associated with them. In general, they are designed to address specific issues on that platform. For instance, the Applet was designed to provide support for executable content in web pages. However, none of the existing application technology fully addresses the specific requirements of television receivers. The application lifecycle defined in this clause is meant to be compatible with existing Java platforms and virtual machine technology.

This clause defines the lifecycle of an instance of a DVB-J application. The lifecycle of a DVB-J application and of a application instance are the same except that when an application instance is destroyed, the application is only transiently destroyed and then becomes not loaded. See `org.dvb.application.AppProxy.NOT_LOADED` in annex S "(normative): Application Listing and Launching" on page 846.

9.2.3.2 Lifecycle state machine for DVB-J application instances

The Xlet state machine ensures that the behaviour of an Xlet is close to the behaviour that television viewers expect, specifically:

- The perceived start-up latency of an Xlet can be very short.
- It is possible to put an Xlet into a state where it is not providing its service.
- It is possible to destroy an Xlet at any time.

The figure 15 shows the state machine model for Xlets. The Xlet states are defined in more detail in table 71.

The different influences that can cause an Xlet to change state include:

- The application manager uses the Xlet API to signal these changes to the Xlet.

  Various factors may stimulate the application manager to act in this way, for example:

  • Broadcast signalling (e.g. a change in the state of the application_control_code parameter carried by the AIT (see clause 10.4 "Application Information Table" on page 222)).

  • User selection of an application in a host provided UI.

- The Xlet itself "decides" to change state.

  The application uses the `XletContext` Object to communicate or request such changes to the application manager.

- Another Xlet acts via the application launching API (see clause 11.7.2 "Application discovery and launching APIs" on page 290).

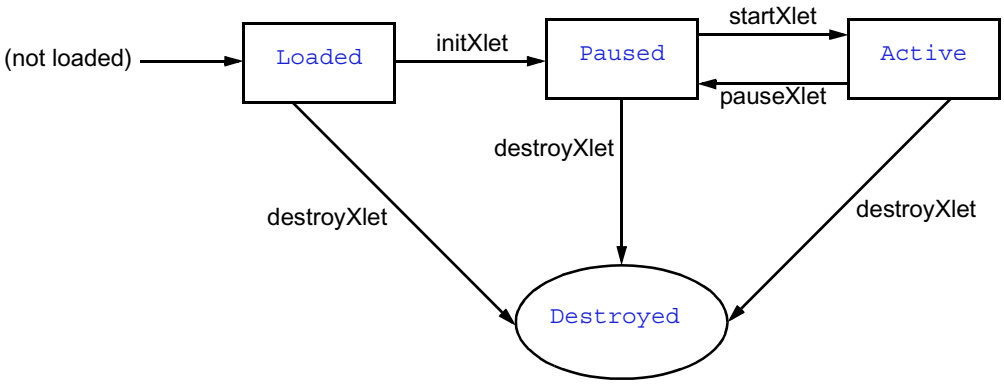


Figure 15: Xlet lifecycle state machine diagram

Table 71: Valid lifecycle states of DVB-J application instances

State Name	Description
`Loaded`	The DVB-J application instance has been loaded and has not been initialized. The signalled Java class used to initiate a DVB-J application instance must implement the `javax.tv.xlet.Xlet` interface. Otherwise, the class (and hence the application instance) may be ignored. An instance of the signalled Java class is created by the application manager e.g. using the `Class.newInstance` method. Therefore a DVB-J application instance must have a public "default constructor". Otherwise, the class (and hence the application instance) shall immediately enter the `Destroyed` state. If the default constructor returns without throwing an uncaught exception, then the application instance is considered to be "`Loaded`", otherwise the application instance immediately enters the `Destroyed` state and is discarded. Once the application instance has been successfully loaded and instantiated, the application manager can transition the application instance to the `Paused` state by invoking the `initXlet` method on the signalled class (implementing the Xlet interface). If the `initXlet()` method throws an `XletStateChangeException` then the application instance shall remain in the Loaded state. The only possible state transition for such an application instance is into the destroyed state. The application instance can request this itself or wait for the application manager to cause this transition. (See notes 1 and 2)
`Paused`	A `Paused` DVB-J application instance should minimize its usage of resources if it wants to maximize its probability of survival. This does not imply that it cannot be holding any resources, but in such a case, it would have a lower priority as concerns access to resources than it had when it was in the `Active` state. When entering the paused state, an application should ensure that any `HScene` instances it is using are invisible. See also clause 9.10. While an application is paused, it should not attempt to make any `HScene` instances visible, and it should not attempt to draw to the screen. Any application that does this while paused may be considered uncooperative, and may be terminated by the application manager. Applications should also respect the rules of "television viewing mode" as defined in clause 11.4.1.4. This state is entered: • From the `Loaded` state after the `Xlet.initXlet()` method returns successfully when invoked by the application manager (the first time). Other invocations of this method do not cause the change of state. (See note 3) • From the `Active` state after the `Xlet.pauseXlet()` method returns successfully when invoked by the application manager. Other invocations of this method do not cause the change of state. • From the `Active` state upon entering the `XletContext.notifyPaused()` method.
`Active`	The DVB-J application instance is functioning normally and providing service. This state is entered: • From the `Paused` state after the `Xlet.startXlet()` method returns successfully.

State Name	Description
`Destroyed`	The DVB-J application instance has released all of its resources and terminated. This state is entered: • When the Xlet's `destroyXlet()` method returns successfully. The `destroyXlet()` method shall release all resources held and perform any necessary clean up so the Xlet may be garbage collected. • Upon entering the `XletContext.notifyDestroyed()` method. The Xlet performs its clean up actions before calling the `notifyDestroyed()` method. (See note 4)
NOTE 1: Application initialization is intended to occur in the `initXlet` method, rather than in the default constructor. NOTE 2: This state is entered only once per instance of an DVB-J application. NOTE 3: The application manager shall only call `initXlet()` once per instance of a DVB-J application. NOTE 4: This state is entered only once per instance of an DVB-J application instance.	

Every time a DVB-J application instance is started (i.e. the constructor of the object implementing Xlet is called), it shall logically run in its own new virtual machine instance. See clause 11.2.1 "Basic Considerations" on page 261.

Only the DVB-J application can determine if it is able to provide the service for which it was designed. As such, in some respects an application manager cannot guarantee whether an DVB-J application can, or is, providing its service; and application manager can only indicate that the DVB-J application is able to do so. A typical sequence of DVB-J application execution is:

Application Manager	DVB-J application
The application manager creates a new instance of an Xlet.	The Xlet's default (no argument) constructor is called, it is in the `Loaded` state.
The application manager creates the necessary context object for the DVB-J application to run, and initializes the Xlet.	The DVB-J application uses the context object to initialize itself. It is now in the `Paused` state.
The application manager has decided that it is an appropriate time for the DVB-J application to perform its service, so it signals it to enter the `Active` state.	The DVB-J application acquires any resources it needs and begins to perform its service.
The application manager no longer needs the DVB-J application to perform its service, so it signals the DVB-J application to stop performing its service.	The DVB-J application stops performing its service and might choose to release some resources it currently holds.
The application manager has determined that the DVB-J application is no longer needed, or perhaps needs to make room for a higher priority application in memory, so it signals the DVB-J application that it is a candidate to be destroyed.	If it has been designed to do so, the DVB-J application saves state or user preferences and performs clean up.

9.2.4 Xlet API

The Xlet API provides MHP application developers with an API that provides life cycle signalling. The Xlet API uses the callback approach to signal state changes.

This API is specified in clause 11.7.1 "APIs to support DVB-J application lifecycle" on page 289.

9.2.4.1 Xlet State Change Semantics

An Xlet's state can change either by having one of the methods on its Xlet Interface called, or by making an internal state transition and notifying the application manager via the `XletContext` Object. The semantics of when that state change actually happens are important:

- Calls to `Xlet`: this interface indicates a successful state change only when the call successfully returns.
- Calls to `XletContext`: the `notifyDestroyed()` and `notifyPaused()` methods indicate a state change on entry. The `resumeRequest()` method indicates no state change, instead only a request to change state.

If a method on the Xlet interface throws an `XletStateChangeException`, the Xlet shall remain in the state it was in immediately prior to the call of the method throwing the exception unless otherwise specified. In the present document, the only exception to this rule is the `destroyXlet` method when the `unconditional` flag is `true` where throwing the `XletStateChangeException` is specified to have no effect. For the case of `initXlet` which may only be called once, the application manager may choose to transition the Xlet to the destroyed state (without calling `destroyXlet`) some implementation specific time later.

9.2.4.2 Xlet state change requests

The following table defines the previous states in which calls to the methods on `XletContext` relating to state management are valid;

NOTE: These methods are called after the Xlet has changed its state.

Table 72: States for valid state management calls

Call	State
notifyDestroyed	all states
notifyPaused	active only
resumeRequest	paused only

Calls to these methods when an Xlet is in any other state shall have no effect.

9.2.5 Multiple application environment support

The DVB-J platform allows for the simultaneous execution of several DVB-J applications.

Allowing several DVB-J applications to run simultaneously implies that some rules be defined for these DVB-J applications to share the resources of the MHP, and in particular for them to share the Input Focus and the Output Focus.

9.2.5.1 Control of DVB-J applications by other DVB-J applications

The MHP provides support for control of the lifetime of a DVB-J application by another DVB-J application. This feature enables broadcasters to write their own "Launcher applications" that take care of the presentation to the user of the availability of DVB-J applications, and that enables eventually the user to launch DVB-J applications.

NOTE: The actual control of the lifetime of an DVB-J applications is done by the Application Manager only. The MHP only provides APIs that enable DVB-J applications to ask the Application Manager to start, stop, pause and resume DVB-J applications.

See clause 11.7.2 "Application discovery and launching APIs" on page 290.

9.2.5.2 Input Focus management

The input focus is defined as follows:

- The application that has input focus is in principle able to receive user-input events.
- Other applications not having the input focus can request to receive a subset of user-input events via a dedicated API. See clause 11.3.2.2 "org.dvb.event" on page 266.

A DVB-J application has input focus if and only if the `java.awt.Component` having focus belongs to the component tree of that application.

9.2.5.3 Other resources management

The APIs defined in the present document provide support for resource allocation/revocation and resource revocation notification. The semantics of the APIs, however does not define under which circumstances an access to a resource is granted or revoked. While it is well understood that in most cases, it is up to the MHP implementation to define its own policy in terms of resource management, this clause defines the basic rules that an MHP implementation has to follow.

The MHP specification describes a multi-application environment. Hence several applications may be competing for access to the same atomic resource. The resource notification API described in clause 11.7.5 provides a common way for applications to negotiate access to scarce atomic resources when such competition happens. This API allows for the MHP terminal to inform the application that currently holds the resource that another application wants to access this resource. It also provides a means for the owner of the resource and to the requester of the resource to communicate by private means. This private communication is reflected by the request_data object that the requester may pass to the owner. The semantics of this object is private and has to be known by both applications.

Some existing and general purposes java APIs that were developed before the MHP work was started do not use this general resource sharing mechanism. Hence access to resources addressed by these APIs are not subject to negotiation. For example, when an application holds a JMF player, if another application was to create a JMF player for the same content-type, the MHP has to decide by itself whether it withdraws the resource underlying the JMF player from the current owner and grants it to the requester.

It is also possible for applications to use the inter-application communication API to establish private communication channels enabling them to negotiate access to resources.

As an optimisation, MHP implementations may make available additional resources (e.g. tuners) to MHP applications which do not ask for them explicitly. Any such additional resources must be successfully reserved on behalf of the application before use and released afterwards. If the reservation fails, the same resource shall be used as on an MHP implementation without those additional resources, e.g. the tuner associated with the service context in which the application is running. If the additional resources are later removed, the MHP implementation shall revert to using the expected resources (e.g. the tuner associated with the service context in which the application is running) transparently to the application.

9.2.5.4 VM implementation

Where there are multiple DVB-J applications being executed as part of the same service, MHP terminals are allowed implement these in a single actual virtual machine instance. Regardless this shall conform to clause 11.2.1 "Basic Considerations" on page 261.

9.3 DVB-HTML Model

9.3.1 The DVB-HTML Application

9.3.1.1 DVB-HTML Application

A DVB-HTML application is defined as a set of documents selected from the DVB-HTML family of elements and content formats as defined in the present document. The extent of the set is described by the application boundary.

9.3.1.2 User agent

A user agent is an application that interprets a content format (in this case DVB-HTML documents).

NOTE: This could be implemented as a plug-in.

9.3.1.3 DVB-HTML Actor

A DVB-HTML actor is defined as the locus of activity or process involved in running the specific set of DVB-HTML documents for some DVB-HTML application, plus any instantiated context for that data. The actor runs inside a user agent (native, plug-in or downloaded). The nature of the process is not defined explicitly as it depends on the nature of the user agent itself. More than one such locus of activity may be present in any given user agent.

There is a single DVB-HTML Actor for each running DVB-HTML Application, each DVB-HTML Application can consist of multiple documents several of which could be simultaneously displayed.

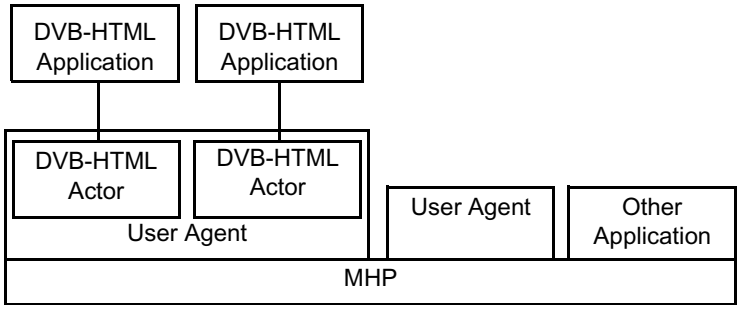


Figure 16: Relationships between actors and applications

9.3.1.4 Application boundary

The application boundary defines the extent of a DVB-HTML Application. Any content documents outside of the application boundary are considered to not be part of the DVB-HTML Application and shall be unavailable to the referencing DVB-HTML application. An MHP terminal may contain an implementation specific mechanism to allow the end-user to decide to explicitly access the resource outside the boundary but this shall not be in the context of the original DVB-HTML application. This namespace can be used by a broadcaster to easily control the perimeter of user navigation and by an MHP implementation to more efficiently pre-fetch applications.

The logical extent of a DVB-HTML application could potentially be quite large, and for various reasons might not all be on the MHP terminal at one time. Part of it might be broadcast, part of it might be on local storage, part of it might be on the world wide web - some of it may even be generated on demand. For this reason the compact format of the regular expression is used to define the extent. The set ofDVB-HTML documents making up a DVB-HTML application is defined by a regular expression over the locator language, broadly a locator consists of a text string in the following form from RFC 2396 [41] and acts as the glue which holds the application together.

```
scheme://host/dir1/dirn/file#subref
```

A regular expression is the definition of a set by a pattern which can test whether a given string is or is not a member of the set, for example the regular expression:

```
https?://www\.(dvb|etsi)\.org/[a-z0-9/]+\.html?
```

Matches the logical locator of any file on both www.dvb.org or www.etsi.org, either reached by http or https, if and only if it is a DVB-HTML file (its name ends in ".htm" or ".html"), and its pathname contains only alphanumeric characters. Quite terse definitions can match a large set of files [see for example Compilers].

9.3.1.4.1 Regular Expression Syntax

A regular expression (RE) specifies a set of character strings to match against. A member of this set of strings is said to be matched by the regular expression.

In order for a locator to match a boundary regular expression the whole locator must be matched by the whole regular expression; any parameters (characters including and after the first "?" or "#" in the locator) are not considered as part of the locator for purposes of boundary matching.

The form of regular expression used for defining application boundaries is defined as a POSIX Extended Regular Expression from POSIX [59] section 2.8.4.:

Relative locators in the DVB-HTML application are expanded to a full URI as defined in RFC 2396 [41], (the default base URI being that carried in the application location descriptor) before being matched.

A pattern may be broken into sub patterns in a set of application boundary descriptors (see signalling). The full pattern is formed from the OR of all the sub patterns. Each application boundary descriptor may be associated with a label (see clause 10.10.3 "DVB-HTML application boundary descriptor" on page 247). This label can be used for pre fetching in a transport specific manner, for example in an object carousel it defines that all modules matching the label should be preloaded.

For example: an application consists of an entry web page /phase0/index.html, and is factored into three sub sections, each of which has an associated stylesheet and image directory.

```
labelA: (/phase0/.+\.html | /phase0/images1/.+\.png | /phase0/scripts1/.+\.js)
labelB: (/phase1/.+\.html | /phase1/images/.+\.png | /phase1/scripts/.+\.js)
labelC: (/phase2/.+\.html | /phase2/images/.+\.png | /phase2/scripts/.+\.js)
```

The entry point locator signalled for this application matches the first regular expression, this allows the pre-fetch mechanism to load the modules labelled with labelA (which the broadcaster arranges to contain the contents of directory phase0), Once the user agent is running, it can use this information to detect which if any links from the current page might transition to a new phase and therefore require more pre-fetching.

9.3.2 DVB-HTML Application Lifecycle

9.3.2.1 Introduction

There are three key parts of the DVB-HTML application lifecycle model:

a) How applications are signalled as available to the MHP, and for auto start and prefetch applications how the start time is synchronized with any associated media stream.

b) How and when the application manager or other launcher application makes the presence of an non auto-start application known to the user and provides it with a trigger. This is covered by the application discovery and launching mechanisms.

c) How a broadcaster controls an actor after it has started.

9.3.2.2 Signalling

The DVB-HTML Application is signalled as described in clause 10 "Application Signalling" on page 220.

The application manager can be requested to start a DVB-HTML application either because it is signalled as auto start, or through the application launching API.

On receiving the request that a DVB-HTML application is to be started (i.e. an AUTOSTART or PREFETCH appears in the AIT or it is user instantiated), and there is no application with the same applicationID already instantiated, the application manager should attempt to find a suitable user agent. It can also at this point begin pre-fetching material.

If the application manager is unable to instantiate a user agent either through lack of resources, or no suitable user agent being available then any pre-fetching can be aborted, and any trigger signal can be ignored.

It is platform dependant at what time a DVB-HTML autostart application starts. For a pre-fetched DVB-HTML application a trigger is required which carries the time at which the application should start providing service.

The DVB-HTML actor can be in one of 5 DVB-HTML Application states.

- Loading.
- Active.
- Paused.
- Destroyed.
- Killed.

Each of these states has a precise meaning outlined in the following clauses. The transitions between states are made as a result of, for example:

- A trigger, such as a request to go to a new document.
- A trigger such as the DVB-HTML application making an explicit request to change state.
- A change in the external environment i.e. the application_control_code in the AIT changes.

Since a user agent may be performing as several actors, it can be in several of these states at one time, each actor however will be labelled with a unique application ID.

A DVB-HTML application proceeds by moving between documents, while the documents remain within the DVB-HTML application boundary the DVB-HTML application continues to run normally.

Links within an DVB-HTML application normally replace the existing document, but attributes may be present on a link which cause both the new and old document to be visible at the same time.

9.3.2.3 Lifecycle control

The state model for the DVB-HTML application lifecycle control model described in this clause reflects the signalling (see clause 10.6 "Control of application life cycle" on page 228) and is an abstract view of how a DVB-HTML application operates, and considers the kinds of resources that a user agent would need in order to function properly: resources concerned with output (rendering), input (event catching) and connection (the availability of the content).

The abstract model however is mostly illustrative and does not imply any resource management strategy nor is it intended to overly constrain the implementation of a user agent;

9.3.2.3.1 State diagram

The following transition diagram summarizes the states and the transitions between them.

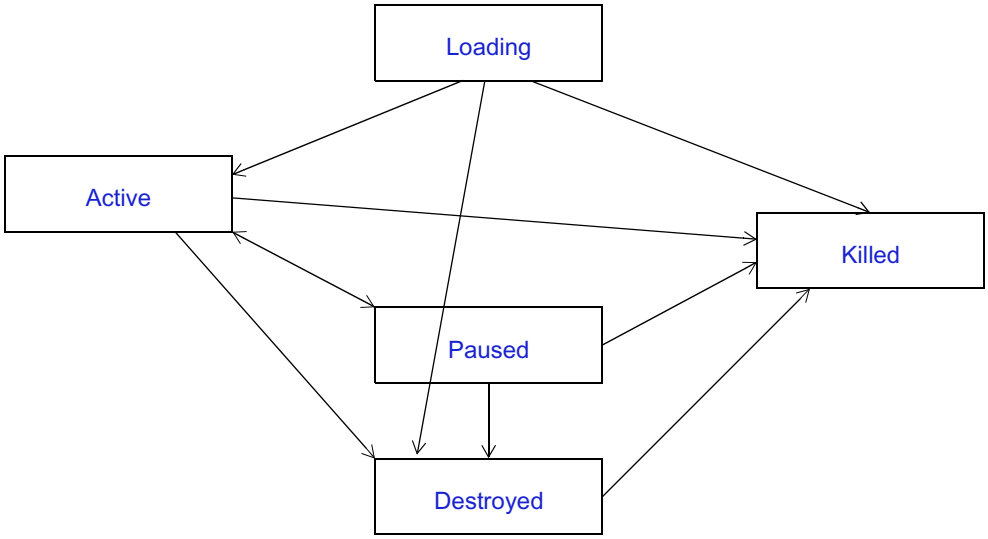


Figure 17: DVB-HTML application life cycle state diagram

9.3.3 The State Model

The entry state of the state machine, Loading, is characterized by access to the content resources and signalling resources but does not have or require input and output resources. This implies the actor can prefetch content and receive triggering events for transition to the Active state, but will not be presented to the viewer.

On entry into the Active state the actor would be assumed to have full access to the content of the current document and all resources of the MHP, subject to resource management and security issues.

The paused state is a reduced operational state. If the application manager or the user agent needs resources for other purposes, an actor may be moved to the paused state, when in this state it may no longer have full (or even any) access to resources. When the actor is reactivated it returns to its previous state.

The destroyed state can be characterized as loss of the content resource. The actor may still be able to run the DVB-HTML application due to caching or other mechanisms but must be prepared for loading of some or all of the documents from within the DVB-HTML application to fail. It is implementation dependent how such failure is handled. This is a way for the broadcaster to signal to the MHP that it is on it's own.

The killed state is characterized by the loss of all resources, and is the signal for actions concerned with cleanup of the actor. The MHP reclaims whatever resources it deems necessary. It is implementation dependent whether cached material is disposed of.

If the AIT signal is KILL, an actor is forcibly terminated (and all resources associated with it reclaimed) regardless of state.

An actor shall not stop running itself or a DVB-HTML application without transitioning the DVB-HTML application into the killed state

9.3.3.1 Loading

9.3.3.1.1 Name

Loading

9.3.3.1.2 Entry actions

Instantiation of an actor.

9.3.3.1.3 Activities

Waiting for documents to be available and loading documents without rendering them.

9.3.3.1.4 Resources

Content, signalling, Output

9.3.3.1.5 Transitions

Active. preconditions:

- Enough data is available to present something sensible.

Killed. preconditions:

- If the DVB-HTML application is signalled as KILL.

Destroyed. preconditions:

- If the DVB-HTML application is signalled as DESTROY.

9.3.3.1.6 Comment

This is the entry state of the state machine This state is entered only once in the lifetime of the DVB-HTML actor. Any start-up phase of a user agent can also be considered as part of this state. When an actor is in this state it is not rendering anything. This state should not be confused with any prefetching of modules which may be carried out by the MHP prior to application launch.

9.3.3.2 Active

9.3.3.2.1 Name

Active

9.3.3.2.2 Activities

Gathering and parsing current document and related resources., rendering document, Maintaining rendered documents. receptive to events, waiting for triggering event to show loaded documents.

9.3.3.2.3 Entry actions

If application is signalled as pre-fetch wait for trigger before displaying anything.

9.3.3.3.5 Comment

The semantics of this state are both user agent and DVB-HTML application specific. When the DVB-HTML application returns from the "Pause" state, the environment might have changed (loss of resources or network connections) and some events may not have been reported.

9.3.3.4 Destroyed

9.3.3.4.1 Name

Destroyed

9.3.3.4.2 Activities

Loading documents. Rendering documents. Consuming events. Interact with the user.

9.3.3.4.3 Resources

input and output.

9.3.3.4.4 Transitions:

Killed.

- {If the DVB-HTML application is signalled as KILL} OR {local event forces the actor to terminate, possibly through application manager}.

9.3.3.4.5 Comment

This state indicates the MHP may no longer be able to access the content resources required to run the DVB-HTML application. It is DVB-HTML application and user agent specific as to whether the actor continues to run, and if it does how the user should be informed if any link is no longer available because the content it refers to is no longer available, or a cached copy has expired. The DVB-HTML actor may continue to execute in the destroyed state until the user actively dismisses it.

9.3.3.5 Killed

9.3.3.5.1 Name

Killed

9.3.3.5.2 Entry actions

Release of resources.

9.3.3.5.3 Activities

Termination of the DVB-HTML application.

9.3.3.5.4 Resources

none.

9.3.3.5.5 Transitions

none

9.3.3.5.6 Comment

After the activities in this state are finished, the application is no longer running. This state is the exit state of the state machine.

9.3.4 Application activity events

Each page within an application shall receive load and unload events with the following constraints:

- The DVB lifecycle `AppActive` event precedes the first DVB-HTML `load` event.
- There is no guarantee on the relative ordering of the first DVB-HTML `load` event and the DVB lifecycle `AppStarting` event.
- When a document is unloaded because of a transition to a new page the current document will receive an `unload` event and all event handlers will be allowed to complete before the new page begins its lifecycle.
- When an application transitions to the Killed state (i.e. the DVB-HTML actor ceases to execute), there is no guarantee that the current document will receive any `unload` event.
- When an application transitions to the Destroyed state the application may continue to execute in the Destroyed state, in which case `unload` events and new `load` events may be received if assets are available.
- The document `load` event is received after all parts that can receive `load` events have received them. Specify when the `load` event is fired for each media type (e.g. streamed, multipart replace).
- No non-lifecycle events are delivered to a page until after the `DVBDOMStable` event is delivered.
- Events that occurred when the application is in the from the Loading state and may be delivered when in the Active state.

NOTE: The first two constraints will not be visible to documents in frames which share an application boundary with their parent, as they do not receive DVB lifecycle events.

The following state diagram illustrates these interactions.

- DVB-HTML lifecycle states and transitions are in This Style.
- DOM events are in **This style**.
- States and transitions which are only part of this model are in *this style*
- The *request* transition indicates a request (from user inputs, trigger events etc.) to navigate to a new page.
- The (*no event*) transition may happen immediately, with no other input.
- The *loading page* state covers loading content for a new page and may cover full or incremental rendering of the page (although the page may not be presented to the user, if the application is signalled as PREFETCH and the AppStarting event has not been received).
- The *loading content* state covers the referenced content for a new page after the initial content is parsed and may cover full or incremental rendering of the page (although the page may not be presented to the user, if the application is signalled as PREFETCH and the AppStarting event has not been received).
- In the *loaded page* state, the page has been loaded. Unless the application is signalled as PREFETCH and no AppStarting event has occurred, it will also have begun to be presented to the user.
- In the *unloading page* state, content loading for the new page may begin.
- The AppStarting, AppPause, AppResume and AppDestroyed DVB-HTML lifecycle events are not shown in this diagram, because the only constraints on them are in relation to the standard MHP lifecycle states and events, not in relation to the DOM load and unload events.

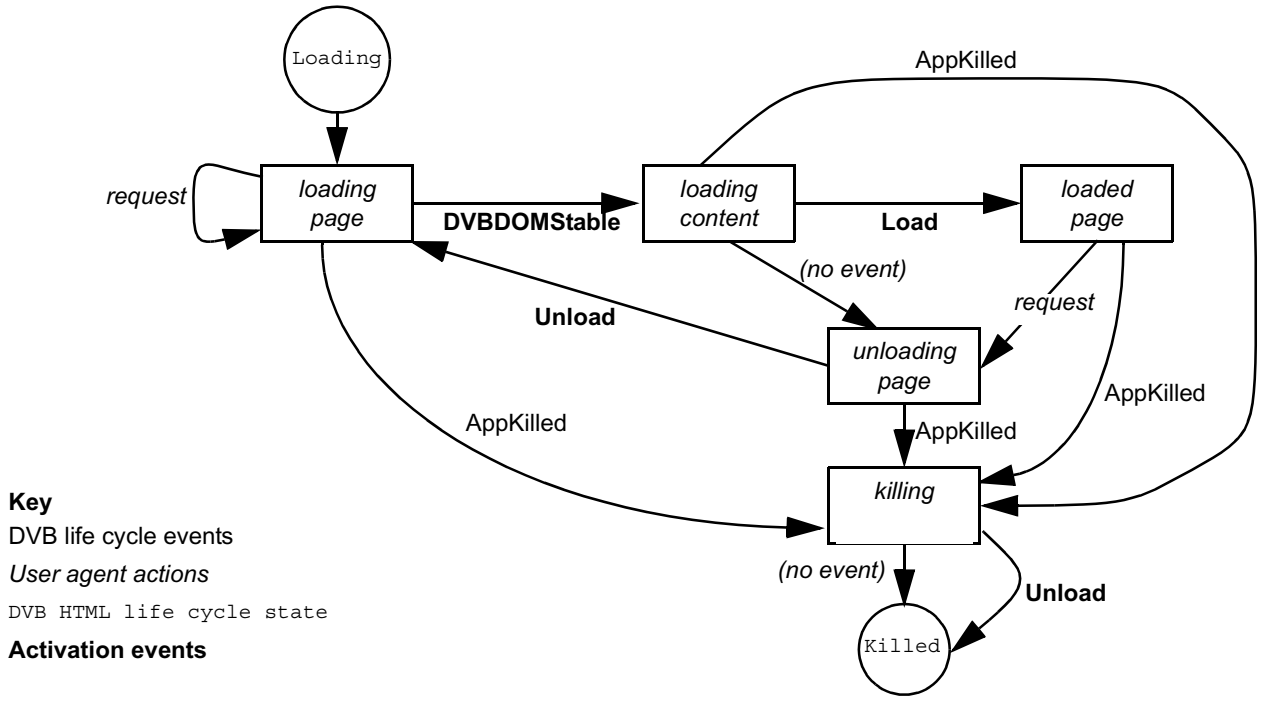


Figure 18: Activation event state model

9.3.4.1 Event queue handling

The HTML and DOM standards say little about how events are inserted by the User Agent or how they are queued. DVB-HTML User Agents shall observe the following list of clarifications.

- After the `unload` event is sent, no other events shall be sent to the document, so all trigger event listeners may be discarded. (For clarification: `AppDestroyed` and `AppKilled` happen before this.).
- When navigating to a new page in a given window or frame, the user agent may load some or all of the new page and its associated files, before sending an `unload` to the current document. It shall not begin to render the new page, or deliver DOM events to it, until event handling of the `unload` event for the old page is complete.
- In loading resources for a new page, the user agent may register for, receive and queue DSM-CC events; however it shall not deliver them to the DOM until after it has delivered the `DVBDOMStable` event.
- The ECMAScript "document" variable shall be bound to the relevant document in all event handlers.

NOTE: Together the above imply that trigger events (as is theoretically the case with user input events) may be lost during page transitions or even during presentation of a page. Authors should be aware of this possibility and code accordingly.

9.4 Inter application resource management

This is implementation dependent except as detailed below. Where there is a resource conflict between two applications signalled as part of the same service and running in the same service context, this shall be resolved using the priority signalled in the application_priority field in the application descriptor for each application. When comparing two applications, the one with the higher application_priority value shall be considered the more important to preserve.

- Where there is a resource conflict between two applications signalled as part of the same service and running in the same service context, this shall be resolved using the priority signalled in the application_priority field in the application descriptor for each application or the external application authorization descriptor depending on which descriptor the application is currently signalled by.
- Unless stated otherwise, only the application which owns a resource has the right to modify the state / settings / configuration of that resource. If a resident application (e.g. the MHP navigator) makes changes to the state / settings / configuration of a resource, the MHP terminal shall inform the MHP application which formerly owned the resource that the MHP application has lost ownership of the resource.

NOTE: The only exception to this rule is where all applications running inside a service context together own the service component handlers of that service context and not any single one of them. See clause 11.6.2 "Service Selection API" on page 284.

When a `ServiceContext` is in the presenting state, it shall keep reserved the resources needed to present the service currently being presented. In particular, when the service being presented is received via a tuner represented by a `org.davic.net.tuning.NetworkInterface`, that tuner shall be kept reserved. It is implementation dependent whether such tuners are reserved when not being used for the presentation of the currently selected service. Any resources reserved by the implementation of `ServiceContext` but not used for the presentation of the currently selected service shall be released if any other application requests them.

If an application running inside a `ServiceContext` attempts to reserve a resource being used for presenting the currently selected service in that `ServiceContext`, it shall be given a higher priority than the implementation of `ServiceContext`. e.g. an application running in a TV service running in a `ServiceContext` shall be able to reserve the `NetworkInterface` currently used to present that TV service and tune away to another transport stream.

9.5 Life cycle of Xlets embedded in DVB-HTML

The state of an Xlet is influenced by the state of the page that contains it, in addition to being influenced by the state of the containing application. The Xlet's lifecycle is bound by the lifecycle of the HTML application and page, but the Xlet may, through its own actions, be in a less active state than the containing HTML page. For example, an Xlet may destroy itself even if the page in which it is contained is active.

9.5.1 Starting embedded Xlets

For each Xlet specified with an object tag, a new classloader shall be created to load its classes. The standard MHP semantics surrounding Xlet classloaders apply. For example, classloaders shall not be shared with other Xlets.

When an HTML page is being loaded, any Xlets embedded within that page shall be requested to enter the loaded state, as defined for the `java.xlet.Xlet interface`.

Sometime before the page becomes visible, the platform shall request all embedded Xlets in that page to enter the paused state.

During the process of making a page visible, the platform shall request all paused Xlets (i.e. those that did not fail or voluntarily terminate before reaching this state) to enter the active state. The exact point during this process at which this happens is implementation dependent, but shall not be before any load event for the page.

When the containing DVB-HTML application transitions from the paused state to the active state, all paused Xlets that are on the current page shall be requested to enter the active state.

9.5.2 Termination

When a page becomes invisible due to navigation away from that page or when the containing DVB-HTML application becomes paused, all embedded Xlets that are in the active state shall be requested to enter the paused state.

It is implementation dependent when an Xlet that was paused due to navigation is transitioned from the paused state to the destroyed state, but this shall be after any unload event for the page in which it was embedded.

When the HTML application enters the killed state, all embedded Xlets must be put into the destroyed state by the platform.

When the DVB-HTML application enters the HTML destroyed state, it has no effect on the state of any embedded Xlets. Those embedded Xlets may choose to change their state as resources are withdrawn during such a transition, however they are only forced to change state when the DVB-HTML application enters the killed state.

The standard MHP rules concerning the destruction of an Xlet apply. Notably, an Xlet that fails to respond to a lifecycle notification is eligible for destruction, even if the containing page is still visible. Similarly, an Xlet can request that it be destroyed. This will cause the Xlet to be destroyed, but it will have no effect on the lifecycle of the page in which the Xlet is contained nor shall it cause the page to be reflowed. Similarly, an Xlet that puts itself in the paused state will have no effect on the state of the enclosing HTML page or application.

Of course, an Xlet might initiate an action that causes the application containing it to be terminated. For example, if the Xlet does a service selection, the application might not be signalled in the new service. Here, the existing MHP semantics concerning application lifecycle apply.

9.5.3 General issues

Multiple Xlets per XHTML document are allowed to the same extent as multiple Xlets are allowed in the same DVB service.

Instances of embedded Xlets:

- Shall not be listed in the AIT.
- Shall not be exposed in the application listing an launching API when launched through a DVB HTML application.
- Inherit the transport protocols of the containing HTML application.

When an embedded Xlet is in its active state, it shall have DOM access. It is implementation dependent if it will have DOM access in other states.

9.6 Services and applications not related to conventional DVB services

Clause 9.1 of the present document describes MHP applications whose lifecycle is controlled through broadcast services. The present document additionally supports applications whose lifecycle is not bound to that of broadcast services. These include:

- Applications signalled through the interaction channel (see clause 9.6.1 "Applications loaded from the interaction channel" on page 211).
- Applications running from storage in the MHP terminal (see clause 9.6.2 "Stored services" on page 211).

9.6.1 Applications loaded from the interaction channel

In this scenario the application signalling comes from the interaction channel rather than the broadcast channel. In overview:

- Data equivalent to the broadcast AIT is provided from the interaction channel in the "AIT file". The connection to the server that provides the data is analogous to a connection to broadcast service.
- A locator specifying the location of the "AIT file" is analogous to the locator specifying a broadcast service.
- Navigation to this locator is analogous to selection of a broadcast service. The service selection could either be from the MHP terminal's intrinsic navigator or via an application using the service selection API.
- As with navigation between broadcast services when an interaction channel locator is selected as the current service the MHP terminal retrieves and decodes the "AIT file". Decisions about which currently running applications are allowed to remain running and which new applications are launched are based on the information in the "AIT file" just as they would be when navigating between broadcast services.
- When a locator specifying an AIT file is successfully used in a service selection operation, the applications database shall be populated with the information from that AIT file.

9.6.2 Stored services

Stored services are an encapsulation of one or more applications. The lifecycle of a stored service shall obey the same rules as defined for a broadcast service in clause 9.1 "Broadcast MHP applications" on page 190. So, for example, currently running applications will be stopped if they are not listed to be runable in the stored service's AIT information.

Hence there is no requirement to execute a stored services simultaneously with a broadcast service or application.

Stored applications running as part of a stored service shall:

- Execute with the Application identification that was stored with them when they were stored.
- Be able to access a file system using MHP APIs where:
  - Any file that is present shall have the same name, relative path as it did in the broadcast file system.
  - Any API providing byte level access to the data of a file shall return the same data as was broadcast.
  - The set stored may be a superset of the files listed in the Application description file.
  - That file system is read-only to the MHP application.

NOTE 1: This does not preclude the implementation also storing an optimized representation of files that would be presented to certain APIs. For example, this allows class files to be precompiled for subsequent presentation at the class loader.

The results of an application attempting to access files or directories above the directory that originally contained the Application description file are implementation dependant but shall either succeed or fail using the failure modes specified for the mechanism used.

When a stored service is started, any previously running streamed media decoders shall continue to run. It is the responsibility of applications to stop them if so required. Any resources used by such streamed media decoders shall have the lowest possible priority in any resource conflicts.

A stored service has the same lifecycle semantics as other services types (such as broadcast). So, when a stored service is selected the stored AIT information is inspected to determine which (if any) applications should auto start and which (if any) currently running applications are allowed to continue running by virtue of being included in the stored service.

NOTE 2: Currently, no API has been defined that would allow the addition of externally authorized applications to a stored service.

A stored service is built up by identifying applications from a broadcast service. It is not a copy of a broadcast service.

When an application is added to a stored service, the following information shall be stored:

- The storage_property and version information from the Application storage descriptor (see clause 10.14.2).
- Sufficient information to be able to reconstruct the application_descriptors_loop (e.g. so that it can be returned by the `org.dvb.application.AppAttributes.getProperty()` method).
- The application type.
- The Application identification.
- At least all those files listed in the Application description file with priority of "critical".
- Implementations may store files in addition to those listed in the Application description file.
- Sufficient information to be able to construct the set of permissions to be granted to the application including the certificate files needed for any credentials.

Implications of the above are:

- If any non-critical files are needed for the application functionality then the application is responsible for obtaining them in the event that they are not stored.
- No information from AIT common loop descriptors is required to be stored.
- Information from the transport protocol descriptors is only relevant during the storing of the application. When the application is executing from storage it is responsible for creating the transport connections it requires.

If applications within a stored service are also listed in a currently selected broadcast service they are runable with the same constraints as other broadcast applications in the context of that broadcast service. So, as with "Cached applications", the consequence of storage is to allow better performance.

If a stored application service is removed while it is being presented then presentation of that service will stop with a `PresentationTerminatedEvent.SERVICE_VANISHED`. The navigator may select another service in an implementation-dependent manner. (For example, a stored application may choose to remove the service it is stored in, including removing itself. This is not an error.)

Stored application services which contain no autostart applications should not be presented to the end-user, either by the navigator or by MHP applications such as EPGs. MHP terminals should delete stored application services which contain no applications when/if no running MHP applications have references to that service.

9.6.3 DVB-J Model

For DVB-J applications, APIs required to include some support for these applications include the following.

- "Service Selection API" (see clause 11.6.2).
- "Content Referencing" (see clause 11.7.6) as described in clause 11.11.12 "Support for the HTTP protocol in DVB-J" on page 311.
- "Protocol Independent SI API" (see clause 11.6.5) as described in clause 11.11.12 "Support for the HTTP protocol in DVB-J" on page 311.

When a stored service is successfully created using the method `StoredApplicationServiceFactory.createStoredApplicationService`, this service shall appear in the list of services maintained by the `SIManager`. It shall be returned by `filterServices` both when passed an instance of `ServiceTypeFilter` constructed with the type `StoredApplicationServiceType.STORED_APPLICATION_SERVICE` and when passed null to list all known services. The method `ServiceContext.select` shall support selecting stored services as identified by instances of `StoredApplicationService` created or returned using all these mechanisms. This is described in more detail in clause 11.12.2.2 "Modified behaviour of MHP 1.0 APIs" on page 312.

In profiles where application signalling over the interaction channel is supported, the method `SIManager.getService` shall accept instances of `javax.tv.locator.Locator` whose external form is valid "http" and "https" URLs and return a `Service` object. The method `ServiceContext.select` shall support selecting services identified by such service objects. This is described in more detail in clause 11.11.12 "Support for the HTTP protocol in DVB-J" on page 311.

9.6.4 Common behaviour

The environment in which stand-alone MHP applications are presented or executed shall be the same as for applications related to a conventional DVB service except as detailed below.

- Any existing video and audio running from before the application was started shall continue running. Applications shall not have a mechanism for attaining the identity of any such existing video or audio. Applications wishing to hide any such existing video may cover the full screen area with graphics. Applications have no ability to hide any such existing audio. MHP terminals shall assign the lowest possible resource priority to the presentation of any such existing video and audio.

9.7 Lifecycle of internet access applications

9.7.1 General issues

MHP terminals supporting the internet access profile shall support at least the execution of one internet access application at one time. There is no requirement to support the execution of more than one internet access application at one time. There is no requirement to support the execution of internet access applications and MHP applications at the same time. MHP terminals where internet access applications and MHP applications can be in memory and executing code at the same time but cannot share access to the screen are allowed. Such MHP terminals shall be considered as supporting internet access applications and MHP applications at the same time in the rest of the present document. In these MHP terminals, any MHP applications in the active state may be put in the paused state when they loose access to the screen to an internet access application. The present document is intentionally silent about priorities for access to resources like memory in the event of a conflict between MHP applications and internet access applications.

NOTE: This means that when running internet access applications and MHP applications simultaneously, if memory in the MHP receiver runs low, some implementations may choose to terminate the MHP applications and others may choose to terminate the internet access applications.

9.7.2 Starting internet access applications from MHP applications

Where MHP terminals support simultaneous execution of internet access applications and MHP applications at the same time, then the internet access application shall start when requested. The internet access application shall be considered to be a peer of the MHP application and not a child of it. The lifecycle of the internet access application is not constrained by the lifecycle of the MHP application which started it.

Where MHP terminals do not support this simultaneous execution then the MHP application shall be destroyed / killed as part of the starting of the internet access application. In this case, when the end user of the MHP terminal exits the internet access application for reasons other than selecting a "dvb:" link to a service, the MHP terminal shall return to presenting the DVB service (if any) which it was presenting before the internet access application was started. Any MHP applications in this service will be re-started without any previous state using the normal mechanisms defined in version 1.0 of the MHP specification.

The APIs to enable DVB-J applications to manipulate internet access applications are defined in annex AH "(normative): Internet client APIs" on page 1077.

9.7.3 Selecting DVB services from internet access applications

In MHP, internet access applications shall support end user starting of DVB services (i.e. using the 'dvb:' URL) and MHP applications signalled over the interaction channel (i.e. using an AIT file referenced by an HTTP URL). This shall be handled by the normal service selection mechanism used elsewhere in the MHP specification (e.g. in the implementation of the service selection API).

On MHP terminals which support running internet access applications and MHP services at the same time, the new MHP service shall start running if and only if the service context in which the internet access application is running can support the running of MHP services. If the service context in which the internet access application is running cannot support the running of MHP services then the service selection operation shall fail and this will be reported to any MHP applications listening for service selection events on that service context. If the internet access application was started by an MHP application using the `org.dvb.internet` API, that MHP application is still running and that MHP application has registered for `InternetClientEvents` then if the service selection fails, that application will also receive an `InternetClientFailureEvent` including the locator of the DVB service which failed to be selected.

NOTE: It is up to the MHP application receiving an `InternetClientFailureEvent` to extract the locator for the DVB service which failed to be selected and if it so desires, select it in its own service context. If it doesn't do this then the end-user's starting of the DVB service fails.

If the internet access application was started directly from the navigator and not by an MHP application, the service context used to present any DVB service selected is implementation dependent but shall be one which can support the selection of DVB services.

On MHP terminals which do not support running internet access applications and MHP applications at the same time, the internet access application shall behave as if the end user of the MHP terminal had asked to exit that application. This may result in a platform specific dialogue with the end user, e.g. to ask about saving partly composed email messages as a draft. Depending on the nature of any such dialogue, the selection of the DVB service may fail if the end user of the MHP terminal does not wish to exit the internet access application concerned.

There is no requirement to remember the internet access application which selected a DVB service or to return to that internet access application when leaving the DVB service which it selected. This is the opposite of starting internet access applications from MHP applications.

9.8 Plug-ins

Clause 5.4 of the present document defines the concept of plug-ins for use in migration situations, for the support of applications in existing content formats. Services and networks using such an approach to migration have a number of choices defined by the present document. Where a service carries one or more applications in an existing content format (referred to as delegated applications), those applications may be signalled either using the native signalling defined for that existing content format or using the AIT based signalling defined in the present document or both. Two types of plug-ins are defined: inter-operable plug-ins and implementation specific-plug-ins. The present document is intentionally silent about the operation and signalling of implementation specific plug-ins. Signalling of inter-operable plug-ins shall be done as defined in clause 10.13.2 "MHP signalling scenario" on page 253.

The lifecycle of inter-operable plug-ins shall obey the semantics of DVB-J applications concerning service selection operations as defined under the heading "A new service being selected replacing a previously selected one" in clause 9.1.4.1 of the present document.

Where the AIT is used to signal delegated applications, the maintainer of the specification for that format shall register with the DVB project to obtain a value for the "application type" field of the AIT (see table 75 "Application types" on page 225). Having done this, the maintainer of the specification for the existing content format is responsible for defining any additional descriptors for the AIT which are required for the support of their content format.

9.9 Stored and cached applications

This section describes the common storage behaviour that applies to all stored applications. See clause 9.1.9 "Cached applications" on page 193 and clause 9.6.2 "Stored services" on page 211.

9.9.1 Storing files

When a file that forms part of an application is stored, the following metadata shall be stored with the file:

- The application type.
- The Application identification.
- The version information from the Application storage descriptor (see clause 10.14.2 "Application storage descriptor" on page 255).
- If the Application description file lists any MHP security file (such as a signature file or a CRL) then these files shall be stored in the normal way (with due regard to the priority etc.). However, it is not necessary to list the security files in order to retain the security information as the method of retention of this information is an implementation detail.
- Sufficient information about the certificate chain that authenticated the application to be able to determine if any of those certificates have been revoked when it comes to run the application.
- Sufficient information to fully implement the method `DSMCCObject.getSigners` for all signed files which are stored.

Implications of the above are:

- It is not required to store file MIME type as carried by the optional Content type descriptor. The application developer is responsible for ensuring that stored files can be correctly interpreted without relying on this information.
- It is not required to store cache priority information from the Caching priority descriptor. The application developer is responsible for ensuring that dynamic data is not listed in the Application description file.

9.9.2 Version management

To be eligible for any kind of application storage, an application must be signalled with an application_storage_ descriptor. This contains the version number for the application.

A stored application is uniquely identified by an organisation_id, application_id, version number triple. Terminals shall support storing multiple versions of the same application. (For example, different broadcasters may use the same third-party application but may update to a new version at different times.)

Application authors are responsible for ensuring that their application is always broadcast with the correct version number.

If the broadcast version number of an application changes whilst that application is being stored or cached (including as part of pro-active caching by the terminal) any files stored since the last time the AIT was received with the old version number shall be erased. If this storing or caching was requested via the MHP APIs and is not pro-active caching, the first time this happens, the platform shall automatically attempt to store or cache the new version of the application instead of the old version. If the broadcast version changes again whilst the same application is still being stored/cached, the download shall fail with an `ApplicationDownloadException`.

9.9.3 Removing stored applications

If an application is running (i.e. in any state other than DESTROYED or NOT_LOADED), the terminal shall not remove it from storage or cache.

The API methods to remove an application from storage or cache shall work normally and shall not fail just because the application is running. When the application terminates, only then shall it be removed from storage or cache.

For applications that are running as part of a stored service, removing them from that stored service shall cause them to be stopped as if they were removed from the AIT (i.e. the `destroyXlet()` method shall be called as normal, and that `destroyXlet()` method shall be able to access stored files).

9.9.4 Interrupted downloads

Storing or caching an application may be interrupted, e.g. if the application that requested the storing or caching terminates or is terminated. (For example, if the user zaps to a service whilst a download is in progress.)

If storing or caching an application is interrupted before all critical files are downloaded, terminals are recommended to keep the partially-downloaded application stored in an implementation-specific cache, and if the terminal is asked to download the same version of that application again, then the terminal should resume where it left off and not download the already-stored files again.

If storing or caching an application is interrupted after all critical files are downloaded, the storing or caching has succeeded, even if there are non-critical files which could still be downloaded and have not been.

9.9.5 Dynamic behaviour

If an application that was not previously stored becomes stored, the following shall apply:

- An `AppsDatabaseEvent` with event id APP_ADDED shall be sent for that application.
- If the application was signalled in the current service as both AUTOSTART and not_launchable_from_broadcast, it shall be started.
- Subsequent calls to `AppsDatabase.getAppAttributes` for that application will return an instance of `ExtendedAppAttributes` whose `isStored()` method will return true until/unless the application is later removed from storage. (Note that for applications with "not_launchable_from_broadcast" set, the return value of the `AppAttributes.isStartable()` method will change at the same time.)

9.10 Lifecycle interactions between MHP and resident applications

Running MHP applications shall not be killed as a direct consequence of showing the UI of a resident application (e.g. the MHP navigator). They may still be killed for reasons such as lack of resources in the receiver or as a consequence of the end-user using some kind of "application manager" user interface provided by one of the resident applications or as a result of other operations performed by the resident application that are required to kill MHP applications, e.g. channel changing by service selection.

If showing the user interface of a resident application results in the graphics of MHP applications being removed from the screen as defined in clause 13.3.8, the MHP applications concerned shall be put into the paused state before their graphics are removed. If other resources are automatically removed as a consequence of a resident application being started, these shall also be removed once the MHP applications concerned are in the paused state.

NOTE: This is to allow DVB-J applications to prepare for the loss of resources in their implementation of the `pauseXlet` method. For example, applications using scaled video may expand that video to full screen in their implementation of the `pauseXlet` method.

If resources that were removed when an application entered the paused state are automatically returned when that application returns to the active state, this shall be done before the `startXlet` method is called.

9.11 Providers

9.11.1 Introduction (informative)

Providers is a term used in Java SE for extensions to platform facilities exposed via standardised APIs. These are often adaptors between implementations of standard APIs and market specific protocols. They use standard APIs and are independent of any particular implementation and hence can be deployed by operators directly without a system software update or similar process.

The present document defines a framework for these. Example providers enabled by that framework include the following:

- provider for the PKCS #11 protocol for connecting smart cards to return channel security
- providers for connecting the standard MHP SI APIs to proprietary SI formats and protocols
- providers for connecting the standard MHP media presentations APIs to various protocols for control of media presentation in IPTV, both proprietary and variations on standards.

Providers may be restricted in scope to a single MHP application or may apply to all MHP application in an MHP terminal. The first of these (called Xlet bound) are available to normal signed MHP applications. The second of these (called System bound) are only available to privileged applications.

3 models for provider class distribution are supported:

- Provider classes are distributed as part of the application using them. They are loaded by the application's Classloader and without any special extension to the signalled classpath. The provider classes need not be stored in the MHP terminal. Each application using the provider has its own copy of the provider classes.
- Provider classes are distributed as part of an application. This application declares (via signalling) that it contains the classes for that provider. When an application using that provider starts, the classes for the provider are used from the application that contains it without an instance of the containing application being started. These provider classes may be loaded from the network or from storage if the containing application has been stored, e.g. using the mechanisms defined in clause 9.9 "Stored and cached applications" on page 215 of the present document.

  They are loaded either by the application's Classloader (with an extended classpath) or by a parent of that Classloader not shared by any other application. Each application using the provider has its own copy of the provider classes.

  NOTE: The application containing the provider classes is used as a container for those classes and may never be instantiated as an application instance in its own right.

  Such applications may be signalled with application control code DISABLED. StoredApplicationServices which only contain applications signalled with this application control code will not be selectable as defined by StoredApplicationService.isSelectable().
- Provider classes are distributed as part of a different application from the one(s) using them. They are installed by an instance of that application. They are loaded by the Classloader of that application. They are never visible to any other application. There is a single copy of those classes.

The first two of these models are only used for XletBoundProviders and the third is only used for SystemBoundProviders.

9.11.2 Lifecycle of xlet bound providers

When an instance of an application with one or more provider usage descriptors in it's AIT starts, the implementation shall attempt to find a provider for each signalled provider name by matching the provider names. For each matching provider, the following shall be done;

- the classes of the application containing the provider shall be added to the classpath of the application being started (or added to the classpath of a parent classloader of the application being started which is not shared with any other application)
- an instance of the class whose name is signalled in the provider_class_name shall be created and registered with the ProviderRegistry as an XletBoundProvider. This shall be created before the constructor of the Xlet class is called.

If no provider is found for a signalled provider name, the implementation shall make provision in the classloader of the application instance in case a provider of that name is installed during the lifetime of that application instance. If a provider of that name is installed during the lifetime of that application instance, the steps listed above shall be followed and the provider shall become available to the application.

Providers may be registered and unregistered during the lifetime of an application instance however any providers which are still registered when the application instance terminates shall be unregistered at that time.

While any application instance is using a provider exported by a second application, that second application shall not be removed from storage, see clause 9.9.3 "Removing stored applications" on page 216. If a request to remove the second application succeeds while providers it exports are in use, it shall only be removed once all of the application instances using providers it exports have terminated. Once such a request has succeeded, no new providers shall be installed from the removed application. If providers of that name are to be used, a new application must be stored which exports that a provider of that name. Once such a new application has been stored, that application shall be used for new providers even though the former application may not actually have been removed yet.

9.11.3 Lifecycle of system bound providers

These are registered by the application containing the provider. The Xlet which registered the provider may unregister it. Otherwise the provider will be unregistered when the Xlet which contains it terminates.

9.12 Impact of graphics constraints on the application model

9.12.1 Impact on generic applications

The graphics constraints descriptor 10.7.6 "Graphics constraints descriptor" on page 236 shall be used in following ways;

a) Selecting the default graphics configuration for an application when an instance of that application starts or deciding not to start the application

b) Defining whether an application can continue to show a user interface (or continue to run) when the set of available graphics configurations changes.

When an instance of an application starts, its requested graphics configuration(s) shall be compared against the available graphics configurations for the context in which the application is being started.

- If exactly one graphics configuration requested by the application is available then that one shall become the default graphics configuration of the application.
- If more than one graphics configuration requested by the application is available then the most preferred available configuration shall become the default graphics configuration of the application.
- If no graphics configuration requested by the application is available then the application instance shall either run without a visible UI or not run at all depending on the value of the can_run_without_visible_ui flag.

While an application instance is running, if the set of available graphics configurations changes then the following shall apply;

- Running applications signalled with handles_configuration_changed set to 0 shall be killed if their default graphics configuration is not available after the change.
- Running application signalled with handles_configuration_changed set to 1 where none of the requested graphics configurations are available shall either be killed or run without a visible UI according to the value of their can_run_without_visible_ui flag**.**
- Running applications signalled with handles_configuration_changed set to 1 where at least one of the requested graphics configurations are available shall run with their default graphics configuration being the most preferred which is available after the change. If this is different from the graphics configuration used before the change then this may result a change in the size and/or the HGraphicsDevice of their HScene.

The following table specifies the behaviour of applications in the same service as video when an application external to the service context where the video is presented takes control of video presentation.

Table 73: application behaviour under external control of video presentation

handles_externally_controlled_video	can_run_without_visible_ui	Video already under external control when application starts	Application already running when video comes under external control
0	0	Fails to start	Killed except for applications with no visible UI which continue to run.
0	1	Starts but shall be unable to obtain a visible UI	UI becomes invisible
1	0	Starts with visible UI	Continues to run
1	1	Starts with visible UI	Continues to run

9.12.2 Impact on DVB-J applications

The default graphics configuration of the application shall be used for the HScene returned by the implementation of the following methods;

- org.havi.ui.HSceneFactory.getDefaultHScene()
- org.havi.ui.HSceneFactory.getDefaultHScene(HScreen)
- javax.tv.graphics.TVContainer.getRootContainer()
- javax.microedition.xlet.XletContext.getContainer()

NOTE: Regardless of the signalled default graphics configuration, applications may use the other facilities provided by the org.havi.ui package to discover HGraphicsConfigurations and attempt to select them subject to being able to reserve the corresponding resource.

For a DVB-J application, running without a visible UI shall mean the following;

- Already running applications shall have the visibility of their HScene set to false. Attempts to change this shall fail silently while the application remains running without a visible UI.
- Applications starting without a visible UI shall have any attempts to obtain a default HScene fail for methods with a defined failure mode. For methods without a defined failure mode, an HScene shall be returned but attempts to set the HScene visibility to true or to call the show method shall fail silently.

In table 73 "application behaviour under external control of video presentation" on page 219 DVB-J applications shall be considered to have no UI if they do not have any HScene instances except for ones which have been disposed.

10 Application Signalling

10.1 Introduction

This clause covers the following topics:

- How the receiver identifies the applications associated with a service and finds the locations from which to retrieve them.
- The signalling that enables the broadcast to manage the lifecycles of applications.
- How the receiver can identify the sources of broadcast data required by the applications of a service.

Much of the signalling is generic. For example, the Application descriptor is independent of the application representation. Other signalling is specific to the application representation or transport protocol (such as the DVB-J application descriptor and the IP signalling descriptor).

10.1.1 Summary of common signalling

The minimum signalling requirements for any MHP applications are summarized as follows:

- PMT with Application Signalling Descriptor to identify the service component carrying the Application Information Table.
- Application Information Table with the following information in its common descriptor loop:

  - Transport protocol descriptor (all applications descriptions shall be within the scope of at least one Transport protocol descriptor. These can be placed in either or both of the descriptor loops).
- Application Information Table with the following information in its application information descriptor loop:

  - Application descriptor.

  - Application name descriptor.

10.1.2 Summary of additional signalling for DVB-J applications

The minimum additional signalling required for DVB-J applications are summarized as follows:

- Application Information Table with the following information in its application information descriptor loop:

  - DVB-J application descriptor.

  - DVB-J application location descriptor.

10.1.3 Summary of additional signalling for DVB-HTML applications

The minimum additional signalling required for DVB-HTML applications are summarized as follows:

- Application Information Table with the following information in its application information descriptor loop:

  - DVB-HTML application descriptor.

  - DVB-HTML application location descriptor.

10.1.4 Summary of additional signalling for applications carried via OC

In either the "common" (first) descriptor loop or the "application" (inner) descriptors loop:

- Transport protocol descriptor, with the selector bytes containing the OC specific information as defined in table 95.

10.1.5 Summary of additional signalling for applications carried via IP

Application Information Table with the following information in its common descriptor loop:

- IP signalling descriptor.

In either the "common" (first) descriptor loop or the "application" (inner) descriptors loop:

- Transport protocol descriptor, with the selector bytes containing the IP specific information as defined in table 96.

10.1.6 How to add a new scheme (informative)

The signalling scheme is intended to be extensible with regard to the application representations and transport protocols that are supported. The areas that need to be addressed when doing this are summarized below.

To add further transport protocols:

- Extend table 94 "Semantic of selector bytes" on page 239.
- Possibly define further specialist descriptors such as the IP signalling descriptor.

To add further application representations:

- Define further specialist descriptors such in clause 10.9 "DVB-J specific descriptors" on page 244.
- Define the application type specific life cycle control codes in clause 10.6 "Control of application life cycle" on page 228.

Where constant values are registered by the present document extend the table 107 "Registry of constant values" on page 247.

10.1.7 Service information

See clause 10.12 "Service Information" on page 249.

10.2 Program Specific Information

The elementary stream (inner) loop of the PMT for a DVB service supporting one or more MHP applications must reference streams for the following:

- Location of the stream transporting the Application Information Table.
- Location of the stream(s) transporting the application code and data.

10.2.1 Application signalling stream

The elementary stream information for the PMT entry describing the elementary stream carrying the Application Information Table has the following characteristics:

- The stream_type is set to 0x05 (ISO/IEC 13818-1 [23] private sections).
- An Application Signalling Descriptor.

There may be more than one elementary stream carrying application signalling information for a service.

10.2.2 Data broadcast streams

The minimum signalling in the PMT associated with data broadcast components is the value of the PMT stream_type field required by the DVB data broadcasting specification (EN 301 192 [5]) for the transport protocol. The full details of the data broadcast protocol, the location of its "principal" component etc. are provided in the AIT (see clause 10.4 "Application Information Table" on page 222).

Optionally the PMT may include Data broadcast id descriptors.

NOTE: Inclusion of Data broadcast id descriptors enables receivers to start mounting the file system that delivers applications concurrently with acquiring the AIT that identifies which applications are of interest. Enabling this concurrent operation may allow receivers to accelerate their activation of an interactive application. See clause B.2.8 "Mounting an Object Carousel" on page 504.

The Data broadcast id descriptor identifies the "principal" component of the data broadcast. The detailed semantics of this optional signalling reflects the transport protocol. For example, in the case of a DVB Object Carousel it identifies the component carrying the DSI.

There may also be certain protocol specific descriptors in the PMT. For example, the Object Carousel requires the inclusion of the carousel_identifier_descriptor (see clause B.2.8 "Mounting an Object Carousel" on page 504).

In its minimum form (with no selector information) a Data broadcast id descriptor just identifies the "principal" component. This optionally may be extended with selector information that identifies the application types of the autostart applications delivered by that data broadcast. See clause 10.7.2 "Data broadcast id descriptor" on page 230.

10.3 Notation

10.3.1 reserved

The term "reserved" when used in the clause defining the coded bit stream, indicates that the value may be used in the future for ISO defined extensions. Unless otherwise specified within the present clause all "reserved" bits shall be set to "1".

10.3.2 reserved_future_use

The term "reserved_future_use", when used in the clause defining the coded bit stream, indicates that the value may be used in the future for ETSI defined extensions. Unless otherwise specified within the present clause all "reserved_future_use" bits shall be set to "1".

10.4 Application Information Table

The Application Information Table (AIT) provides full information on the data broadcast, the required activation state of applications carried by it etc. The AIT comprises the set of AIT sub-tables (see clause 10.4.5) within the selected service which have an application_type that the receiver can decode.

Data in the AIT allows the broadcaster to request that the receiver change the activation state of an application.

10.4.1 Data errors

AITs which contain errors shall be processed as follows:-

- An error in a descriptor shall result in that descriptor being silently discarded. Processing of that descriptor loop shall continue with the next descriptor (if any). The scope of error detection of a descriptor should be limited to the application information section in which it is carried.
- An error in an application loop outside a descriptor shall result in that entry in the application loop being silently discarded. Processing of that application loop shall continue with the next entry (if any).

NOTE: The consequence of the above is that an error in a mandatory descriptor which results in that descriptor being silently ignored may then result in a application loop which is missing such a mandatory descriptor. Hence that application loop shall also be silently ignored.

- An error in an application information section outside of an application loop shall result in that entire application information section being silently discarded. Processing of the AIT shall continue with the next application information section (if any).

10.4.2 AIT transmission and monitoring

MHP terminals shall monitor the PMT for changes in the number of AIT elementary streams present. Changes shall be detected within 1 second. MHP terminals shall monitor all AIT elementary streams within the selected service, as described in more detail below.

The minimum repetition rate for each AIT subtable is 10 seconds. The AIT shall be carried in an elementary stream which is not scrambled.

Provided that AITs for the selected service are delivered on 3 or fewer elementary streams then the maximum time interval between the moment the AIT is updated and the moment the new version is detected by the MHP shall be no more than 30 seconds.

NOTE: If broadcasts use more than 3 elementary streams to deliver AITs then receiver response time may degrade in an unpredictable way.

The MHP terminal is only required to monitor AIT sections for application types that it can decode. The application types a terminal can decode include those types for which the terminal has available interoperable plug-ins (see figure 7 "Illustrative plug-in implementation options" on page 58). Available inter-operable plug-ins shall include those MHP applications of application types it can already decode which are signalled with plug-in descriptors (see clause 10.13.4 "Plug-in descriptor" on page 254).

The set of application types listed in the application database reflects the set of AIT sections being monitored. So, this may be a subset of the application types being broadcast in the case that the broadcast carries a superset of the terminal's capabilities.

Applications removed from the AIT sub-table which was signalling them but where that AIT sub-table remains present in the network, shall be stopped as if they had been signalled with a DESTROY control code.

If the AIT sub-table signalling an application vanishes from the network completely, that application shall continue to run. The MHP terminal shall monitor for the re-appearance of the AIT sub-table as defined for the appearance of new AIT sub-tables above.

10.4.3 Optimized AIT signalling

The optional AIT_version_number carried by the Application Signalling Descriptor allows a possible optimization of receiver burden as it allows receivers to acquire the AIT only after they see changes in the AIT version advertised in the PMT.

See clause 10.7.1 "Application Signalling Descriptor" on page 229.

10.4.4 Visibility of AIT

If an application tunes away from a transport stream where its signalling is carried without selecting a new service, it will continue running although the AIT is not visible.

In MHP terminals with multiple network interfaces, if the AIT of the selected service is visible via any of them, then the AIT signalling is used as normal.

10.4.5 Definition of sub-table for the AIT

All sections on the same PID with the AIT table_id and the same value of application_type are members of the same sub-table.

10.4.6 Syntax of the AIT

The Application Information Section describes applications and their associated information. Each Application Information Section includes one "common" descriptor loop at the top level for descriptors that are shared between applications of that sub table and a loop of applications. Each application in the application loop has an "application" descriptor loop containing the descriptors associated with that application.

Like DVB SI tables, the scope of common loop descriptors is the sub-table. So, any descriptors present in the common descriptor loop apply to all sections of the sub-table. Typically, common descriptors would normally only be present in section 0 of a sub-table, unless there was not enough space.

Like other DVB SI tables, any strings contained in these tables shall not have null terminations.

Table 74: Application Information Section syntax

	No.of Bits	Identifier
application_information_section() {		
table_id	8	uimsbf
section_syntax_indicator	1	bslbf
reserved_future_use	1	bslbf
reserved	2	bslbf
section_length	12	uimsbf
test_application_flag	1	bslbf
application_type	15	uimsbf
reserved	2	bslbf
version_number	5	uimsbf
current_next_indicator	1	bslbf
section_number	8	uimsbf
last_section_number	8	uimsbf
reserved_future_use	4	bslbf
common_descriptors_length	12	uimsbf
for(i=0;i<N;i++){		
descriptor()		
}		
reserved_future_use	4	bslbf
application_loop_length	12	uimsbf
for(i=0;i<N;i++){		
application_identifier()		
application_control_code	8	uimsbf
reserved_future_use	4	bslbf
application_descriptors_loop_length	12	uimsbf
for(j=0;j<N;j++){		
descriptor()		
}		
}		
CRC_32	32	rpchof
}		

table_id: This 8 bit integer with value 0x74 identifies this table.

section_syntax_indicator: The section_syntax_indicator is a 1-bit field which shall be set to "1".

section_length: This is a 12-bit field, the first two bits of which shall be '00'. The remaining 10 bits specify the number of bytes of the section starting immediately following the section_length field, and including the CRC_32. The value in this field shall not exceed 1 021 (0x3FD).

test_application_flag: This 1-bit field when set indicates an application which is transmitted for the purposes of receiver testing and which shall not be started or listed in any API or displayed in any user interface by MHP receivers under normal operational conditions. The means (if any) by which an MHP receiver is put into a mode where applications signalled with this bit set are treated as if this field is set to zero is implementation dependent but should not be one which typical end-users might discover on their own.

application_type: This is a 15-bit field which identifies the type of the applications described in this AIT sub_table. See table 75.

Table 75: Application types

application_type	description
0x0000	reserved_future_use
0x0001	DVB-J application
0x0002	DVB-HTML application
0x0003 to 0x7FFF	subject to registration with DVB

version_number: This 5-bit field is the version number of the sub_table. The version_number shall be incremented by 1 when a change in the information carried within the sub_table occurs. When it reaches value "31", it wraps around to "0".

current_next_indicator: This 1-bit indicator shall be set to "1".

section_number: This 8-bit field gives the number of the section. The section_number of the first section in the sub_table shall be "0x00". The section_number shall be incremented by 1 with each additional section with the same table_id, and application_type.

last_section_number: This 8-bit field specifies the number of the last section (that is, the section with the highest section_number) of the sub_table of which this section is part.

common_descriptors_length: This 12-bit field gives the total length in bytes of the following descriptors. The descriptors in this descriptor loop apply for all of the applications contained in this AIT sub_table.

application_control_code: This 8-bit field controls the state of the application. The semantics of this field is application type dependant. See clause 10.6 "Control of application life cycle" on page 228.

application_loop_length: This 12-bit field gives the total length in bytes of the following loop containing application information.

application_identifier(): This 48 bit field identifies the application. The structure of this field is defined in clause 10.5 "Application identification" on page 226.

application_descriptors_loop_length: This 12-bit field gives the total length in bytes of the following descriptors. The descriptors in this loop apply to the specific application.

CRC_32: This is a 32-bit field that contains the CRC value that gives a zero output of the registers in the decoder defined in annex B of EN 300 468 [4] after processing the entire section.

10.4.7 Use of private descriptors in the AIT

Private descriptors may be included in the AIT provided that they are in the scope of a DVB-SI EN 300 468 [4] private data specifier descriptor. The scope rules for the private data specifier descriptor are as follows:

- If this descriptor is located within any descriptor loop of the AIT, then any specifier identified within this descriptor loop applies to all following descriptors and user-defined values in the particular descriptor loop until the end of the descriptor loop, or until another occurrence of a private_data_specifier_descriptor.
- The use of the descriptor in the common (first) descriptor loop does not apply to descriptors or user-defined values in the application (second) descriptor loop.

10.4.8 Text encoding in AIT

Unless otherwise specified, all fields interpreted as text strings in the AIT shall be encoded as UTF8 (see clause 7.1.5 "Monomedia format for text" on page 71), but shall not include the null character. See also clause 14.5 "Text encoding of application identifiers" on page 398.

10.4.9 AIT file

10.4.9.1 Syntax

The interaction channel encoding of the AIT into the AIT file is as follows:

- A single file shall contain all of the data.
- The file shall contain a concatentation of Application Information Sections (specified in MHP 1.0)
- The possibly multiple sections shall be ordered as follows:

  - Ascending order of `application_type`.

  - Within a single value of `application_type` in ascending order of `section_number`.
- All sections shall have `current_next_indicator` set to '1'.

10.4.9.2 Syntactic restrictions

10.4.9.2.1 Transport protocols

The only allowed transport protocol type has id value 0x0003. See table 93 "Protocol_id" on page 238.

10.4.9.3 Semantics

The AIT file shall be loaded once during service selection. There is no requirement to monitor or poll the AIT file for any subsequent changes except as part of a subsequent service selection operation referring to the same AIT file. Consequences of this are:

- Only the AUTOSTART and PRESENT application control codes (of those defined in MHP 1.0) are appropriate.
- No standard mechanism for dynamic lifecycle control is provided.

NOTE: If dynamic lifecycle control is required application private mechanisms could be used. For example, a TCP connection over the interaction channel to a controlling server.

- Changes made to the AIT file after service selection shall not be detected or reported.

10.4.9.4 MIME type

The MIME type for an AIT file shall be "application/dvb.ait". The file extension shall be ".ait".

10.5 Application identification

10.5.1 Encoding

Each application is associated with an application identifier. This is a 6 byte field with the following structure:

Table 76: Application identifier syntax

	No.of Bits	Identifier	Value
`application_identifier {`			
`organisation_id`	32	bslbf	
`application_id`	16	bslbf	
`}`			

organisation_id: This 32 bit field is a globally unique value identifying the organization that is responsible for the application. These values are registered inTS 101 162 [10]. Values of zero shall not be encoded.

This field is reproduced in the organisationName field of the subject name in the "leaf" certificate of an authenticated application (see clause 12.5.6 "subject" on page 327).

NOTE: The inclusion of this field in the leaf certificate provides authentication of the value.

application_id: This 16 bit field uniquely identifies the application function. This is allocated by the organization registered with the organisation_id who decides the policy for allocation within the organization. Values of zero shall not be encoded.

The application id values are divided into two ranges: one for unsigned applications and one for signed applications. This is for security reasons (see clause 12.1.1 "Overview of the security framework for applications" on page 316). Applications transmitted as unsigned shall use an application id from the unsigned applications range and applications transmitted as signed shall use an application id from the signed applications range.

Table 77: Value ranges for application_id

application_id values	Use
0x0000	Shall not be used
0x0001 to 0x3fff	Application_ids for unsigned applications
0x4000 to 0x7fff	Application_ids for signed applications
0x8000 to 0xfffd	Reserved for future use by DVB
0xfffe	Special wildcard value for signed applications of an organization
0xffff	Special wildcard value for all applications of an organization

Application id values 0xffff and 0xfffe are wild cards. They shall not be used to identify an application but, for example, are allowed for use in the External application authorization descriptor see clause 10.7.5. The value 0xffff matches all applications with the same organisation_id. The value 0xfffe matches all signed applications with the same organisation_id.

The same application identifier may be used in different application types for applications performing essentially the same function.

The same `application_identifier()` shall appear only once within the set of AIT subtables of the same application_type inside a service.

10.5.2 Effects on life cycle

The main concepts here are:

- On service change, currently running, previously broadcast, applications whose service_bound_flag is set to "0" shall (subject to resource restrictions) continue running if their application identifier is listed in the Application Information Table of the newly selected service.
- On service change, currently running, previously broadcast, applications whose service_bound_flag is set to "0" shall (subject to resource restrictions) continue running if their application identifier is suitably listed in the External application authorization descriptor even if they are not part of the current service.
- Only a single instance of an application with a particular application identifier is allowed to execute at any time in the same service context. So, if an application is already running in a service context, then another instance of the same application shall not be launched in that same service context. This affects the behaviour with respect to the application launching API and autostart applications after service selection.
- If the application signalling for an application has the "service_bound_flag" is set to "1", then the application is killed upon service selection.

See also annex S "(normative): Application Listing and Launching" on page 846.

When an application continues running after service change, it shall run as signalled by its AIT entry in the new service and not the former service excluding effects of transport protocol descriptors.

10.5.3 Authentication of application identification

See clause 12.5.6 "subject" on page 327.

10.6 Control of application life cycle

The broadcast signalling provides a mechanism for broadcasters to control the life cycle of standard application types. See also clause 9.1 "Broadcast MHP applications" on page 190.

10.6.1 Entering and leaving the domain of an application

The domain of an application is defined as the set of services where the application is listed in the AIT. This can be either as applications listed in the application (inner) loop of the AIT or as applications listed in the External application authorization descriptor. Services where the application is not listed in either of these two ways are outside of the domain of the application.

10.6.2 Dynamic control of the application life cycle

The dynamic control of the application life cycle is signalled through the application_control_code for the application in the AIT.

This control code allows the broadcaster to signal to the receiver what to do with the application with regard to its lifecycle. The set of codes have some differences between application types and so are defined on an application type specific basis.

If the receiver receives a code that it does not recognize the application shall continue in its current state.

When a change in these control codes causes a state change of a running MHP application, an `AppStateChangeEvent` shall be generated to all DVB-J applications which have registered to receive such events for the application concerned.

10.6.2.1 DVB-J

The application control codes for DVB-J applications are listed in table 78.

Table 78: DVB-J application control code values

code	identifier	semantics
0x00		reserved_future_use
0x01	AUTOSTART	The file system element(s) (e.g. an Object Carousel module) containing the class implementing the Xlet interface is loaded, The class implementing the Xlet is loaded into the VM and an Xlet object is instantiated, and the application is started subject to usual restrictions, etc.
0x02	PRESENT	Indicates that the application is present in the service, but is not autostarted.
0x03	DESTROY	When the control code changes from AUTOSTART or PRESENT to DESTROY, the destroy method of the Xlet is called (with the **`unconditional`** parameter set to **false**) by the application manager and the application is allowed to destroy itself gracefully.
0x04	KILL	When the control code changes from AUTOSTART or PRESENT to KILL, the destroy method of the Xlet is called (with the **`unconditional`** parameter set to **true**) by the application manager.
0x05	reserved_future_use	
0x06	REMOTE	This identifies a remote application that is only launchable after service selection.
0x07	DISABLED	Application shall not be started and attempts to start it shall fail. Such applications need not be signalled with a dvb_j_application_ descriptor and the initial_class_byte in the dvb_j_application_ location_descriptor is never used.
0x08 to 0xFF		reserved_future_use

See clause 9.2.3 "DVB-J Application Lifecycle" on page 195.

10.6.2.2 DVB-HTML

The application control codes for DVB-HTML applications are listed in table 79.

Table 79: DVB-HTML application control code values

code	identifier	semantics
0x00		reserved_future_use
0x01	AUTOSTART	The Application Entry Point of the DVB-HTML application is loaded. This is loaded into the user agent, and the DVB-HTML actor is created (in the Loading state) and the DVB-HTML application is started. When these steps are complete the DVB-HTML actor is in the Active state.
0x02	PRESENT	Indicates that the DVB-HTML application is present in the service, but is not autostarted.
0x03	DESTROY	When the control code changes from AUTOSTART or PRESENT to DESTROY, the DVB-HTML actor goes to the Destroyed state.
0x04	KILL	When the control code changes from AUTOSTART or PRESENT or DESTROY to KILL the DVB-HTML actor goes to the Killed state.
0x05	PREFETCH	As for AUTOSTART except that the DVB-HTML actor holds on entry to the Active state and waits for a trigger before completely transitioning to the Active state.
0x06	REMOTE	This identifies a remote application that is only launchable after service selection.
0x07 to 0xFF		reserved_future_use

See clause 9.3.2 "DVB-HTML Application Lifecycle" on page 202.

10.7 Generic descriptors

10.7.1 Application Signalling Descriptor

The application signalling descriptor is defined for use in the elementary stream loop of the PMT where the `stream_type` of the elementary stream is 0x05. It identifies that the elementary stream carries an Application Information Table.

The application signalling descriptor optionally carries a loop of application_type and version_number pairs. These allow the descriptor to optionally reproduce the current version number state of the associated Application Information Table. This allows the receiver to be informed of the version of the AIT as a side effect of monitoring the PMT (which is expected to be monitored closely, under normal conditions). See clause 10.4.3 "Optimized AIT signalling" on page 223.

When the MHP detects a change of the content of the application signalling descriptor, it shall acquire the new version of the AIT and respond accordingly.

The presence of the application_type and AIT_version subfields is optional. If not present then the AIT transmission and monitoring applies, see clause 10.4.2 "AIT transmission and monitoring" on page 222.

Table 80: application signalling descriptor syntax

	No.of Bits	Identifier
application_signalling_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for(i=0; i<N; i++){		
reserved_future_use	1	
application_type	15	uimsbf
reserved_future_use	3	bslbf
AIT_version_number	5	uimsbf
}		
}		

descriptor_tag: This 8 bit integer with value 0x6F identifies this descriptor.

descriptor_length: This 8 bit field indicates the number of bytes following the descriptor length field.

application_type: This 15 bit field identifies the application type of an Application Information Table sub-table that is on this elementary stream.

AIT_version_number: This 5 bit field provides the "current" version number of the Application Information Table sub-table identified by the application type field.

10.7.2 Data broadcast id descriptor

The data broadcast id descriptor is defined for use in the elementary stream information of the PMT. The descriptor identifies:

- The transport format of the data broadcast whose "principal component" is on this elementary stream.

  The semantics of "principal component" is transport protocol specific.
- The set of application types for any autostart applications delivered by the data broadcast.

A single elementary stream may have more than one data broadcast id descriptor to indicate conformance with more than one data broadcast specification. In addition, more than one data broadcast id descriptor may be used to list additional application types within the scope of a particular data broadcast id.

More than one elementary stream may have a data broadcast id descriptor indicating that auto start applications are carried by more than one delivery mechanism (for example a single service may have more than one object carousel delivering auto start applications).

10.7.2.1 Generic descriptor

The data broadcast id descriptor is defined in a generic form by EN 300 468 [4] (illustrated in table 81). Where no "id specific data" is provided the descriptor just identifies the "principal" component of a data broadcast.

Table 81: generic data broadcast id descriptor syntax

	No.of Bits	Identifier	Value
data_broadcast_id_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
data_broadcast_id	16	uimsbf	
for (i=0; i<N; i++) {			
id specific data	8	bslbf	

Table 81: generic data broadcast id descriptor syntax

	No.of Bits	Identifier	Value
} }			

10.7.2.2 MHP data broadcast id descriptor

When the data broadcast id is 0x00F0 or 0x00F1, (see table 107) the syntax of the data broadcast id descriptor is as shown in table 82. This extends the generic descriptor with an optional list of application types for which autostart applications may exist within the data broadcast. This list provides a hint to allow the MHP terminal to prioritize connection to a data broadcast when several are provided by the service. If no list is provided then the data broadcast id descriptor is silent on the types of autostart applications that may be carried by the data broadcast. If the application list is not empty, then the data broadcast shall not include autostart applications of application types other than those in the list. It is not required that the data broadcast always include autostart applications of all types in the list.

Table 82: MHP data broadcast id descriptor syntax

	No.of Bits	Identifier	Value
data_broadcast_id_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
data_broadcast_id	16	uimsbf	
for (i=0; i<N; i++) {			
reserved_future_use	1		
application_type	15	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x66 identifies this descriptor.

data_broadcast_id: This 16 bit field indicates the format of the data broadcast transport protocol. These values are registered inTS 101 162 [10].

application_type: This 16 bit field indicates the type of the application (i.e. the engine or plug-in on which the application can be executed). See table 75.

10.7.3 Application descriptor

Exactly one instance of the application descriptor shall be contained in every "application" (inner) descriptor loop of the AIT.

Table 83: application descriptor syntax (Sheet 1 of 2)

	No.of Bits	Identifier	Value
application_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
application_profiles_length	8	uimsbf	
for(i=0; i<N; i++) {			
application_profile	16	uimsbf	
version.major	8	uimsbf	
version.minor	8	uimsbf	
version.micro	8	uimsbf	
}			
service_bound_flag	1	bslbf	
visibility	2	bslbf	

Table 83: application descriptor syntax (Sheet 2 of 2)

	No.of Bits	Identifier	Value
reserved_future_use	5	bslbf	
application_priority	8	uimsbf	
for(i=0; i<N; i++) {			
transport_protocol_label	8	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x00 identifies this descriptor.

application_profiles_length: This 8-bit field indicates the length of the application_profile loop in bytes.

application_profile: This 16 bit field is an integer value which represents the application type specific profile. This indicates that a receiver implementing one of the profiles listed in this loop is capable of executing the application.

version.major: This 8 bit field carries the numeric value of the major sub-field of the profile version number.

version.minor: This 8 bit field carries the numeric value of the minor sub-field of the profile version number.

version.micro: This 8 bit field carries the numeric value of the micro sub-field of the profile version number.

The four above fields indicate the minimum profile on which an application will run. Applications may test for features found in higher (backwards compatible) profiles and exploit them. The MHP terminal shall only launch applications if the following expression is true for at least one of the signalled profiles:

$$
\begin{aligned}
&(\text{application\_profile} \in \text{terminal\_profiles\_set}) \\
&\quad \wedge \{(\text{application\_version.major} < \text{terminal\_version.major(application\_profile)}) \\
&\qquad \vee [(\text{application\_version.major} = \text{terminal\_version.major(application\_profile)}) \\
&\qquad\quad \wedge (\{\text{application\_version.minor} < \text{terminal\_version.minor(application\_profile)}\} \\
&\qquad\qquad \vee \{[\text{application\_version.minor} = \text{terminal\_version.minor(application\_profile)}] \\
&\qquad\qquad\quad \wedge [\text{application\_version.micro} \leq \text{terminal\_version.micro(application\_profile)}]\})]\}
\end{aligned}
$$

Where:
$\in$ represents "belongs to the set of"
$\wedge$ represents "logical AND"
$\vee$ represents "logical OR"

See table 149 "Profile encoding" on page 409 for the encoding of these values.

service_bound_flag: If this field is set to "1", the application is only associated with the current service and so the process of killing the application shall start at the beginning of the service change regardless of the contents of the destination AIT.

visibility: This 2 bit field specifies whether the application is suitable to be offered to the end-user for them to decide if the application should be launched. Table 84 lists the allowed values of this field.

NOTE 1: This applies equally to any generic launching menu application provided in the MHP service and to any application launching user interface provided in the MHP navigator.

Table 84: Definition of visibility states for applications

visibility	description
00	This application shall not be visible either to applications via an application listing API or to users via the navigator with the exception of any error reporting or logging facility, etc.
01	This application shall not be visible to users but shall be visible to applications via an application listing API.

Table 84: Definition of visibility states for applications

visibility	description
10	reserved_future_use
11	This application can be visible to users and shall be visible to applications via the application listing API.

NOTE 2: For example, in a service offering a number of games to the end-user, these values would be used as follows:

00 - the autostart generic launcher application offering the end user the choice of which game to launch

11 - the games which the end-user can chose between

01 - the common server application which all the games use to communicate with a server over the interaction channel.

application_priority: This field identifies a relative priority between the applications signalled in this service.

- Where there is more than one application with the same Application identification this priority shall be used to determine which application is started.
- Where there are insufficient resources to continue running a set of applications, this priority shall be used to determine which applications to stop or pause.
- A larger integer value indicates higher priority.
- If two applications have the same application identification and the same priority, the MHP may make an implementation-dependent choice on which to start.

transport_protocol_label: This 8-bit field identifies a transport protocol that delivers the application. See transport_protocol_label in Transport protocol descriptor.

If more than one protocol is signalled then each protocol is an alternative delivery mechanism. The ordering indicates the broadcaster's view of which transport connection will provide the best user experience (first is best). This may be used as a hint by MHP terminal implementations. It shall be evaluated only once during the life time of the application.

The protocol selection by the MHP terminal may depend on a variety of factors including user preferences and the performance of the transport connections to the terminal.

10.7.4 User information descriptors

The user information descriptors complement the "Application descriptor" by providing information suitable for presentation to the user (where the "Application descriptor" provides technical information for automatic use by the receiver).

These descriptors are defined for use in the application loop of the AIT.

10.7.4.1 Application name descriptor

Exactly one instance of this descriptor shall be included in the application information of an application. The application name shall distinguish the application and shall be informative to the user.

Table 85: application name descriptor syntax

	No.of Bits	Identifier	Value
`application_name_descriptor() {`			
`  descriptor_tag`	8	uimsbf	
`  descriptor_length`	8	uimsbf	
`  for (i=0; i<N; i++) {`			

Table 85: application name descriptor syntax

	No.of Bits	Identifier	Value
ISO_639_language_code	24	bslbf	
application_name_length	8	uimsbf	
for (i=0; i<N; i++) {			
application_name_char	8	uimsbf	
}			
}			
}			

descriptor_tag: This 8 bit integer with value 0x01 identifies this descriptor.

ISO_639_language_code: This 24-bit field contains the ISO 639-2 [19] three character language code of the language of the following bouquet name. Both ISO 639.2/B and ISO 639.2/T may be used.

Each character is coded into 8 bits according to ISO 8859-1 [20] and inserted in order into the 24-bit field.

application_name_length: This 8 bit unsigned integer specifies the number of bytes in the application name.

application_name_char: This field carries a string (not null terminated) of characters encoded in accordance with annex A of EN 300 468 [4], as profiled by clause 11.2.11.1. The string names the application in a manner intended to be informative to the user.

10.7.4.2 Application icons descriptor

Zero or one instance of this descriptor shall be included in the application information of an application. It allows icons to be associated with the application. The content format for these possible icons shall be restricted PNG as specified in clause 15.1 "PNG - restrictions" on page 407.

Table 86: application icons descriptor syntax

	No.of Bits	Identifier	Value
application_icons_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
icon_locator_length	8	uimsbf	
for (i=0; i<N; i++) {			
icon_locator_byte	8	uimsbf	
}			
icon_flags	16	bslbf	
for (i=0; i<N; i++) {			
reserved_future_use	8	bslbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x0B identifies this descriptor.

icon_locator_length: This 8 bit integer specifies the number of bytes in the string that prefixes standard icon file name.

icon_locator_byte: This 8 bit value is one byte of the icon locator string.

The icon locator is the first part of the string that specifies the location of the icon files. This is application type dependant. See table 87. The `icon_locator` shall not end with a "/" slash character.

Table 87: Icon locator semantics

application_type	description
0x0000	reserved_future_use
0x0001	For DVB-J this is a path relative to the base directory of the application as defined in clause 10.9.2 "DVB-J application location descriptor" on page 244.
0x0002	For DVB-HTML this is a path relative to the physical root of the application as defined in clause 10.10.2 "DVB-HTML application location descriptor" on page 246.
0x0003 to 0xFFFF	reserved_future_use

icon_flags: This 16 bit field carries a value which is the bitwise OR of the flag bits that identify the icons that are provided for the application. The flag bits are defined in table 88.

Table 88: Definition of different icon flags

Icon flag bits	Description of icon size and pixel aspect ratio
0000 0000 0000 0001	32 x 32 for square pixel display
0000 0000 0000 0010	32 x 32 for broadcast pixels on 4:3 display (note)
0000 0000 0000 0100	24 x 32 for broadcast pixels on 16:9 display
0000 0000 0000 1000	64 x 64 for square pixel display
0000 0000 0001 0000	64 x 64 for broadcast pixels on 4:3 display
0000 0000 0010 0000	48 x 64 for broadcast pixels on 16:9 display
0000 0000 0100 0000	128 x 128 for square pixel display
0000 0000 1000 0000	128 x 128 for broadcast pixels on 4:3 display
0000 0001 0000 0000	96 x 128 for broadcast pixels on 16:9 display
0000 0010 0000 0000	256 x 256 for square pixel display
0000 0100 0000 0000	256 x 256 for broadcast pixels on 4:3 display
0000 1000 0000 0000	192 x 256 for broadcast pixels on 16:9 display
xxxx xxx0 0000 0000	reserved_future_use
xxxx 0000 0000 0000	reserved_future_use
NOTE: approx. 15/16 pixel aspect ratio on 50 Hz system	

The file names for the icon files are encoded in a standard way:

```
filename       = icon_locator "/dvb.icon." hex_string
hex_string     = 4*4hex
hex            = digit | "A" | "B" | "C" | "D" | "E" | "F" | "a" | "b" | "c" | "d" | "e" | "f"
digit          = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```

An icon file shall contain exactly one icon. The icon contained in the icon file shall have the format specified by the 4 hexadecimal digit postscript of its file name.

NOTE: This means that if the `icon_flags` field of the application_icons_descriptor were to have a value indicating the presence of multiple icons, each of the indicated icons would have its own icon file. For example, if icon_flags has a value of 0x0005, the directory specified by `icon_locator` would contain two files named dvb.icon.0004 (for 24 x 32 square pixel rendering) and dvb.icon.0001 (for 32 x 32 square pixel rendering).

10.7.5 External application authorization descriptor

The "common" (first) descriptor loop of the Application Information Table may contain zero or more external_ application_authorization_descriptors. Each descriptor contains information about external applications that are allowed to continue to run with the applications listed in this Application Information Table sub-table but cannot be launched from this service. The external authorization applies to applications with the identified application_identifier() that are of the application_type identified by the AIT subtable where this descriptor is contained.

Table 89: external application authorisation descriptor syntax

	No.of Bits	Identifier	Value
external_application_authorisation_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
for(i=0; i<N; i++) {			
application_identifier()			
application_priority	8	uimsbf	
}			
}			

descriptor_tag: This 8-bit integer with value 0x05 identifies this descriptor.

application_identifier(): This 48-bit field identifies an application. The structure of this field is defined in clause 10.5 "Application identification" on page 226.

application_priority: This 8-bit integer specifies the priority that this application assumes in the context of the current service.

If the 0xffff or 0xfffe wildcard is used for the application_id within the application_identifier() and there are some applications from the same organisation_id explicitly signalled in the application loop of the AIT, the priority for those applications shall be the one signalled in the application_descriptor (see clause 10.7.3).

See application_priority under clause 10.7.3 "Application descriptor" on page 231.

10.7.6 Graphics constraints descriptor

The graphics configuration descriptor defines the circumstances under which an application can work (or has been tested to work). These circumstances are;

- which full screen graphics resolutions an application supports
- whether an application can work when its video is controlled (e.g. scaled to less than full screen size) by another application running external to the first application's service context (e.g. EPG or navigator).

This descriptor may be present either in the inner (application) loop of an AIT in which case it applies to only that application or the outer (common loop) of an AIT in which case it applies to all applications signalled in that AIT sub-table.

Table 90: Graphics constraints descriptor syntax

	No. of Bits	Identifier	Value
graphics_constraints_descriptor() {			
descriptor_tag	8	uimsbf	0x14
descriptor_length	8	uimsbf	
reserved_future_use	5	bslbf	
can_run_without_visible_ui	1	bslbf	
handles_configuration_changed	1	bslbf	
handles_externally_controlled_video	1	bslbf	
For(i=0;i<N;i++) {			

Table 90: Graphics constraints descriptor syntax

	No. of Bits	Identifier	Value
`graphics_configuration_byte`	8	uimsbf	
`}`			
`}`			

Where the fields have the following meanings;

descriptor_tag: This 8 bit integer with value 0x14 identifies this descriptor.

descriptor_length: This 8 bit field indicates the number of bytes following the descriptor length field.

can_run_without_visible_ui: If this 1 bit field is set to 1 then the application can usefully run with no user interface visible. If this field is set to 0 then the application is not useful with no user interface visible. Applications signalled with this bit set are responsible for registering listeners to detect when it would be reasonable to show their user interface again.

handles_configuration_changed: If this 1 bit field is set to 1 then the application can handle changes in the graphics configuration between those signalled in this descriptor. If set to zero then once the default graphics configuration has been set for an application instance, it will only correctly display under that graphics configuration.

handles_externally_controlled_video: If this 1 bit field is set to 1 then the application can handle being displayed when the presentation of the video in the same service is controlled by an application external to that service. Examples include picture in picture and picture outside picture.

graphics_configuration_byte: This 8 bit field contains a value from the following table. The full screen configurations are sorted from most preferred to least preferred.

Table 91: graphics configuration byte values

Value	Meaning
0	Reserved
1	Full screen standard definition
2	Full screen 960x540
3	Full screen 1280x720
4	Full screen 1920x1080
5-31	Reserved for future use by DVB project
32-255	Reserved for future use

Applications where this descriptor is not signalled shall be assumed to have a descriptor containing one graphics_ configuration_byte whose value is 1, can_run_without_visible_ui being '0', handles_configuration_changed being 0 and handles_externally_controlled_video being 0.

NOTE: A consequence of the preceding statement about can_run_without_visible_ui is that MHP 1.0 applications which intentionally do not have a visible UI must have their signalling modified if they are ever used in an context where SD graphics are not available. Such a context is not defined by the present document but could potentially exist in GEM terminal specifications or other MHP derivatives.

Applications where the loop of graphics configuration bytes is empty shall be assumed to not care about a default graphics configuration. Either they do not use graphics or they are written to support the full range of graphics configurations defined in the present document and tested accordingly.

10.8 Transport protocol descriptors

10.8.1 Transport protocol descriptor

The transport protocol descriptor identifies the transport protocol associated with a service component and possibly provides protocol dependent information.

The descriptor may be used in either the "common" (first) descriptor loop or the "application" (inner) descriptors loop. When in the "common" loop it applies to all of the applications in that sub-table. Any such descriptors in the "application" loop describe additional transport protocols available to a specific application.

Each application described in this section shall be in the scope of at least one transport protocol descriptor.

Table 92: transport protocol descriptor syntax

	No.of Bits	Identifier	Value
transport_protocol_descriptor() {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
protocol_id	16	uimsbf	
transport_protocol_label	8	uimsbf	
for(i=0; i<N; i++) {			
selector_byte	8	uimsbf	N1
}			
}			

descriptor_tag: This 8 bit integer with value 0x02 identifies this descriptor.

protocol_id: An identifier of the protocol used for carrying the applications. The values of the protocol_id are be registered here and in ETR162.

Table 93: Protocol_id

protocol_id	description
0x0000	reserved_future_use
0x0001	MHP Object Carousel as defined in annex B "(normative): Object carousel" on page 476.
0x0002	IP via DVB multiprotocol encapsulation as defined in EN 301 192 [5], TR 101 202 [i.5]
0x0003	Transport via HTTP over the interaction channel as described in clause 10.8.1.3 "Transport via interaction channel" on page 240.
0x0004 to 0x00FF	Reserved for use by DVB
0x0100 to 0xFFFF	Subject to registration inTS 101 162 [10]

transport_protocol_label: This 8 bit field uniquely identifies a transport protocol within this AIT section. The Application descriptor refers to this value to identify a transport connection that carries the application.

selector_byte: Additional protocol specific information.

Table 94: Semantic of selector bytes

protocol_id	selector byte data
0x0000	reserved_future_use
0x0001	See clause 10.8.1.1, "Transport via OC".
0x0002	See clause 10.8.1.2, "Transport via IP".
0x0003	See clause 10.8.1.3, "Transport via interaction channel".
0x0004 to 0xFFFF	TBD

10.8.1.1 Transport via OC

When the protocol ID is 0x0001 the selector bytes in the Transport protocol descriptor shall be as shown in table 95.

Table 95: Syntax of selector bytes for OC transport

Syntax	Bits	Mnemonic
remote_connection	1	bslbf
reserved_future_use	7	bslbf
if(remote_connection == "1") {		
original_network_id	16	uimsbf
transport_stream_id	16	uimsbf
service_id	16	uimsbf
}		
component_tag	8	uimsbf

component_tag: Identifies the "principal" service component that delivers the application. The identified component is the elementary stream that carries the DSI of the object carousel.

remote_connection: This single bit flag if set to "1" indicates that the transport connection is provided by a service that is different to the one carrying the AIT. Such applications shall not be autostarted by receivers but are visible (subject to the visibility field of the application descriptor) via an application listing API for possible launching by service selection (but not via an application launching API). When this bit is set, the following 3 fields (original_network_id, transport_stream_id and service_id) are included in the selector bytes. This flag shall be set to "0" when the transport connection is provided by the current service.

Applications with this flag set shall either have their application control code set to REMOTE (see table 78 and 79), or they shall have an application storage descriptor with "launchable_completely_from_cache" set to "1". (In the latter case they should be signalled as requiring a receiver that supports the MHP 1.1 profiles, so that they will be ignored by MHP 1.0 receivers).

Applications where remote_connection is "1" that also have an application storage descriptor with "launchable_completely_from_cache" set to "1" are a special case. If such an application is cached on the terminal, it can be launched in the usual way. There are no special restrictions on the control code for an application signalled in this way - e.g. it could be PRESENT or even AUTOSTART. If the application is not cached on the terminal, it cannot be launched and the signalled control code will be ignored - it will always be treated as if it was REMOTE.

Remote applications can be cached and stored in the usual way if an application first tunes the network interface to the appropriate transport stream.

See clause 11.7.2 "Application discovery and launching APIs" on page 290.

original_network_id: This 16 bit field identifies the DVB-SI original network id of the transport stream that provides the transport connection.

transport_stream_id: This 16 bit field identifies the MPEG transport stream id of the transport stream that provides the transport connection.

service_id: This 16 bit field identifies the DVB-SI service id of the service that provides the transport connection.

10.8.1.2 Transport via IP

When the protocol ID is 0x0002 the selector bytes in the Transport protocol descriptor shall be as shown in table 96.

This structure includes two important components of the data_broadcast_descriptor defined in EN 301 192 [5]. It provides all the information necessary for the MHP to acquire applications and application data components delivered by IP protocols. The profiles where this is an optional or mandatory feature are listed in clause 15 "Detailed platform profile definitions" on page 404.

Table 96: Syntax of selector bytes for IP transport

Syntax	Bits	Mnemonic
remote_connection	1	bslbf
reserved_future_use	7	bslbf
if(remote_connection == "1") {		
original_network_id	16	uimsbf
transport_stream_id	16	uimsbf
service_id	16	uimsbf
}		
alignment_indicator	1	bslbf
reserved_future_use	7	bslbf
for(i=0; i<N; i++){		
URL_length	8	uimsbf
for(j=0; j<URL_length; j++){		
URL_byte	8	uimsbf
}		
}		

remote_connection: This and the associated 3 fields (original_network_id, transport_stream_id and service_id) have identical syntax and semantics to the fields with the same names under clause 10.8.1.1 "Transport via OC" on page 239.

alignment_indicator: This 1-bit field indicates the alignment that exists between the bytes of the datagram_section and the Transport Stream bytes (equivalent to the field with this name defined in the EN 301 192 [5] MPE data_broadcast_descriptor).

URL_length: This 8-bit field indicates the number of bytes in the URL.

URL_byte: These bytes form a URL conforming to RFC 2396 [41].

For URL using the "server" field including the host:port notation as defined in RFC 2396 [41], only numeric IP addresses shall be used for identifying IP transmissions carried in the broadcast channel as there is no Domain Name Service in the broadcast-only scenario to be used for resolving names.

IP to MAC mapping shall be done as described in RFC 1112 [45].

NOTE: The present document intentionally does not define or require any URL format to be supported in this descriptor. Hence it cannot be used in an inter-operable way.

10.8.1.3 Transport via interaction channel

When the protocol ID is 0x0003 the selector bytes in the Transport protocol descriptor shall be as shown in table 97 "Syntax of selector bytes for interaction transport" on page 241. This allows encoding of a number of URLs. For efficiency when encoding possibly many similar URLs the encoding divides the URL into a shared base part and a set of URL extensions. The set of URLs can identify ZIP (ZIP [91]) files, or base URLs ending in the "/" character, that encapsulate portions of the file system. See clause 6.4.1.1 "File system logical structure" on page 65 for a description of this file system.

Multiple transport protocol descriptors with the protocol ID value 0x0003 and the same transport protocol label may be provided to define a larger set of URLs to describe the file system.

Table 97: Syntax of selector bytes for interaction transport

Syntax	Bits	Mnemonic
for(i=0; i<N; i++){		
URL_base_length	8	uimsbf
for(j=0; j<N; j++){		
URL_base_byte	8	uimsbf
}		
URL_extension_count	8	uimsbf
for(j=0; j<URL_extension_count; j++){		
URL_extension_length	8	uimsbf
for(k=0; k<URL_length; k++){		
URL_extension_byte	8	uimsbf
}		
}		
}		

URL_base_length: This 8-bit field provides the number of bytes in the base part of the URL.

URL_base_byte: These bytes form the first part of a HTTP URL conforming to HTTP 1.0 (see RFC 1945 [92]), or the first part of an HTTPS URL conforming to HTTPS (see RFC 2818 [112]). Where an HTTP URL is found, http shall be used as in clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63. Where an HTTPS URL is found, https shall be used as in clause 6.3.7.3 "HTTPS" on page 64.

URL_extension_count: This 8-bit field indicates the number of URLs conveyed by this descriptor.

URL_extension_length: This 8-bit field indicates the number of bytes in the extension part of the URL.

URL_extension_byte: These bytes form the later part of an HTTP URL conforming to HTTP 1.0 (see RFC 1945 [92]), or the later part of an HTTPS URL conforming to HTTPS clause 6.3.7.3 "HTTPS" on page 64.

URLs are formed by concantenating the URL extension with the preceding URL base. The URL so formed either identifies a file system directory or a specific ZIP file. See clause 6.4.1.1 "File system logical structure" on page 65.

10.8.2 IP signalling descriptor

The IP signalling descriptor is defined for use either in the "common" or in the "application" loop of the AIT. This descriptor indicates the identification of the organization providing the IP multicast streams used by all applications (when present in the "common" loop) or by the particular signalled application (when present in the "application" loop). See EN 301 192 [5] for the definition of the INT.

This descriptor and the INT with action_type 0x01 shall be used for applications relying on the presence of IP Multicast streams on the broadcast link. The knowledge of the identification present in the descriptor enables to recover the appropriate IP Notification Table (INT) with action_type 0x01 that contains the correspondence between the multicast IP address and port and the stream localization.

Table 98: Syntax of the IP signalling descriptor

Syntax	Bits	Mnemonic
ip_signalling_descriptor () {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
platform_id	24	uimsbf
}		

descriptor_tag: This 8-bit field with value 0x11 identifies this descriptor.

descriptor_length: This 8-bit field identifies the number of bytes following the length field.

platform_id: This is a 24 bit field containing a platform_id of the organization providing IP/MAC streams on DVB transport streams/services.

Allocations of the value of platform_id are found in theTS 101 162 [10].

10.8.3 Pre-fetch signalling

10.8.3.1 Introduction

This signalling is defined to enable implementations to start fetching files that will be required during the early part of an application's life. Later in an applications' life it can actively request file pre-fetching using API mechanisms. Descriptors in this clause do not have a relation to the API-based pre-fetching for this version of the present document.

For one application, the pre-fetch descriptor(s) and possible DII location descriptor present in the AIT shall point to the same transport connection. If the transport_protocol_labels present in these descriptors are different, the referenced transport protocol descriptor shall point to the same transport connection (carousel).

This signalling is optional to broadcast and optional for implementations to consider.

10.8.3.2 Pre-fetch descriptor

Zero or one pre-fetch descriptors can be included in the "application" (inner) descriptor loop of the AIT. It is defined for use where the protocol_id of the transport is 0x0001 (MHP Object Carousel). Each descriptor is associated with a specific Transport protocol descriptor via the transport_protocol_label.

MHP terminals may use this descriptor to improve application start-up time by pre-fetching modules that have the indicated labels (see clause B.2.2.4.1 "Label descriptor" on page 479).

Table 99: Syntax of the pre-fetch descriptor

Syntax	Bits	Mnemonic
prefetch_descriptor () {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
transport_protocol_label	8	uimsbf
for(i=0; i<N; i++) {		
label_length		
for(j=0; j<label_length; j++) {		
label_byte	8	uimsbf
}		
prefetch_priority	8	uimsbf
}		
}		

descriptor_tag: This 8-bit field with value 0x0C identifies this descriptor.

descriptor_length: This 8-bit field identifies the number of bytes following the descriptor length field.

transport_protocol_label: This 8-bit field identifies the Transport protocol descriptor that specifies the object carousel that delivers the modules to which this prefetch descriptor refers. See "transport_protocol_label" on page 233.

label_length: This 8-bit field identifies the number of bytes in the module label.

label_byte: These 8-bit fields carry an array of bytes that are a module label. This label matches a label on one or more module carried by Label descriptors in the userInfo fields of the moduleInfo structure of DIIs (see "Label descriptor" on page 479). The match shall be done as a byte-by-byte comparison between the two byte arrays.

The same module label may be attached to several modules.

prefetch_priority: A value between 1 and 100 (both inclusive). It expresses a pre-fetching hint of the modules with the corresponding label using the specified priority (100 highest, 1 lowest).

10.8.3.3 DII location descriptor

For each application zero or one DII location descriptors can be provided. It can be located in either the "common" (first) or "application" (inner) descriptor loop of the AIT. It is defined for use where the protocol_id of the transport is 0x0001 (MHP Object Carousel). Each descriptor is associated with a specific Transport protocol descriptor via the transport_protocol_label.

The modules that are part of a DSM-CC object carousel are signalled in DownloadInfoIndication (DII) messages. The object carousel does not list all the existing DII messages in a single place.

In order to find all of the modules that match a particular pre-fetch label (see clause 10.8.3.2 "Pre-fetch descriptor" on page 242), it is necessary that all the relevant DII messages can be found. The DII location descriptor lists the locations of these DII.

If DII location descriptor is not included, then only the DII that signals the module that contains the ServiceGateway shall be taken into account when looking for modules matching a particular label.

The DII identifications in the loop should be sorted on importance. The DII that contains the label(s) with the highest pre-fetch priority should be listed first. Receivers that implement module-based pre-fetching should examine the DIIs for labels in the order in which they are listed in the DII location descriptor.

Table 100: Syntax of the DII location descriptor

Syntax	Bits	Mnemonic
DII_location_descriptor () {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
transport_protocol_label	8	uimsbf
for(i=0; i<N; i++) {		
reserved_future_use	1	bslbf
DII_identification	15	uimsbf
association_tag	16	uimsbf
}		
}		

descriptor_tag: This 8-bit field with value 0x0D identifies this descriptor.

descriptor_length: This 8-bit field identifies the number of bytes following the descriptor length field.

transport_protocol_label: This 8-bit field identifies the Transport protocol descriptor that specifies the object carousel that delivers the modules to which this prefetch descriptor refers. See "transport_protocol_label" on page 233.

DII_identification: This 15-bit field identifies the DII message. It corresponds to the identification portion of the transactionId. See clause B.34 "Sub-fields of the transactionId" on page 503.

association_tag: This 16-bit field identifies the connection (i.e. elementary stream) on which the DII message is broadcast.

10.9 DVB-J specific descriptors

10.9.1 DVB-J application descriptor

One instance of this descriptor shall be contained in the "application" (inner) descriptor loop of the AIT for each DVB-J application. It provides start-up parameter information.

Table 101: DVB-J application descriptor syntax

	No.of Bits	Identifier	Value
dvb_j_application_descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
for(i=0; i<N; i++) {			
parameter_length	8	uimsbf	
for(j=0; j<parameter_length; j++) {			
parameter_byte	8	uimsbf	
}			
}			
}			

descriptor_tag: This 8 bit integer with value 0x03 identifies this descriptor.

parameter_length: This 8 bit integer specifies the number of bytes in the parameter_byte string.

parameter_byte: The parameter bytes contain a string that is passed to the application as a parameter.

10.9.2 DVB-J application location descriptor

One instance of this descriptor shall be contained in the "application" (inner) descriptor loop of the AIT for each DVB-J application. It provides various items of path information to allow the DVB-J application to be found and then operated.

Table 102: DVB-J application location descriptor syntax

	No.of Bits	Identifier	Value
dvb_j_application_location_descriptor {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
base_directory_length	8	uimsbf	
for(i=0; i<N; i++) {			
base_directory_byte	8	uimsbf	
}			
classpath_extension_length	8	uimsbf	
for(i=0; i<N; i++) {			
classpath_extension_byte	8	uimsbf	
}			
for(i=0; i<N; i++) {			
initial_class_byte	8	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x04 identifies this descriptor.

base_directory_length: This 8 bit integer specifies the number of bytes in the base_directory_byte string.

The value of this field shall be at least one.

base_directory_byte: These bytes contain a string specifying a directory name with directories delimited by the slash character "/" (0x2F). The directory name is relative to the top-level directory of the file system carrying the application as defined by the transport_protocol_descriptor for this application. This directory is used as a base directory for relative path names. This base directory is automatically considered to form the first directory in the class path (after the path to the system's classes).

If the base directory is the root the string shall be "/".

classpath_extension_length: This 8 bit integer specifies the number of bytes in the classpath_extension_byte string.

classpath_extension_byte: These bytes contain a string specifying a further extension for the DVB-J class path where the classes of the application are searched in addition to the base directory.The class path extension string contains path names where the elements in the path are delimited by the semicolon character ";" (0x3B). The elements of the path may be either absolute paths starting from the root of the file system or they can be relative to the base directory. The directories are delimited by the slash character "/" (0x2F) and absolute path names begin with the slash character "/" (0x2F).

initial_class_byte: These bytes contain a string specifying the class implementing one of the Xlet interfaces specified in clause 11.7.1 "APIs to support DVB-J application lifecycle" on page 289.

This string is a DVB-J class name that is found in the class path (e.g. "com.broadcaster.appA.MainClass"). The length of this string must be at least one.

NOTE: Since the classpath may only contain directories, the initial class must be present in the form of a Java class file. A jar file cannot be referenced from the DVB-J application location descriptor.

10.10 DVB-HTML Specific descriptors

10.10.1 DVB-HTML application descriptor

One instance of this descriptor shall be contained in the "application" (inner) descriptor loop of the AIT for each DVB-HTML application. It indicates the value of the application parameters and signals the control applied by the broadcaster on the state of the application.

Table 103: DVB-HTML application descriptor syntax

	No.of Bits	Identifier	Value
dvb_html_application_descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
appid_set_length	8	uimsbf	N1
for(i=0; i<N1; i++) {			
application_id	16	bslbf	
}			
for(j=0; j<N; j++) {			
parameter_bytes	8	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x08 identifies this descriptor.

appid_set_length: This 8 bit integer specifies the length of the list of application_ids.

application_id: The values of these 16 bit fields form a set of application ids (see clause 10.5 "Application identification" on page 226). This set is the set of application ids that are allowed to be associated with inner applications of a DVB-HTML application, see clause 8.7 "Xlet integration" on page 127.

parameter_bytes: The parameter bytes contain the string that is appended to the application initial path as parameters.

The parameter bytes are joined using simple concatenation, it is the authors responsibility to ensure it is prefixed by a legal joining character (such as ? or #) to form a syntactically correct URL.

10.10.2 DVB-HTML application location descriptor

One instance of this descriptor shall be contained in the "application" (inner) descriptor loop of the AIT for each DVB-HTML application.

Table 104: DVB-HTML application location descriptor syntax

	No.of Bits	Identifier	Value
dvb_html_application_location_descriptor () {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
physical_root_length	8	uimsbf	N1
for(i=0; i<N1; i++) {			
physical_root_bytes	8	uimsbf	
}			
for(i=0; i<N; i++) {			
initial_path_bytes	8	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x09 identifies this descriptor.

physical_root_length: This 8 bit integer specifies the length of the physical_root_byte string.

physical_root_bytes: These bytes contain a string specifying the physical root of the application entry point. The semantic of this string is transport protocol specific as shown in table 105.

Table 105: Transport specific semantic of physical root bytes

protocol_id	semantic
0x0000	reserved_future_use
0x0001	A directory specification
0x0002	One of the base URLs defined in the Transport protocol descriptor signalled for the application (see clause 10.8.1.2 "Transport via IP" on page 240).
0x0003 to 0xFFFF	TBD

initial_path_bytes: These bytes contain a string specifying the URL path component to the entry point document. This path is relative to the root defined in the physical_root_bytes field.

10.10.2.1 Example

The following example describes the usage of the DVB-HTML application location descriptor.

An application author designs an HTML application in the following manner:

- The application data is distributed among several directories, let say an "`image`" directory and a "`main`" directory.
- The application entry point is an HTML document called "`index.htm`" and stored in the "`main`" directory.

10.10.2.2 Application Entry Point

From the application author's point of view, the application entry point is specified by the path "`main/index.htm`". This path is stored in the initial_path_bytes string of the location descriptor.

If the broadcaster inserts this application in a file system sub-directory called "application", the physical_root_bytes content of the location descriptor will be the string "application/".

If the broadcaster uses a transport via IP for this application, they shall signal the used protocol and IP address in the Transport protocol descriptor associated with this application and the physical_root_bytes field shall contain the corresponding URL string.

10.10.3 DVB-HTML application boundary descriptor

This descriptor is defined for use in the application loop of the AIT. It provides a regular expression that describes the data elements that form the application.

This descriptor is optional. When absent, the application boundary defaults to the complete set of all content coming from the transport signalled in the Transport protocol descriptor associated with the application.

Multiple boundary descriptors can be used for the same application. In this case, the equivalent global regular expression is the OR combination (union) of the individual regular expressions.

Table 106: DVB-HTML application boundary descriptor syntax

	No.of Bits	Identifier	Value
dvb_html_application_boundary_descriptor {			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
label_length	8	uimsbf	N1
for(i=0; i<N1; i++) {			
label_bytes	8	uimsbf	
}			
for(i=0; i<N; i++) {			
regular_expression_bytes	8	uimsbf	
}			
}			

descriptor_tag: This 8 bit integer with value 0x0A identifies this descriptor.

label_length: This 8 bit integer specifies the length of the label_bytes string.

label_bytes: These bytes contain a string specifying the label that is associated with the set of data identified by the regular expression. This label can be used for pre-fetching in a transport specific manner.

regular_expression_bytes: These bytes contain a string specifying the regular expression that can generate all URLs that are in the domain of the application.

See clause 9.3.1.4.1 "Regular Expression Syntax" on page 201.

10.11 Constant values

Table 107: Registry of constant values

Where used	Type	Value	Where Defined	Scope
private data specifier descriptor	descriptor tag	0x5F	PSI and SI tables	SI
Data broadcast id descriptor		0x66	PMT	
Application Signalling Descriptor		0x6F	PMT	
Service identifier descriptor		0x71	SDT	

Where used	Type	Value	Where Defined	Scope
Label descriptor	descriptor tag	0x70	DII moduleInfo userInfo	SI-DAT
Caching priority descriptor		0x71		
Content type descriptor		0x72	BIOP objectInfo (note 1)	
reserved to MHP for future OC descriptors		0x73 to 0x7F	OC	
reserved to MHP for future use	table ID on AIT PID	0x00 to 0x73		MHP
Application Information Table		0x74		
reserved to MHP for future use		0x75 to 0x7F		
reserved for private use		0x80 to 0xFF		
Application descriptor	descriptor tag	0x00	AIT	MHP
Application name descriptor		0x01		
Transport protocol descriptor		0x02		
DVB-J application descriptor		0x03		
DVB-J application location descriptor		0x04		
External application authorization descriptor		0x05		
reserved to MHP for future use		0x06, 0x07		
DVB-HTML application descriptor		0x08		
DVB-HTML application location descriptor		0x09		
DVB-HTML application boundary descriptor		0x0A		
Application icons descriptor		0x0B		
Pre-fetch descriptor		0x0C		
DII location descriptor		0x0D		
IP signalling descriptor		0x11		
provider export descriptor (see table 115 "provider export descriptor syntax" on page 259)		0x12		
provider usage descriptor (see table 116 "provider usage descriptor syntax" on page 260)		0x13		
graphics constraints descriptor (see clause 10.7.6 "Graphics constraints descriptor" on page 236)		0x14		
reserved to MHP for future use		0x15 to 0x5E		
delegated application descriptor		0x0E		
Plug-in descriptor		0x0F		
Application storage descriptor		0x10		
reserved to MHP for future use		0x12 to 0x5E		
private data specifier descriptor (note 2)		0x5F		
Subject to registration in TS 101 162 [10]		0x60 to 0x7F		
User defined (note 3)		0x80 to 0xFE		
MHP Object Carousel	data broadcast id	0x00F0	PMT, AIT	SI
reserved for MHP Multi Protocol Encapsulation		0x00F1		
MHP application presence		0x00F2	EIT, SDT	SI
reserved to MHP for future use		0x00F3 - 0x00FE	PMT, AIT	SI

Where used	Type	Value	Where Defined	Scope
MHP Application Service (see 10.11.1)	service type	0x10	SDT	SI
NOTE 1: Strictly MessageSubHeader::ObjectInfo in the file message and the bound object info in a file binding of a directory or service gateway message.				
NOTE 2: The DVB SI private data specifier descriptor is defined for use in the Application Information Table to introduce private descriptors.				
NOTE 3: All user defined descriptors shall be within the scope of a private data specifier descriptor (see 10.4.7 "Use of private descriptors in the AIT" on page 225).				

10.11.1 MHP Application Service

This service type should be used for services which contain at least one auto-start MHP application where this application is the main component of the service. If a service signalled with this type contains any broadcast audio or video, the navigator shall not start presenting them but leave this to the auto-start application.

10.12 Service Information

10.12.1 Service identifier descriptor

Zero or more service identifier descriptors may be included in the SDT description of a service. Each such descriptor defines a single textual identifier for the service. The syntax of this identifier is specified in clause 14.9.1 "Syntax of the textual service identifier" on page 401.

A single service identifier can be assigned to services in different physical networks even if they have different `original_network_id` and `service_id`. A given service identifier shall only be associated with services that are considered to be the same service.

NOTE: It is up to the service provider to decide which services are "same" and which are not. For example, two services in two different networks where the service have the same programme content but different regional adverts could be generally considered to be the "same" service. However, this decision is entirely up to the service provider.

More than one service identifier may be allocated to a service instance.

Table 108: Service identifier descriptor

	No.of Bits	Identifier	Value
`service_identifier_descriptor () {`			
`  descriptor_tag`	8	uimsbf	
`  descriptor_length`	8	uimsbf	
`  for (i = 0; i < descriptor_length; i++) {`			
`    textual_service_identifier_bytes`	8	uimsbf	
`  }`			
`}`			

descriptor_tag: This 8 bit integer with value 0x71 identifies this descriptor.

textual_service_identifier_bytes: These bytes contain the unique identifier for a service encoded using the normal encoding for text strings in DVB SI.

10.12.2 Data broadcast descriptor for MHP application announcement

The generic data broadcast descriptor is defined in EN 300 468 [4]. This clause defines the syntax and semantics of the selector bytes when the data broadcast id has the value 0x00F2 (see table 109). In this case the selector bytes provide a list of MHP applications and information about each application. Zero or more instances of this descriptor may be listed in the SDT or the EIT to identify MHP applications associated with the service or the event where the descriptor is present. This descriptor only indicates the association between the service or event and the applications. The location of each listed application shall be resolved through the AIT. This descriptor shall not list applications where the test_application_flag is (or will be) set in the corresponding entry in the AIT.

Table 109: Syntax of extended data broadcast descriptor - broadcast id 0xF2

	No.of Bits	Identifier	Value
data_broadcast_descriptor(){			
descriptor_tag	8	uimsbf	
descriptor_length	8	uimsbf	
data_broadcast_id	16	uimsbf	
component_tag	8	uimsbf	
selector_length	8	uimsbf	
for(i=0; i<selector_length; i++){			
organization_id	32	uimsbf	
application_id	16	uimsbf	
reserved_future_use	1	bslbf	
application_type	15	uimsbf	
application_profile_length	8	uimsbf	
for (j=0; j<N; j++){			
application_profile	16	uimsbf	
version.major	8	uimsbf	
version.minor	8	uimsbf	
version.micro	8	uimsbf	
}			
application_names_length	8	uimsbf	
for(j=0; j<N2;j++){			
ISO_639_language_code	24	bslbf	
application_name_length	8	uimsbf	
for(l=0; l<N3; l++){			
application_name_char	8	bslbf	
}			
}			
reserved_length	8	uimsbf	
for(j=0; i<N4; i++){			
reserved_future_use	8	bslbf	
}			
private_data_length	8	uimsbf	
for(j=0; j<N5; j++){			
private_data_byte	8	bslbf	
}			
}			
ISO_639_language_code	24	bslbf	
text_length	8	uimsbf	
for (i=0; i<text_length; i++){			
text_char	8	uimsbf	
}			
}			

Semantics of the data broadcast descriptor:

The semantics for the following elements of the syntax are defined in EN 300 468 [4]:

descriptor_tag: For this 8-bit field see EN 300 468 [4].

descriptor_length: For this 8-bit field see EN 300 468 [4].

data_broadcast_id: For this 16-bit field see EN 300 468 [4]. This field has the value 0x00F2 (see table 107) when announcing MHP applications (regardless of the transport method(s) used for the MHP application and data).

component_tag: For this 8-bit field see EN 300 468 [4].

selector_length: For this 8-bit field see EN 300 468 [4].

The semantics for the following elements of the syntax are defined in the present document:

organization_id: This is 32-bit field encodes the organisation_id of the application. See clause 10.5.1.

application_id: This is 16-bit field encodes the application_type of the application. See clause 10.5.1.

application_type: This is 15-bit field encodes the application_type of the application. See clause 10.4.6.

application_profile_length: This 8-bit field indicates the length of the application profile loop in bytes.

application_profile: This is 16-bit field encodes the application_profile of the application. See clause 10.7.3.

version.major: This is 8-bit field encodes the version.major of the application. See clause 10.7.3.

version.minor: This is 8-bit field encodes the version.minor of the application. See clause 10.7.3.

version.micro: This is 8-bit field encodes the version.micro of the application. See clause 10.7.3.

application_names_length: This 8-bit unsigned integer specifies the number of bytes in the following multilingual application names.

ISO_639_language_code: This is 24-bit field encodes the ISO_639_language_code of the application name. See clause 10.7.4.

application_name_length: This is 8-bit field encodes the application_name_length of the application name. See clause 10.7.4.

application_name_char: See application_name_char in clause 10.7.4.

reserved_length: This 8-bit unsigned integer specifies the number of reserved bytes that follow.

reserved_future_use: This is an 8-bit field.

private_data_length: This 8-bit unsigned integer specifies the number of private data bytes that follow.

private_data_byte: This is an 8-bit field.

The semantics for the following elements of the syntax are defined in EN 300 468 [4]:

ISO_639_language_code: For this 24-bit field see EN 300 468 [4].

text_length: For this 8-bit field see EN 300 468 [4].

text_char: For this 8-bit field see EN 300 468 [4].

10.13 Plug-in signalling

Two signalling scenarios are defined for delegated applications and plug-ins:

- Native signalling scenario.
- MHP signalling scenario.

10.13.1 Native signalling scenario

In this scenario it is sufficient for the plug-in to be signalled as a normal MHP application. Optionally it could also be signalled as a plug-in using the Plug-in descriptor (see clause 10.13.4).

10.13.2 MHP signalling scenario

In this scenario MHP plug-in signalling can replace some or all of the native signalling of the delegated application. The MHP signalling allows the MHP terminal to:

- Identify that one (or more) delegated applications are available.
- The plug-in that is required.
- How to start the plug-in.
- How to introduce the delegated application to the plug-in.

The plug-in may use native signalling defined for the delegated application to locate, load and execute it. This is outside the scope of the present document.

Each delegated application is associated with an application descriptor (see clause 10.7.3 "Application descriptor" on page 231). The semantics of this descriptor are maintained with the following comments:

- The profile and version information is specific to the application format and are not registered by the MHP. However, the MHP rules for comparing profile and version values are maintained. So, the values in these fields are an encoding of the application's own profile and version numbering scheme to ensure that they are compatible with the MHP rules.
- The transport protocol label field which is allowed to be empty if the delegated application is not transported by an MHP supported transport protocol.

The additional MHP signalling provided to support plug-ins is:

- "delegated application descriptor" (see clause 10.13.3).

  An optional descriptor for delegated applications.

- "Plug-in descriptor" (see clause 10.13.4)

  A mandatory descriptor for plug-in using MHP signalling.

10.13.3 delegated application descriptor

Zero or one instance of this descriptor can be placed in either the common or application loops of the AIT of the delegated application.

This optional descriptor allows one or more specific plug-ins to be identified for this delegated application. This overrides the default identification of the plug-in based on the application type signalled in the AIT for the delegated application. If this descriptor is absent then no specific plug-in is identified.

Where more than one application is identified they are listed in order from most preferred to least preferred. If none of the preferred applications is available to the MHP terminal then it shall use its default mechanism to identify the plug-in for this delegated application.

Table 110: Plug-in reference descriptor

	No.of Bits	Identifier
delegated_application_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
for(i=0; i<N; i++){		
application_identifier	48	uimsbf
}		
}		

descriptor_tag: This 8 bit integer with value 0x0E identifies this descriptor.

descriptor_length: This 8 bit field indicates the number of bytes following the descriptor length field.

application_identifier: This 48 bit field identifies a specific application that can consume this application.

10.13.4 Plug-in descriptor

One or more plug-in application descriptors shall be placed in the application loop of each plug-in.

This descriptor defines for an application that implements a plug-in the set of delegated application formats that it supports. The descriptor identifies both the type of delegated application supported and the set of profiles and versions supported. The normal MHP rules for matching an application to a compatible platform apply to when matching an delegated application with a suitable plug-in.

DVB-J applications signalled with this descriptor shall implement the API defined in clause 11.7.8 "Plug-in APIs" on page 294.

The plug-in shall be considered suitable for running content if the application_type matches, and the version numbers are compatible according to the algorithm specified in clause 10.7.3 "Application descriptor" on page 231.

Table 111: Plug-in application descriptor

	No.of Bits	Identifier
plugin_application_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
application_type	16	uimsbf
for(i=0; i<N; i++){		
application_profile	16	uimsbf
version.major	8	uimsbf
version.minor	8	uimsbf
version.micro	8	uimsbf
}		
}		
}		

descriptor_tag: This 8 bit integer with value 0x0F identifies this descriptor.

descriptor_length: This 8 bit field indicates the number of bytes following the descriptor length field.

application_type: This 16 bit field identifies an delegated application type that this application can consume.

application_profile: This 16 bit field is an integer value which represents the application type specific profile.

version.major: This 8 bit field carries the numeric value of the major sub-field of the profile version number.

version.minor: This 8 bit field carries the numeric value of the minor sub-field of the profile version number.

version.micro: This 8 bit field carries the numeric value of the micro sub-field of the profile version number.

10.14 Stored applications

10.14.1 Use of signalling defined in MHP 1.0

Storable applications follow the standard MHP 1.0 application signalling. An MHP terminal that doesn't provide storage or doesn't recognize these extensions will perceive storable applications as viable applications that potentially can be run from the broadcast connection.

So, the signalling described here augments the signalling described in MHP 1.0.

10.14.1.1 Stored broadcast service related applications

For stored broadcast service related applications the broadcast AIT information shall be used when launching the stored application. So, little information from the AIT needs to be stored with the application.

10.14.1.2 Stored stand-alone applications

For stored stand-alone applications, the AIT information used when launching the application shall come from a stored representation of the AIT. While a stored service is being presented in a service context, the following apply:

- The applications database shall be populated with information from this stored representation of the AIT for the applications forming part of that stored service
- The implementation shall report any changes in the stored representation of the AIT in the same way as it would report changes in a broadcast AIT

10.14.2 Application storage descriptor

This application storage descriptor advertises that an application can be stored and provides some indications of its properties. The presence of this application storage descriptor indicates that an "Application description file" is provided for the application (see clause 10.14.3). For a storable application a single application storage descriptor shall be placed in either the common descriptor loop or application descriptor loop of the AIT.

This descriptor, and the implied "Application description file", also supports receivers that implement speculative caching.

Table 112: Syntax of application storage descriptor

	No.of Bits	Identifier
application_storage_descriptor() {		
descriptor_tag	8	uimsbf
descriptor_length	8	uimsbf
storage_property	8	uimsbf
not_launchable_from_broadcast	1	bslbf
launchable_completely_from_cache	1	bslbf
is_launchable_with_older_version	1	bslbf
reserved	5	bslbf
reserved	1	bslbf
version	31	uimsbf
priority	8	uimsbf
}		

descriptor_tag: This 8 bit integer with value 0x10 identifies this descriptor.

descriptor_length: This 8 bit field indicates the number of bytes following the descriptor length field.

storage_property: This 8 bit field indicates the characteristics of the application w.r.t storage.

Table 113: Semantics of storage property values

storage_property	property
0	broadcast related
1	stand alone
2 to 255	reserved

If the storage property is "broadcast related" then the application's life cycle is controlled by the broadcast service. Such applications are suitable for caching but not for running as a stand alone application.

If the storage property is "stand alone" then the application can usefully be launched by the user independently of a broadcast service. Applications with this property may also be launched as if broadcast related if the currently selected service lists them in its AIT.

l**aunchable_completely_from_cache:** This 1 bit field is a flag. When set to "1", this indicates that this application can be run entirely from cache, without connecting to the transport protocol signalled in the application's AIT, if all the critical files have been cached. If set to "0", a connection to this transport protocol must be made in order to run this application as a broadcast-related application. This flag only applies if running the application as a broadcast-related application, it is ignored when storing an application into a stored service, as all applications signalled as "standalone" can run without a connection to the transport protocol when run as part of a stored service.

This flag shall only be set to "1" when not_launchable_from_broadcast is also set to "1"

NOTE: This flag should be set to "1" only for applications where the object carousel is not present at all.

is_launchable_with_older_version: This 1-bit field is a flag. When set to "1", the STB shall start the cached application where the version number of the cached application is lower than the version number of the broadcast application. If the version number of the cached application is higher than the version number of the broadcast application, the cached application shall not be started.

If set to "0", the cached application shall not be started. Informative: If this flag is set, the cached application is responsible to handle version conflicts between cached application code and broadcast application data.

not_launchable_from_broadcast: This 1 bit field is a flag. When set to "1" this indicates that the delivery characteristics of this application are such that it is not useful to launch the application unless it has been completely cached/stored. If set to '0' then caching provides some benefit but is not essential.

Applications in stored services and applications where the not_launchable_from_broadcast bit is set to "1" shall only be launched where the MHP terminal has stored the complete set of files which are listed in the "Application description file" as being critical.

version: This 31 bit field provides the version number of the application. This number starts at zero and increments by one each time any of the files listed in the "Application description file" change or the contents of the "Application description file" itself changes. Used values shall never reused, in the event that the number range is exhausted a new application id shall be used.

priority: This field indicates the priority of this application for storage relative to the other applications signalled in this service.

It is only meaningful for applications which have been proactively cached by the MHP terminal implementation and shall be ignored otherwise.

Higher values indicate more important applications to store. The behaviour when applications have the same priority is implementation dependent.

Table 114: Storage descriptor flag combinations

not_launchable_ from_broadcast	launchable_ completely_ from_cache	is_launchable with_older_ version	Description
0	0	0	Normal case. MHP 1.0 equivalent.
0	0	1	Shall not be signalled
0	1	0	Shall not be signalled
0	1	1	Shall not be signalled
1	0	0	Runs if signalled version is stored.
1	0	1	Runs if signalled or older version is stored.
1	1	0	Runs completely from cache if signalled version is stored. The application cannot be stored due to unavailability of DSM-CC for the current service.
1	1	1	Runs if signalled or older version is stored. The application cannot be stored due to unavailability of DSM-CC for the current service.
When set, flag indicates that files are present but bitrate is too low.	When set, flag indicates that files are not present in current broadcast at all.		

10.14.3 Application description file

10.14.3.1 Description

The "Application description file" provides the list of files that need to be installed as well as other related necessary information. The notation uses an XML-based syntax.

For those applications that can be stored, an "Application description file" file shall be placed in the same carousel as the application.

NOTE: The application description file does not duplicate all the information needed to run the application, the MHP terminal needs to use also the information in the AIT when installing the application.

Where a file is listed in the "Application description file" of more than one application and is stored, the MHP terminal shall ensure that each application sees the correct version of the file for that application. The version of the file visible to one application shall not be changed by any changes in the version of the file visible to any other application which may share that same file.

10.14.3.2 Application description file name and location

The application description file shall be located in the base directory of a DVB-J application (as signalled in the dvb-j application location descriptor) or the physical root of a DVB-HTML application (as signalled in the DVB-HTML application location descriptor). By convention, the name of a ADF is:

```
'dvb.storage.oooooooo.aaaa'
```

where:

oooooooo is the organisation id of the application as a 8 character hexadecimal string

aaaa is the application id as a 4 character hexadecimal string

The organisation id and application id shall be padded with leading zeros to the specified length.

Lowercase hex digits are used to encode the organisation id and application id.

See also clause 10.14.2 "Application storage descriptor" on page 255.

10.14.3.3 Syntax

The syntax of the "Application description file" is defined by the following XML DTD.

The `PublicLiteral` to be used for specifying this DTD in document type declarations of the XML files is:

```
"-//DVB//DTD Application Description File 1.0//EN"
```

and the URL for the SystemLiteral is:

```
"http://www.dvb.org/mhp/dtd/applicationdescriptionfile-1-0.dtd"
```

```
<!ENTITY % object "(dir|file)">

<!-- the main element for the application description -->
<!ELEMENT applicationdescription (%object;)+>

<!ATTLIST applicationdescription version NMTOKEN #REQUIRED>

<!ELEMENT dir (%object;)*>
<!ATTLIST dir
   name CDATA #REQUIRED
   priority NMTOKEN #IMPLIED
>

<!ELEMENT file EMPTY>
<!ATTLIST file
   name CDATA #REQUIRED
   priority NMTOKEN #IMPLIED
   size NMTOKEN #REQUIRED
>
```

10.14.3.4 Semantics

version: A decimal integer denoting the version number of this application.

Must not contain leading zeros (unless it is "0"). Must match the version number signalled in the version field of the application storage descriptor in the AIT entry of this application otherwise the application description file is invalid. (This field allows application authors to ensure that the version number signalled in the AIT is correct. If it is wrong then this prevents any files being stored.)

name: This attribute provides the name of a file system object (directory or file) that is storable. This is the name of the object within its enclosing directory and hence does not include any directory path information. For the name attribute of a file element only, the last character of the name can be the wild-card character "*". This character will match any string including an empty string.

If name is "." or "..", contains the path separator character "/", or contains the character NUL (U+0000), then receivers shall reject the ADF as invalid.

NOTE 1: No elements are provided for naming object types such as Stream or StreamEvent therefore there is no mechanism to specify that Stream and StreamEvent objects are required to be stored.

NOTE 2: Listing a directory object in the file does not imply anything about those contents of the directory which are not themselves listed in the file.

For requirements on filenames of stored applications, see clause 14.6.3 "Stored applications" on page 399.

priority: This attribute describes how important it is to store this object. The value must be between 0 and 255, inclusive. If it is outside this range then the application description file is invalid. The value zero indicates that it is critical to store the object (i.e. there is no benefit in storing any objects unless this part is stored). Higher values indicate lower storage priority.

The default value for the priority attribute is zero (i.e. critical).

The priority for an object inherits from the immediately enclosing directory.

size: This attribute defines the size in bytes of the file, or files where the name attribute includes a wild-card.

Paths are relative to the directory containing the application description file, i.e. <file> and <dir> elements immediately inside the <applicationdescription> element refer to files and directories in the same directory as the application description file.

10.15 Signalling for providers

The provider export descriptor is used in the application (inner) loop of the AIT for an application which exports (contains) an XletBoundProvider. It declares that the classes of the XletBoundProvider are found in that application. This descriptor is meaningless if used in the common (outer) loop of the AIT.

Table 115: provider export descriptor syntax

	No. of Bits	Identifier	Value
provider_export_descriptor() {			
descriptor_tag	8	uimsbf	0x12
descriptor_length	8	uimsbf	
For(i=0;i<N;i++) {			
provider_name_length	8	uimsbf	
For(j=0; i<N; i++) {			
provider_name_byte	8	uimsbf	
}			
provider_class_name_length	8	uimsbf	
For(j=0; i<N; i++) {			
provider_class_name_byte	8	uimsbf	
}			
}			
}			

Where the fields have the following meanings:

provider_name_length: This 8 bit unsigned integer specifies the number of bytes in the provider name.

provider_name_byte: These bytes contain a string specifying the name of the provider.

provider_class_name_char_length: This 8 bit unsigned integer specifies the number of bytes in the application name.

provider_class_name_byte: These bytes contain a string specifying the fully qualified name of the class in the application that implements the named provider.

The provider usage descriptor is used in either the application (inner) or common (outer) loop of the AIT for an application which uses an XletBoundProvider and does not include the classes of the provider as part of itself.

Table 116: provider usage descriptor syntax

	No. of Bits	Identifier	Value
provider_usage_descriptor() {	No. of Bits	Identifier	Value
descriptor_tag	No. of Bits	Identifier	Value
descriptor_length	No. of Bits	Identifier	Value
For(i=0;i<N;i++) {	No. of Bits	Identifier	Value
provider_name_length	No. of Bits	Identifier	Value
For(j=0; i<N; i++) {	No. of Bits	Identifier	Value
provider_name_byte	No. of Bits	Identifier	Value
}	No. of Bits	Identifier	Value
}	No. of Bits	Identifier	Value
}	No. of Bits	Identifier	Value

Where the fields have the following meanings:

provider_name_length: This 8 bit unsigned integer specifies the number of bytes in the provider name.

provider_name_byte: These bytes contain a string specifying the name of the provider.

11 DVB-J Platform

11.1 The Java Platform

The Java platform is defined in PBP 1.1 [116].

11.2 General issues

11.2.1 Basic Considerations

Unless otherwise specified in the present document, MHP implementations are not required to include any classes or methods marked as deprecated in those API specifications which are either referenced by or included in the present document. Where a class is defined by the present document as implementing a specific interface, and that interface requires the class to provide an otherwise deprecated method. Then the interface overrides the deprecated mark and the method is required by the present document.

Each DVB-J application instance is considered to logically run in its own virtual machine instance. For this reason, it cannot rely on finalizers that are defined in application classes being run when the application terminates. When the application manager terminates the entity that represents the virtual machine in which the application is run, a conformant implementation is permitted to not run application finalizers, as spelled out in section 2.17.9 of the Java virtual machine specification volume 2, as referenced by PBP 1.1 [116]

DVB-J applications shall not synchronize on system classes or other exposed system static objects else undefined behaviour may occur.

SecurityExceptions shall only be thrown either where they are specified by the defining document or where identified in the present document for selected references which do not include any SecurityExceptions.

Unless specified otherwise for a referenced specification, it is an allowable implementation choice to not override methods as long as the defined semantics are respected. The implication of this is that such differences between implementations will be visible when using the java.lang.reflection package.

The inclusion of java packages shall not imply the inclusion of other sub packages e.g. the inclusion of the `javax.tv.media` package does not automatically imply the inclusion of the `javax.tv.media.protocol` sub package. Inclusion of sub packages shall be explicitly listed in the present document.

DVB-J applications shall not use additional public or protected methods or fields in the org.dvb namespace which are not listed in the present document. Applications which scale to run on multiple revisions of the present document shall only use org.dvb methods etc. appropriate to the version of the platform on which they are running.

Applications shall not define classes or interfaces in any package namespace defined in the present document. MHP terminals shall enforce this using the SecurityManager.checkPackageDefinition mechanism.

NOTE: DVB-J applications that are written to be scalable across multiple MHP profiles and/or versions of profiles and/or optional features may include references to API classes that are only present if the MHP terminal implements the profile or version of a profile or an optional feature that these API classes represent. Such applications must be written with care using a standard Java idiom for this case. This will ensure that they work on all MHP and GEM terminal implementations, including those that "eager linking" technology. A simple idiom to achieve this is presented in clause W.5.

11.2.2 Approach to Subsetting

Where a class included in the present document has methods, fields or constructors with signature dependencies on classes not included in the implemented profile, these methods are not required to be present in an implementation. A compliant implementation choice may require these methods and classes to be present.

Where the present document subsets a package, inclusion of the complete package is allowed but clearly not required. The behaviour of the additional features is not specified for broadcast applications.

11.2.3 Class Loading

11.2.3.1 Fundamental principles

The DVB-J application environment shall be written such that each application appears to run within its own classloader or classloader hierarchy for all classes that are not a part of the platform. As a consequence, two applications will never be able to access the same copy of any application-defined static variable.

In a signed application, all classes or files to be loaded through the classpath shall be signed by at least the set of certificates used to sign the initial xlet class of the application. This applies, for example, to class files comprising the application, and images and other data loaded via the java.lang.Class.getResource() mechanism. When authenticating a signed application, an MHP terminal can select any one of these certificates to use to authenticate all subsequent classes or files loaded. The mechanism used to make this selection is implementation dependent.

Where a jar file is included in the search path (e.g. for a `DVBClassLoader`) and is signed according to the MHP security model, all classes or files to be loaded from that jar file shall be considered to be signed by the certificates signing the jar file under the MHP security model.

NOTE: The present document imposes no requirements on the use of the signing information within a jar file.

NOTE: Where an MHP terminal trusts more than one of the certificates used to sign the initial xlet, it should attempt to select the most trusted of these.

See clause 12 "Security" on page 316.

Inappropriate, meaningless or illegal locators are silently skipped and searching continues.

11.2.3.2 Class loading and providers

For providers, the above requirement for the classes to be signed with a specific certificate is modified as follows. The classes of the provider shall be signed by a certificate where the organisation_id in the subject field of the certificate matches the organisation_id in the provider name.

11.2.4 Unloading

NOTE: Class unloading as required by PBP 1.1 [116] is required

11.2.5 Event listeners

In `org.dvb` and `org.davic` all methods to remove event listeners shall have no effect if the listener is not registered.

NOTE: The number of threads used to send events to event listeners is intentionally implementation dependent. Applications should not block in event listeners as this may prevent other events being delivered.

11.2.6 Event model in DAVIC APIs

Events defined in DAVIC APIs DAVIC 1.4.1p9 [3] which currently directly extend `java.lang.Object` shall extend `java.util.EventObject`. Event listeners defined in DAVIC 1.4.1p9 [3] shall extend `java.util.EventListener`.

11.2.7 Event model in DAVIC and DVB APIs

Each class in `org.dvb` and `org.davic` inheriting from `java.util.EventObject` is just a container for these fields and no validity checks are done for the parameters by this constructor. Instances of these classes are intended to be constructed by the platform implementation and not by applications. The platform implementation will only construct these events with the appropriate information passed in.

In `org.dvb` and `org.davic`, unless explicitly specified otherwise, all methods to add event listeners add each listener only once if the add method is called with the same parameters multiple times. This means that the same event is delivered only once to each listener even if it has been added twice.

11.2.8 Tuning as a side-effect

No MHP API shall cause tuning unless explicitly specified as such. For example, if a locator that requires tuning is received by the `DVBClassLoader` it shall behave as if the specified file is not available.

11.2.9 Intra application media resource management

Where an application makes conflicting requests for limited media decoding resources, the media decoding resources that are requested most recently are presumed to be the ones that are most wanted. This applies between MPEG-2 I-Frames, MPEG-2 Video "drips" and streaming video. Similarly, this applies between streaming audio and audio from memory.

When a non broadcast media presentation (audio or video from memory or still image) is interrupted by a resource loss within the same application, the first presentation is cancelled and will not be restored.

If a broadcast media presentation is interrupted by a resource loss within the same application, the broadcast presentation is restored when the interrupting presentation ends.

11.2.10 Application thread priority

The `ThreadGroup` of application threads shall have a `MaxPriority` of `java.lang.Thread.NORM_PRIORITY`.

NOTE: As a consequence applications will not be able to create threads at priorities greater than `java.lang.Thread.NORM_PRIORITY` since they don't have `java.lang.RuntimePermission( "modifyThread" )`. Applications may perform compute intensive tasks within application created threads without being considered unresponsive.

11.2.11 Text Encodings

Where the specification of the Java APIs refers to the default character encoding of the platform, the default for MHP shall be "UTF8" as defined in clause 7.1.5 "Monomedia format for text" on page 71. The encoding "latin1" shall also be supported as defined in ISO 8859-1 [20].

When present in a Java `String`, the mark-up codes defined in table D.7 "Codes defined for use in marked-up text files" on page 531 shall be encoded in Java chars whose most significant byte is zero and whose least significant byte is the value from table D.7. The encoding `"DVBMarkupUTF8"` shall be supported and is defined to be the same as UTF8 except as follows:

- In byte to char translations, the mark-up sequences in table D.7 shall be translated into chars as defined above.
- In char to byte translations, sequences of characters matching the encodings above shall be translated into the corresponding mark-up code sequences in table D.7.

11.2.11.1 Text encoding in Service Information

Where methods of the DVB SI API or Java TV APIs access strings encoded in the SI tables and return them to applications are String objects, the following character encodings shall be supported as defined in annex A of the DVB SI specification EN 300 468 [4]:

- ISO 6937 [47] (default).
- ISO 8859-5 [48] through ISO 8859-9 [49] (SI string first byte codes 0x01...0x05).
- ISO 8859-1 [20] through ISO 8859-9 [49] (SI string first byte code 0x10).
- 16-bit ISO/IEC 10646-1 [18] UCS-2 (SI string first byte code 0x11).

These encodings shall also be supported by the methods in the `org.dvb.si.SIUtil` class. Support of the other character encodings whose signalling is specified in the DVB SI specification is not required from MHP terminals.

11.3 Fundamental DVB-J APIs

11.3.1 Java platform APIs

NOTE: The following packages are defined in PBP 1.1 [116].

11.3.1.1 java.lang package

The java.lang package is supported with the following notes and requirements.

c) The following fields shall not be used by inter-operable applications:

- System.in.

d) Applications shall be able to use:

- System.out;
- System.err;
- Runtime.traceInstructions();
- Runtime.traceMethodCalls();

for debugging without any adverse effects to the application. The output shall not be visible to normal end users and shall not conflict with any other API.

e) The `java.lang.Compiler` class and following methods shall be taken as hints from an application to the system. However, as specified by PBP 1.1 [116] there is no guarantee of what happens:

- Runtime.gc();
- System.gc().

f) In addition to the system properties required by PBP 1.1 [116], the following properties are required to be supported for `System.getProperty()`:

- dvb.returnchannel.timeout (see clause 11.5.3 "Support for IP over the Return Channel" on page 281);

- dvb.persistent.root (see clause 11.5.6 "Persistent Storage API" on page 282).

- dvb.display.aspect_ratio (see clause 11.4.1.2 "TV user interface" on page 267).

With the exception of `dvb.persistent.root` all of these properties are accessible to all applications.

`dvb.persistent.root` is accessible only as defined in clause 11.10.2.1 "java.util.PropertyPermission" on page 302.

Property names beginning "`dvb.`" are reserved for future use.

g) The methods `java.lang.SecurityManager.checkPackageDefinition` and `java.lang.SecurityManager.checkPackageAccess` are documented to check a package name against a list of restricted packages.

MHP terminal implementors are recommended to use this mechanism to prevent application classes from having access to implementation classes where this could compromise the security of the MHP terminal.

MHP terminals shall not define classes in the empty ("") package name-space.

NOTE: MHP terminal implementors who are also implementing MHP applications need to ensure that the namespaces used for applications do not collide with those used for their MHP implementation.

The call `System.currentTimeMillis()` shall feature a granularity of the returned time value of not more than 10 ms. The terminal should attempt to keep an accurate clock, e.g. by initialising it's clock from a TDT. The default `TimeZone for java.util.Calendar` shall either be as defined by the end-user or as defined in a TOT if the end-user has not defined any TimeZone. With the call `Object.wait(long timeout)`, the timeout value is specified as a maximum time to wait. The MHP further guarantees that if not notified the object will wait for at least timeout - 10 ms.

11.3.1.2 java.void

As specified in PBP 1.1 [116], the constants in the `java.util.Locale` class do not imply support (or otherwise) for these Locales. Locales supported in the MHP are specified in profiles (see clause 15.4 "Locale support" on page 407).

Inter-operable applications shall not call the `java.util.TimeZone.setDefault` method. The behaviour if this method is called is implementation dependent.

11.3.1.3 void

11.3.1.4 java.io, javax.microedition.io

The deprecated method `java.io.ObjectInputStream.readLine()` shall not be called by inter-operable applications.

The classes and interfaces in this package relating to files and file systems have additional semantics defined for MHP specific file systems as follows.

- For broadcast carousels in clause 11.5.1.1 "Constraints on the java.io.File methods for broadcast carousels" on page 279.
- For persistent storage in clause 11.5.6 "Persistent Storage API" on page 282.
- For applications running as part of stored services in clause 11.12.2.2 "Modified behaviour of MHP 1.0 APIs" on page 312.

NOTE: PBP 1.1 [116] requires that javax.microedition.io support a number of protocols, such as "socket:", "http:" and "file:"

11.3.1.5 java.net

Consistent with PBP 1.1 [116], support is required for at least one implementation dependant `java.net.URL` protocol. Platform methods that return a URL to access resources, such as `Class.getResource`, `ClassLoader.getSystemResource` and `ClassLoader.getResource` shall return instances of java.net.URL using such a protocol where no appropriate protocol is defined in the present document.

In a signed application, a URL to this resource shall be returned as for an unsigned application, regardless of whether the underlying file is signed. When that file is accessed (e.g. via an input stream obtained from `java.net.URL.openStream()`), then if the file fails authentication as described in clause 11.2.3 "Class Loading" on page 262, the system shall behave as if the file contained no data (i.e. as if it were a zero-length file).

NOTE: Due to the overhead of processing the signature verification, asset files which are not critical to be authenticated should be loaded using `java.io.File` or `org.dvb.dsmcc.DSMCCObject` and sent as unsigned.

Support is required for the "file:" protocol. Applications shall be able to construct instances of `java.net.URL` using strings containing "file:" URLs as defined in RFC 1738 [67] where the `<host>` element is the empty string and the <path> element is an absolute filename.

The return types of URL.getContent() are defined by the mappings from data type to java class name listed in table 117.

Table 117: Return types of URL.getContent()

Data type	Return type
Unknown or unsupported data types	java.io.InputStream
text/plain	java.io.InputStream
text/dvb.utf8	java.io.InputStream
text/Generic	java.io.InputStream
image/png	java.awt.image.ImageProducer
image/jpeg	java.awt.image.ImageProducer
image/mpeg	org.havi.ui.HBackgroundImage

The behaviour of URL.getContent() responds to data type using information with the following priority:

a) Content type signalling such as:

- The content type descriptor in the OC (see clause B.2.3.4 "Content type descriptor" on page 483).
- The HTTP header (if supported in the profile) the Content-Type header field (if present).

b) The filename extension (if known) (see table 7 "File type identification" on page 77).

c) Open the file and study.

`getContentType` returns the value contained in the optional content type descriptor in the OC (see clause B.2.3.4 "Content type descriptor" on page 483) if present.

`getFileNameMap` returns information derived from table 7 "File type identification" on page 77.

See the Object Carousel signalling described in clause B.2.3.4 "Content type descriptor" on page 483.

11.3.1.6 void

11.3.1.7 void

11.3.1.8 void

11.3.2 MHP platform APIs

11.3.2.1 org.dvb.lang

The `org.dvb.lang` package is supported as defined in annex I "(normative): DVB-J fundamental classes" on page 552.

Where no parent is specified at creation, the delegation parent classloader of `DVBClassLoader` shall be the original classloader of the calling application.

Classloader delegation is defined in the specification for `java.lang.ClassLoader` in PBP 1.1 [116].

11.3.2.2 org.dvb.event

The `org.dvb.event` package is supported as defined in annex J "(normative): DVB-J event API" on page 556.

When sending events from a `org.dvb.event.EventManager` to listeners, the implementation shall ensure that any single listener shall only be sent one platform generated event instance at one time. If a new event is generated before the listener method has returned from processing a previous event, the MHP terminal shall not call that listener method until the call for processing the previous event returns.

The behaviour where applications have multiple such event listeners registered is implementation dependent. Implementations may use multiple threads to send the same event instance to any such multiple listeners. Implementations may ensure that at most one event listener in any one application for all these events is executing at any one time.

The return value of `UserEvent.getWhen()` shall be the difference, measured in milliseconds, between the time when the event occurred and midnight, January 1, 1970 UTC, i.e. like `System.getCurrentTimeMillis()`.

11.3.3 Java TV

The Java TV APIs are defined in Java TV [51].

NOTE: This includes the packages javax.tv, javax.media and their subpackages.

11.4 Presentation APIs

11.4.1 Graphical User Interface API

11.4.1.1 The Core GUI API

Property names for use with the `getProperty` method on `java.awt.Image` and its sub classes beginning "dvb." are reserved for future use.

Applications shall be able to use Toolkit.beep without any adverse effects to the application. The output is not required to be audible to normal end users and shall not conflict with any other API.

The methods `getScreenResolution` and `getScreenSize` shall be supported with the additional semantics described in HAVi [50].

The encoding of image content types for use by java.awt.image are defined in clause 7.1.1 "Bitmap image formats" on page 69. The set of formats supported is profile dependent.

When using the java.awt.FontMetrics class, the width of a set of characters or string returned by the charsWidth or stringWidth method shall be correct taking into account any kerning and sub-pixel positioning applied by the font renderer. Calculating the same number by adding the widths of the individual characters is not required or expected to return the same number since it will not take into account any kerning or sub-pixel positioning applied by the font renderer.

The downloading of fonts from the network (see clause D.2.2 "Downloaded fonts" on page 514) shall be supported using the methods concerned on `org.dvb.ui.FontFactory`. Failure to download a font shall be reported by these methods. The constructor for `java.awt.Font` shall only be aware of platform resident fonts.

For MHP terminals, the time at which an input event occurs as reported by `java.awt.event.InputEvent.getWhen` does not mean the time at which the event is reported to a listener of a MHP application. In particular, if an MHP application has a backlog in processing events and events are being queued, the time at which the event occurred shall be before the event enters the queue and hence also before when it leaves the queue to be reported to the MHP application's listener. The return value of `getWhen()` shall be the difference, measured in milliseconds, between the time when the event occurred and midnight, January 1, 1970 UTC, i.e. like `System.getCurrentTimeMillis()`.

In implementations of the present document, the "single instance of an application-created Frame" that "is permitted per GraphicsDevice" will be created by the MHP implementation for the default `HGraphicsDevice`. Attempts by MHP applications to construct instances of Frame for the default `HGraphicsDevice` will cause the constructor to throw `java.lang.UnsupportedOperationException`.

11.4.1.2 TV user interface

The packages `org.havi.ui` and `org.havi.ui.event` defined in HAVi [50] shall be supported. Instances of `org.havi.ui.event.HRcEvent` are reported through the normal `java.awt` event mechanism due to the inheritance from `java.awt.event.KeyEvent`.

With the exception of the `HSound.load` method, no methods specified in HAVi [50] shall throw a security exception in the MHP context. The permissions for `HSound.load` are those defined for java.io.

The `DVBTextLayoutManager` specified in annex U "(normative): Extended graphics APIs" on page 892 shall be supported.

The following semantics shall be used for the `getVideoController` method on `HVideoDevice`.

- It shall only return JMF players (see javax.media in Java TV [51]) which are in the Prefetched or Started states and which are using that `HVideoDevice` as one of their scarce resources. Otherwise null will be returned. It shall not return JMF players from other applications if those are using the video device underlying the `HVideoDevice`.
- Except as specified below, it shall only return JMF players which have been already created in response to the application calling `javax.media.Manager.createPlayer` or which have been returned by `javax.tv.service.selection.ServiceContext.getServiceContentHandlers` (see Java TV [51]).
- The only exception to the above is the situation where video is being played in the background as part of the context of an application but where `javax.tv.service.selection.ServiceContext.getServiceContentHandlers` has not yet been called. In this case, `getVideoController` shall return the same JMF player as would be returned by `getServiceContentHandlers` if it was to be called subsequently.

The signatures of the classes `HComponent` and `HContainer` shall be extended with "`implements org.dvb.ui.TestOpacity`".

The methods `HGraphicsConfiguration.getPunchThroughToBackgroundColor` shall not be used by inter-operable applications.

The methods `fontAvailable()` and `downloadFont()` in the class `org.havi.ui.HFontCapabilities` shall not be used by inter-operable applications.

NOTE: The package javax.tv.graphics is required, as per 11.3.3 "Java TV" on page 266.

Applications shall only pass in calls to the method `javax.tv.graphics.TVContainer.getRootContainer` the exact same `XletContext` instance as was passed to their `initXlet` method when it was called by the MHP terminal. The behaviour of `getRootContainer` if passed any other `XletContext` is implementation dependent and returning null is one valid option. Except for this case, this method shall never return null in an MHP implementation. The methods `javax.microedition.xlet.XletContext.getContainer` and `javax.tv.graphics.TVContainer.getRootContainer` shall return the same as would be returned by a call to `org.havi.ui.HSceneFactory.getDefaultHScene()` under the same circumstances.

The method `HComponent.isDoubleBuffered` shall not be used by inter-operable applications.

Any changes made to the `org.havi.ui.HGraphicsConfiguration` of an `org.havi.ui.HGraphicsDevice` shall be reported via the `java.awt.GraphicsDevice` and `java.awt.GraphicsConfiguration` APIs, as appropriate. For each `HGraphicsConfiguration`, there shall be a `GraphicsConfiguration` where `getBounds()` returns the same values as `HGraphicsConfiguration.getPixelResolution()`.

NOTE: Application developers should not rely on MHP terminals supporting full-screen exclusive mode, thus, as permitted by Personal Basis Profile, the method `java.awt.GraphicsDevice.isFullScreenSupported` may always return false.

The system property `dvb.display.aspect_ratio` shall indicate the shape of the physical display that the MHP terminal believes is used by its default HScreen.This may not be the same as the aspect ratio of the receiver's current output signal. This shall be encoded as the ratio of width to height, both expressed as positive decimal integers and separated by a ":". For example, "4:3" or "16:9". This shall be the same ratio as would be returned by `VideoFormatControl.getDisplayAspectRatio` for a JMF player decoding on that HScreen.

11.4.1.3 Extended graphics

See annex U "(normative): Extended graphics APIs" on page 892.

11.4.1.4 Television viewing mode

The MHP includes two ways for applications to receive input events: the normal AWT method in `java.awt.Component` and the `org.dvb.event` package (see clause 11.3.2.2 "org.dvb.event" on page 266). Via the normal AWT method, the application normally receives all input events when the component has the focus. The minimum set of input events that are supported is defined in clause G.5 "Input events" on page 547.

Often the resident Navigator software of the MHP terminal uses many of the keys on the remote control for its own navigation purposes. The navigator shall not act on input events which are delivered to MHP applications. In particular, the navigator shall not respond to number key input if that input is delivered to one or more MHP applications. Conversely, if the MHP application with input focus has indicated disinterest in number key input (using `HScene.setKeyEvents` with an `HEventGroup` not including the number keys) then navigators which respond to number key input are free to do so. Rules on when MHP applications should request interest in particular input events and when they should not are found below.

To ensure consistent user experience, the following rules are defined:

- An application creating an `HScene` and placing components into it shall not by default get the input focus for these components.
- The application may request to get the input focus by calling `Component.requestFocus()`. If this is granted and the focus moved to the requested component, this component shall receive input events as defined in clause J.1.
- The application may request to receive a subset of input events via the `org.dvb.event` API even when not having the AWT focus.

For applications delivered within normal television services, it is recommended that the following items are taken into account:

- When the display is primarily showing the video of the television service and the user perception is that he is not actively interacting with an application but is just watching the television service (called 'television viewing mode'), the applications should not request the AWT focus but let most of the input events go to the resident Navigator (e.g. number keys, directional arrow keys and Enter may cause the normal actions the user expects from the Navigator)
- In the 'television viewing mode' the applications should request only the minimum required input events, e.g. only input events that cause some further action to happen and that may transition the user from the 'television viewing mode' into a state where the user more actively interacts with the applications.
- If the applications require some input events for the user to be able to activate the application when in the 'television viewing mode', it is recommended that the VK_COLORED_KEY_(0 to 3) and VK_TELETEXT (see note below) input events are used for this purpose and the applications request them via the org.dvb.event API. In practice this means that the navigator can not map any essential function directly to the VK_COLORED_KEY(0 to 3) events in television viewing mode.
- Subtitles should be available when end-users perceive themselves as watching television. In order to achieve this, MHP applications shall not have a visible full screen HScene where more than 60% of the pixels are wholly transparent to video when in "television viewing mode".
- MHP applications wishing to leave "television viewing mode" and receive events other than the VK_COLORED_KEY_(0 to 3) and VK_TELETEXT are obliged to display a non-transparent graphics object on the screen that covers at least 3 % of the visible area on the screen (equivalent to 9 852 pixels on a 634 x 518 visible screen in a 720 x 576 or 720 x 480 graphics mode) which clearly indicates to the user the "non-navigator" mode of the receiver with respect to input event handling.

NOTE 1: In television services where DVB Teletext is transmitted within the service, a typical Navigator action in the 'television viewing mode' can be to activate a teletext decoder, if supported by the terminal. The application requesting this input event may cause the DVB Teletext decoder not to be conveniently accessible to the end user. Therefore, within services that carry DVB Teletext it is

recommended that the VK_TELETEXT input event is requested in the 'television viewing mode' only by such applications that provide a simulcast MHP application version of the teletext service, thus providing a replacement for the DVB Teletext information.

In environments where WST Teletext services are prevalent when there is no DVB Teletext service associated with the video service, the MHP application should display an information service of a similar nature to teletext. When receiving this event for the second time the information service should terminate and the user will return to normal viewing mode.

The VK_TELETEXT event should have no other purposes in MHP applications.

NOTE 2: The items above apply only to the 'television viewing mode' as explained above. In states where the user experience is that the user is clearly primarily interacting actively with an application the applications can naturally use the normal AWT input event mechanism and request the focus as well as use any of the supported input events via the org.dvb.event API.

NOTE 3: For data services, the first interaction state of an application that is automatically started after service selection should behave as television viewing mode. This is in order to allow users who are navigating with the navigator to seamlessly navigate through these services without getting confused.

11.4.1.5 Font bindings

11.4.1.5.1 PFR0

For fonts in the PFR0 format clause 7.4.1 "PFR" on page 72, the bindings between the Java APIs relating to font metrics and the font format itself shall be as follows;

The return values of the methods `FontMetrics.getMaxAscent` and `FontMetrics.getMaxDescent` shall be `yOffsetTop` and `yOffsetBottom` respectively as defined in clause D.3.5.3 "Conversion of units" on page 520.

For PFR fonts with the auxiliary data record;

- `FontMetrics.getAscent` shall be obtained from the ascent field.
- `FontMetrics.getDescent` shall be obtained from the descent field.
- `FontMetrics.getLeading` shall be obtained from externalLeading.

  All values in the auxiliary data record shall be converted from font metrics units to pixels as described in clause D.3.4 "Converting font metrics to display pixels" on page 519 before being returned. This conversion shall round up.

For PFR fonts without the auxiliary data record;

- `FontMetrics.getAscent` shall be the same as getMaxAscent.
- `FontMetrics.getDescent` shall be the same as getMaxDescent.
- `FontMetrics.getLeading` shall be zero.

The "advance width" of a character, in metrics units, is defined as follows:

- For PFR fonts with the "proportionalEscapement" flag set, the advance width of a character is given by the "charSetWidth" field in the character record.
- For PFR fonts without the "proportionalEscapement" flag set, the advance width of a character is given by the "standardSetWidth" field in the physical font record.

`java.awt.FontMetrics.charWidth()` shall return the advance width of the character converted to pixels. This conversion shall round up.

`java.awt.FontMetrics.stringWidth()`, `java.awt.FontMetrics.bytesWidth()` and `java.awt.FontMetrics.charsWidth()` are calculated by summing the advance widths of all the characters in the string, and adjusting for any kerning in the font. Adjustments for kerning are performed in metrics units, then the result is converted to pixel units. This conversion shall round up.

`java.awt.FontMetrics.getMaxAdvance()` returns the maximum value that `java.awt.FontMetrics.charWidth()` can return.

NOTE: For proportional fonts the implementation must calculate this value from the advance width of every character in the font; there is no field in the PFR file which contains it.

11.4.1.5.2 OpenType

For fonts in the OpenType format as described in clause 7.4.2 "OpenType" on page 73, the binding between the Java API relating to font metrics and the font format itself shall be as follows.

The return values of the methods `FontMetrics.getMaxAscent`, `FontMetrics.getMaxDescent`, `FontMetrics.getAscent`, `FontMetrics.getDescent` and `FontMetrics.getLeading` shall be as follows:

- `FontMetrics.getMaxAscent` shall be obtained from the `yMax` field of Font Header ('head') table;
- `FontMetrics.getMaxDescent` shall be obtained from the `yMin` field of Font Header ('head') table, and shall return -yMin;
- `FontMetrics.getAscent` shall be obtained from the `Ascender` field of Horizontal Header ('hhea') table;
- `FontMetrics.getDescent` shall be obtained from the `Descender` field of Horizontal Header ('hhea') table, and shall return -Descender;
- `FontMetrics.getLeading` shall be obtained from the `LineGap` field of Horizontal Header ('hhea') table.

All font metrics values shall be converted from font metrics units to pixels as described in clause D.3.4 "Converting font metrics to display pixels" on page 519 before being returned. This conversion shall round up.

For OpenType fonts, the values `metricsResolution` and `outlineResolultion` shall be equal to the value of `unitsPerEm` field, defined in the Font Header ('head') table.

The "advance width" of a character in font metrics units is defined as follows:

- For proportional fonts, where the value of `isFixedPitch` defined in the PostScript ('post') table of OpenType/TrueType font equals to '0' (i.e. false), the advance width for each glyph is given in the Horizontal Metrics ('hmtx') table array;
- For monospaced fonts, with the value of `isFixedPitch` set (non-zero), the advance width of a character is determined by the single entry in the Horizontal Metrics ('hmtx') table.

`java.awt.FontMetrics.charWidth()` shall return the advance width of the character converted to pixels. This conversion shall round up.

`java.awt.FontMetrics.stringWidth()`, `java.awt.FontMetrics.bytesWidth()` and `java.awt.FontMetrics.charsWidth()` are calculated by summing the advance widths of all the characters in the string, and adjusting for any kerning in the font. Adjustments for kerning are performed in metrics units, and then the result is converted to pixel units. This conversion shall round up.

`java.awt.FontMetrics.getMaxAdvance()` returns the maximum value that `java.awt.FontMetrics.charWidth()` can return. This value shall be obtained from the `advanceWidthMax` field of Horizontal Header ('hhea') table of OpenType font.

11.4.2 Streamed Media API

11.4.2.1 Framework of solution

The javax.media and javax.media.protocol packages from Java TV [51] shall be implemented with the clarifications, extensions and restrictions as defined in the corresponding clauses below.

11.4.2.2 Clarifications

The JMF "time base time" when playing MPEG content delivered in MPEG transport streams is used as a constantly progressing time whose rate may be synthesized from the Program Clock References / the System Time Clock in MPEG or by some other appropriate method. The value does not have any direct relation to the value of the MPEG System Time Clock in the receiver.

The media time of JMF when playing MPEG content delivered in MPEG transport streams is just a time value that progresses as the media stream is played, but whose actual value is implementation dependent.

NOTE: There is no implied or expected connection between the JMF media time and any time base(s) provided by the MPEG-2 / DSM-CC Normal Play Time.

When creating a JMF player, Locators and URLs which reference a DVB service, event or elementary stream will create a player which plays the content concerned direct from the network. Locators and URLs which reference files will create a player which will download the content concerned from the network during the Prefetching state of the player concerned. If the content cannot be downloaded then such players will never enter the Prefetched state.

Interoperable applications shall not call javax.media.MediaHandler.setSource().

In the `javax.media.PackageManager`:

a) The effect of the `set<xxx>PrefixList` methods is limited to the application calling the method.

b) The `SecurityException` of the `commit<xxx>` methods shall always be thrown in MHP.

The events `javax.media.ControllerEvent` and `javax.media.GainChangeEvent` shall inherit from `java.util.EventObject`.

The `interfaces javax.media.ControllerListener` and `javax.media.GainChangeListener` shall inherit from `java.util.EventListener`.

`SubtitlingLanguageControl.isSubtitlingOn()` returns the current state of subtitle presentation and NOT the last value set with `setSubtitling`. In particular `setSubtitling` may be set to true but if there are no subtitles in the network or no subtitle service component selected then `isSubtitlingOn` shall return false.

Any elements in `DVBLocators` after and including the `event_id` element are ignored by JMF players.

11.4.2.3 Default media player behaviour

For a JMF player which is presenting a DVB service, the following rules will be followed in the order given to decide which service components will be presented when multiple audio, video or subtitle components are present in a service:

a) For audio and subtitle streams in different languages, user preferences will be used to determine which streams are selected.

b) The streams which are first in the network signalling information (i.e. in the PMT) will be presented.

If any of the media components comprising the service change then the implementation will as far as possible replace the changed components with suitable replacements in a user preference and implementation dependant manner.

11.4.2.4 Required controls for video drips

The following controls are supported for video drips (see clause 7.1.3 "MPEG-2 Video "drips"" on page 70):

- `javax.tv.media.AWTVideoSizeControl`.
- `org.dvb.media.BackgroundVideoPresentationControl`.

11.4.2.5 Extensions to the Framework

11.4.2.5.1 DVB specified extensions

The classes and interfaces defined in annex N "(normative): Streamed Media API Extensions" on page 688 of the present document are included.

If a `Player` bound to a `DripFeedDataSource` receives a `ResourceWithdrawnEvent` and later a `ResourceReturnedEvent`, the video output from the video decoder to which the player is bound is implementation dependent. The MHP application using the `Player` shall call the `DripFeedDataSource.feed` method with an I-frame as soon as possible after `ResourceReturnedEvent` is received.

NOTE: Application developers should take this into account when constructing video drip sequences. A large number of P-frames between I-frames could lead to a significant delay before the visible display can be refreshed due to the limitations on the frequency with which new data can be fed to the decoder.

11.4.2.5.2 Extensions in org.davic

The following classes and interfaces will be included from the `org.davic.media` package, as defined in annex L of DAVIC 1.4.1p9 [3].

- MediaPresentedEvent.
- MediaLocator.
- MediaTimePositionControl.
- FreezeControl.
- ResourceWithdrawnEvent.
- ResourceReturnedEvent.
- MediaTimePositionChangedEvent.
- LanguageNotAvailableException.
- NotAuthorizedException.
- NotAuthorizedMediaException.
- MediaFreezeException.
- LanguageControl.
- AudioLanguageControl.
- SubtitlingLanguageControl.

The following classes will be included from the `org.davic.media` package as defined in annex L of DAVIC 1.4.1p9 [3] with the following semantic modification:

- The completion of the action started by calling `setMediaTimePosition()` on the `MediaTimePositionControl` will be signalled by a `org.davic.media.MediaTimePositionChangedEvent`.
- The `org.davic.media.MediaPresentedEvent` shall only be thrown following changes caused using controls in the `org.davic package` and as a consequence of the transition of a JMF player into the Started state. Instances of this event shall be generated as close to the presentation of the content as the device can detect, e.g. when the new content leaves the output of a hardware decoder. In this second case, it augments the JMF state transition events and does not replace them.

NOTE 1: Changes effected using `javax.tv.media.MediaSelectControl` do not lead to the `org.davic.media.MediaPresentedEvent` being thrown.

NOTE 2: The present document defines more specific conditions under which `ResourceWithdrawnEvent` and `ResourceReturnedEvent` than the original DAVIC specification. This can be found in clause 11.6.2 "Service Selection API" on page 284.

11.4.2.5.3 Extensions in javax.tv

In `javax.tv.media.MediaSelectControl` the `InsufficientResourcesException` is thrown by the `select()` method if selecting any service component fails due to a lack of system resources.

In `javax.tv.media.AWTVideoSize.equals()`, the "data members" shall be considered to be the "source" and "dest" parameters used to create the object.

The components returned by `javax.tv.media.MediaSelectControl.getCurrentSelection` are the currently selected components which may be different from those previously selected by this control. Mechanisms which may modify the current selection include:

- Control of subtitles and audio language.
- The CA system including the common interface e.g Host Control replace / clear_replace.
- User intervention via the navigator.

The following clarifications shall apply to the method `getDefaultSize` in `javax.tv.media.AWTVideoSizeControl`:

a) This method shall return the current default `AWTVideoSize`. The default shall be that which would be implemented by the MHP terminal when the video scaling and positioning of a JMF player is under control of the MHP platform (see `org.dvb.media.VideoFormatControl.DFC_PLATFORM`). When the video scaling and positioning is in the DFC_PLATFORM mode, the return value of this method shall change to track changes made by the policy underlying DFC_PLATFORM.

b) Calling `AWTVideoSizeControl.setSize()` with the `AWTVideoSize` object returned by this method as the parameter shall set the video scaling to the current default at the time `getDefaultSize()` was called. Hence it shall be equivalent to calling `BackgroundVideoPresentationControl.setVideoTransformation` with the video transformation returned by the method `VideoFormatControl.getVideoTransformation(getDecoderFormatConversion())` and not with the video transformation returned by `getVideoTransformation(DFC_PLAFORM)`.

NOTE: When the MHP terminal is in pan and scan mode, (see `org.dvb.media.VideoFormatControl.DFC_PROCESSING_PAN_SCAN`), the return value of `AWTVideoSizeControl.getSize()` will be out of date almost as soon as the method has returned.

11.4.2.5.4 Required controls for broadcast profiles

The following controls are supported for the broadcast streaming formats specified in clause 7.2 "Broadcast streaming formats" on page 71:

- `org.davic.media.LanguageControl.`
- `org.davic.media.AudioLanguageControl.`
- `org.davic.media.SubtitlingLanguageControl.`
- `org.davic.media.FreezeControl.`
- `javax.tv.media.MediaSelectControl.`
- `javax.tv.media.AWTVideoSizeControl.`
- `org.dvb.media.VideoPresentationControl.`
- `org.dvb.media.BackgroundVideoPresentationControl.`
- `org.dvb.media.SubtitlingEventControl.`
- `org.dvb.media.VideoFormatControl.`
- `org.dvb.media.DVBMediaSelectControl.`

The following controls are supported for media decoded from clause 7.1.4 "Monomedia format for audio clips" on page 71:

- `org.davic.media.MediaTimePositionControl.`

11.4.2.5.5 Clarifications

In SubtitlingLanguageControl, subtitling being presented shall be defined as the subtitle decoder running. It does not require subtitles to be visible on screen at that time. See clause 13.5 "Subtitles" on page 389.

When a `PresentationChangedEvent` is generated, the Player in question should re-evaluate the list of controls returned by the `getControls()` method for that player. Similarly, Players supporting the `MediaSelectControl` should re-evaluate the list of Controls returned by `getControls()` after calls to the `MediaSelectControl.select()` method is called.

Any controls referenced by an application after a `PresentationChangedEvent` or a `MediaSelectSucceededEvent` is generated may fail silently if they are no longer valid. Controls which are valid for the new content remain unaffected. Applications should re-acquire any controls they require after either of these events has been generated.

If the content being presented by a JMF player becomes unavailable due to tuning, `org.davic.media.ResourceWithdrawnEvent` shall be sent to listeners registered to receive that events. A `ResourceReturnedEvent` shall be sent to all listeners registered at that time if the content becomes available again.

The following controls shall work on a JMF Player in any state (including Unrealized, Realizing, Realized, Prefetching, Prefetched and Started Players) and changes made via these controls shall be preserved across JMF state transitions:

- `javax.tv.media.AWTVideoSizeControl`
- `org.dvb.media.VideoPresentationControl`
- `org.dvb.media.BackgroundVideoPresentationControl`

It is implementation-specific whether or not the effect of other JMF controls included in this specification survives JMF state transitions.

When decoding of the media stream is frozen by `org.davic.media.FreezeControl`, scaling the video (e.g. by `BackgroundVideoPresentationControl`) it is recommended that this have immediate effect on the existing frozen video still. MHP terminals that cannot do this shall temporarily resume decoding of the media stream to acquire a new video still that shall be scaled as specified, and shall automatically re-freeze the media after this video still has been acquired.

Where streaming service components of the same service (e.g. MPEG-2 elementary streams) are being decoded by different JMF players, there shall be no synchronisation between those components. Specifically, if the video and audio from a service are being presented by separate JMF players then they shall be presented in "free-running" mode ignoring the PCR.

11.4.2.5.6 Component-based JMF players

JMF Players start as background players. Players which do not provide a `org.dvb.media.ComponentBasedPlayerControl` can only be used to present video in the background and their `getVisualComponent` method shall always return null. Players that provide an implementation of the `org.dvb.media.ComponentBasedPlayerControl` are capable of acting both as background and component-based players, and their `getVisualComponent` method must follow the semantics defined by that control and this section.

If an application calls `Player.getVisualComponent()` and receives a non-null Component, that application then owns the visual component for that Player. It continues to own the visual component for that Player until the application is destroyed or calls `ComponentBasedPlayerControl.releaseVisualComponent()`. An application that owns the visual component of a Player will get the same component returned by calls to `Player.getVisualComponent()` on that Player until it releases the component. Calls to `Player.getVisualComponent()` will return null if the visual component for that Player is owned by another application.

If `getVisualComponent` returns non-null, video shall continue running in the background until the first call to the paint method of the component returned by `getVisualComponent`. When this transition happens the video is resized and repositioned as required by the visual component. Possible areas outside of the component are updated to follow the rules in clause 13.3 "Graphics" on page 377.

After this transition, applications shall re-acquire the list of JMF controls for the player. It is implementation dependent whether any previous JMF controls are re-used. Applications shall not use any previous JMF controls which are not in the new list of JMF controls. When a JMF player is performing as a component based player, the following JMF controls shall not be supported and video scaling and positioning shall be done by controlling the size and position of the component returned by the `getVisualComponent` method.

- `org.dvb.media.BackgroundVideoPresentationControl`
- `javax.tv.media.AWTVideoSizeControl`.

Players which return a non-null `java.awt.Component` from the `getVisualComponent` method must fully support the semantics for `java.awt.Component` concerning positioning and scaling.

11.4.2.6 Restrictions on the Framework for Broadcast

Controls that are supported the MHP need not have an associated GUI component. Any calls to `Control.getControlComponent()` may return null.

Developers of MHP applications should not rely on the presence of the following classes or interfaces:

- `javax.media.CachingControl` (unless returned by a call to a JMF method).
- `javax.media.CachingControlEvent`.
- `javax.media.GainControl` (unless returned by a call to a JMF method).

An MHP implementation need not return a `CachingControl` or `GainControl` from a call to `Player.getControls()` however this is not prohibited. If an MHP implementation does return a `GainControl`, then the volume that is set using this control may not be greater than the system volume level. I.e. the gain control may only change the volume between mute and the volume level at the time the application was started. This system volume level shell be represented as 1.0.

If the visual component returned by `Player.getVisualComponent()` is hidden (as returned by `Component.isHidden()`), the video is hidden. It is legal to remove a visual component from an AWT hierarchy and add it back to an AWT hierarchy (perhaps in a different place). The video will be hidden when the component is removed and shown again when the component is painted again.

Applications should not expect `PushDataSource` and `PullDataSource` to exist for broadcast MPEG content, and it is not required that functional implementations be provided for implementations of JMF in DVB. The `DataSource` used may be implementation-specific and non-specified apart from its inheritance from `javax.media.protocol.DataSource`.

The constructor for `URLDataSource` may always throw `IOException` for broadcast MPEG content.

For the purposes of integration with `javax.tv.media.MediaSelectControl` "resynchronization" is not considered to occur provided that the same PCR_PID is referenced between the new and existing service components.

Implementations of JMF shall not tune but shall allow selection of media components from transport streams which can be reached without tuning even where they are not part of a currently selected service.

The failure modes if a locator is used which cannot be reached without tuning are defined as follows;

- For a JMF player which is a `ServiceMediaHandler`, the failure modes are fully specified in the description of `MediaSelectControl`.
- If a JMF player which is not a `ServiceMediaHandler` is created with such a locator then it shall not be able to enter the `Realized` state.

  The `Realizing` state shall be exited with the posting of a `ResourceUnavailableEvent`.
- For JMF players which are not `ServiceMediaHandlers`, `MediaSelectControl` shall be restricted to operating only on service components belonging to transport streams currently available without tuning.

NOTE: In this version of the present document, no media types are defined for which `javax.media.Player.addController` can have any other behaviour apart from throwing a `IncompatibleTimeBaseException`.

11.4.2.7 Intersection Between MediaSelectControl and SubtitlingLanguageControl / AudioLanguageControl

The method `org.davic.media.LanguageControl.listAvailableLanguages()` shall list all available languages in the service concerned. This includes languages carried in service components which are not currently selected, either because the service component concerned has been de-selected using `MediaSelectControl` or because it was never selected initially because it was not carried in one of the components listed in the component tags of a locator which included component tags.

The method `org.davic.media.LanguageControl.selectLanguage()` shall over-ride any selection of service components made either by `javax.tv.media.MediaSelectControl` or by using a locator for a service which included component tags. If `selectLanguage()` has changed the set of service components selected, the methods on `javax.tv.media.MediaSelectControl` shall behave as if that change had been made through `MediaSelectControl` and return the correct set of service components taking into account the change made by `selectLanguage()`.

If the methods on `javax.tv.media.MediaSelectControl` are used to replace or remove the service component carrying the currently active audio or subtitles then the presentation of this service component shall stop. If the methods on `javax.media.MediaSelectControl` are used to add a service component carrying audio or subtitles when a service component of this media type is not already being presented then presentation of this service component shall be started. The language of the newly selected service component shall be returned by calls from the application to the method `getCurrentLanguage` on `AudioLanguageControl` or `SubtitlingLanguageControl` respectively. Attempting to select multiple service components of the same media type to be presented at the same time using methods on `MediaSelectControl` shall fail unless the MHP terminal concerned has sufficient resources to present them simultaneously. The failure mode shall be that as specified in `MediaSelectControl` for when insufficient resources are available.

Control of the availability of subtitles using `MediaSelectControl` or the methods `selectLanguage` and `selectDefaultLanguage` (which `SubtitlingLanguageControl` inherits from `LanguageControl`) shall not impact the value of "Application Control" as mentioned in figure 39 "Determining subtitling language and presentation setting" on page 389 and vice versa.

11.4.2.8 Intersection between Streamed Media API and TV User Interface API

11.4.2.8.1 Basic Principles

The receiver's output picture shape and/or WSS signalling is normally derived from the configuration of the `HVideoDevice` and the decoder format conversion being applied, as in "TV behaviour control". When an application has the `HGraphicsDevice` reserved, the picture shape and/or WSS signalling shall be derived solely from the output aspect ratio of the `HGraphicsDevice`.

Some of the decoder format controls pre-defined as part of `org.dvb.media.VideoFormatControl` may require control over the pixel aspect ratio of the final video output signal after video, graphics and backgrounds have been combined as shown in figure 22. In order to enable this, a JMF player shall attempt to reserve the `HVideoDevice` instance on which its output is being displayed. Failure to reserve or appropriately configure the `HVideoDevice` shall not be considered fatal to the JMF player but may result in an inferior TV video presentation.

NOTE: The actual configurations of the `HVideoDevice` used and available are dependent on the precise configuration of the MHP terminal. Differences will exist between set-top boxes, integrated digital TVs and PCs. The precise nature of any "inferior TV video presentation" is dependent on the configuration of the MHP terminal, on the input video and the characteristics of the final output device. Typically, the result will be distorted, cropped or scaled video.

Component-based Players shall not have an associated `HVideoDevice`. Therefore the `HVideoComponent.getVideoDevice()` method shall always return null.

11.4.2.8.2 TV Behaviour Control

The "TV Behaviour Control" in figure 36 "Format control in the presence of a JMF player" on page 387, is the default video transformation behaviour for JMF players which have none other set. Setting the `VideoTransformation` to `DFC_PLATFORM` shall set the video format control to TV behaviour control mode.

NOTE 1: In this mode, any changes in the video input signal where "television behaviour control" requires changing the pixel aspect ratio of the final output signal (i.e. after the combination of video with graphics, subtitles and backgrounds) will also change the pixel aspect ratio of any graphics, subtitles and backgrounds combined into that one final output signal, assuming the JMF player has successfully reserved the `HVideoDevice` and can configure it appropriately.

NOTE 2: For an example of "TV behaviour control" in set-top boxes and integrated digital TVs, see E-Book.

NOTE 3: Where the JMF player is unable to change the configuration of the `HVideoDevice`, "TV behaviour control" shall take into account the active `HVideoConfiguration` when determining the decoder format conversion to apply. This situation may occur if another application has reserved the `HVideoDevice` or if an application has set a conflicting configuration on another `HScreenDevice` of the `HScreen`.

11.4.2.8.3 Application Behaviour Control

When an MHP application is controlling video presentation through `BackgroundVideoPresentationControl` (for video in the background) or `VideoPresentationControl` and methods on `java.awt.Component` (for video in a component), the application is responsible for monitoring the incoming video format and changing the video presentation if desired.

Instances of `VideoTransformation` constructed using the constructor of that class shall not impact the configuration of the `HVideoDevice`. Instances of `VideoTransformation` returned by `VideoFormatControl.getVideoTransformation` shall have the same impact on the `HVideoDevice` as the equivalent conversion applied in "TV behaviour control mode". These may not be fully achievable if the JMF player does not have the `HVideoDevice` reserved or if an application has set a conflicting configuration on another `HScreenDevice` of the `HScreen`.

11.4.2.8.4 Dynamic Behaviour

A JMF player shall attempt to reserve the `HVideoDevice` instance on entry to the `Prefetched` state from any state except the `Started` state. A JMF player in the prefetched or started states which does not have the `HVideoDevice` reserved shall attempt to reserve it only when the application which created the JMF player calls the `setVideoTransformation` method of the control `org.dvb.media.BackgroundVideoPresentationControl`. A JMF player leaving the `Started` or `Prefetched` state for the `Realized` state shall release the `HVideoDevice` if it has it reserved.

A JMF player which has the `HVideoDevice` reserved and then loses the right to control that device shall post an instance of the event `org.davic.media.ResourceWithdrawnEvent` to all registered listeners for `ControllerEvents` on that `Player` instance. If the right to control that device is subsequently recovered when a attempt to reserve the device (as defined above) succeeds, then an `org.davic.media.ResourceReturnedEvent` shall be posted.

11.4.2.8.5 Resource Management Details

Inter-operable applications shall not call any of the methods on the instance of `ResourceClient` returned by `HVideoDevice.getClient` when a JMF player has reserved that `HVideoDevice` instance.

Inter-operable applications are allowed to call `HVideoDevice.releaseDevice` or `HVideoDevice.setConfiguration` directly. MHP terminals shall continue to present video on a best effort basis within the constraints imposed by the new video configuration.

11.5 Data Access APIs

11.5.1 Broadcast Transport Protocol Access API

The broadcast transport protocol access API is defined in P "(normative): Broadcast Transport Protocol Access" on page 746.

Relative file names used to access objects in the carousel shall be taken as being relative to the base directory indicated in clause 10.9.2 "DVB-J application location descriptor" on page 244. Calling `new DSMCCObject(".")` or `new java.io.File(".")` will instantiate the directory object that refers to the base directory as indicated in clause 10.9.2 "DVB-J application location descriptor" on page 244.

The caching rules specified in clause B.5 "Caching" on page 510 shall be evaluated at the time when the information is loaded using `DSMCCObject.synchronousLoad()` or `DSMCCObject.asyncronousLoad()` or is loaded implicitly in response to other actions as defined in the following clause (11.5.1.1). After the DVB-J object has been loaded, any possible changes in the object carousel to the content the object represents are not visible to the application when it accesses the content using this DVB-J object instance.

11.5.1.1 Constraints on the java.io.File methods for broadcast carousels

The application shall be able to use the standard java.io.File class for access to broadcast carousels (e.g. a carousel unaware application). In this case, the following definitions shall apply:

- The constructor of File only creates an instance of the abstract pathname and shall not cause synchronous access to the broadcast carousel that would block the thread.
- After the constructor of the DVB-J File object has been run, the directory entry information relating to this object may be in an unloaded state. The information relating to this object (e.g. its length) comes from the parent directory which is not required to have been loaded at this point by the constructor. However, this information may be available if the implementation has the information in cache.
- If the directory entry information for a DVB-J File object is in the unloaded state, then this information shall be synchronously loaded when any of the following methods are called on the object: `canRead()`, `exists()`, `isDirectory()`, `isFile()`. If the loading fails, all these methods shall return false.
- If the content is in unloaded state, it shall be synchronously loaded when the list() method is called for a directory. If this implicit load should result in a service transfer, it shall not be done implicitly and the list() shall return an empty list.
- The method lastModified() returns moduleVersion from the DII for the module that carries the file (treating the octet as an unsigned integer).
- Any version changes in a file after the constructor for an `FileInputStream`, `FileReader` or `RandomAccessFile` is called or an `InputStream` referring to a file is obtained through other means (e.g. via `javax.microedition.io.InputConnection`) will not be visible in the data read from that instance.
- The creation of a `FileInputStream`, `FileReader` or `RandomAccessFile` shall throw `FileNotFoundException` if the referenced object is not a file.
- Failure of a signed file to be authenticated shall be reported as defined in clause 12.6.1 "General principles" on page 330.
- Failure of a signed directory to be authenticated shall be reported by the list methods returning null when called on a file object representing the directory whose authentication failed.
- The value returned by `java.io.File.length()` may not be accurate as it returns the value from the directory information rather than the actual size of the file.

There are no guarantees that the most recent version of a file will be returned unless the network signalling specifies that the file concerned requires transparent access.

NOTE: Although jar files may be accessed, using them extensively is not recommended within object carousels. Accessing files contained within a jar file that is contained within an object carousel is likely to be slower than accessing the same file when the jar file is unpacked into an object carousel.

11.5.1.2 Methods dealing with write access

The `java.io.File` class also contains methods that assume write access to the file system. Due to its broadcast nature, the receiver naturally does not have write access to the carousel.

NOTE: A broadcast carousel is not a read-only file system (which has the property of not changing). The carousel content can certainly be written and modified, but only by broadcaster - not the receiver. Therefore, the situation is equivalent to a Unix file system where the user has only read permissions, but not write permissions or ownership of the files.

The following `java.io.File` methods deal with write access to directories: `canWrite()`, `mkdir()`, `mkdirs()`, `renameTo()`.

For abstract pathname entries in the broadcast carousel, the following behaviour shall apply:

- canWrite() returns false to indicate that the file can not be written to.
- mkdir(), mkdirs() and renameTo() return false to indicate that the request failed.

11.5.1.3 Behaviour following loss of a broadcast carousel

When a broadcast carousel is lost to an application as described in clause 6.2.5.3 "Loss of Carousel Behaviour" on page 61, the following failure modes shall be followed for data which is unavailable.

- Attempting to load data from a file using a content format specific API shall fail as if the file itself never existed. This shall be done according to the specific API concerned.
- The classloader created by the platform when the application was first launched never attempts to automatically recover following loss of its initial broadcast file system.
- Attempting to load a class which is unavailable shall fail as if the class was never present.
- After the constructor for an `InputStream` has been successfully called, the data for that `InputStream` shall be maintained by the platform until the `InputStream` is closed. This is the same behaviour as specified for `InputStream` and file version changes in clause 11.5.1.1 "Constraints on the java.io.File methods for broadcast carousels" on page 279.
- Attempting to create a `FileInputStream` for a file whose data is unavailable shall fail with a `FileNotFoundException`.
- Attempting to create a `RandomAccessFile` for a file whose data is unavailable shall fail with an `IOException`.
- Attempting to use a `FileDescriptor` of a `FileInputStream` whose data is unavailable shall result in a FileInputStream or InputStreamReader where all methods shall throw an `IOException`.
- Attempting to call methods on a `File` object where the filesystem information needed for the method call (see clause 11.5.1.1) is unavailable shall fail in the same way as if the `File` itself never existed.
- Operations ongoing at the time of loss of broadcast carousel shall be terminated. Blocked Java I/O operations shall throw `InterruptedIOException`.

11.5.2 Support for Multicast IP over the Broadcast Channel

Where support for carriage of multicast IP over the broadcast channel (see clause 6.2.6) is included, the following shall apply;

a) Void.

b) In `java.net.MulticastSocket`, the `send` method shall throw an `IOException` when called on sockets bound to unidirectional sources of IP multicast data.

c) In `java.net.DatagramSocket`, the `send` method shall throw an `IOException` when called on sockets bound to unidirectional sources of IP multicast data.

d) Void.

e) The class `org.dvb.net.DatagramSocketBufferControl` shall be supported see annex Q "(normative): Datagram Socket Buffer Control" on page 815.

f) Behaviour if unsupported:

When the application tries to joinGroup() on a Multicast address, ProtocolException shall be thrown to indicate failure on joining the group.

11.5.3 Support for IP over the Return Channel

NOTE: Where support for IP over the return channel is not included, APIs in the `java.net` package will fail as defined in the specification of this API. Where support for IP over the return channel is supported, platforms not implementing specific optional return channel protocols shall fail as defined in the specification of this API.

On devices whose return channel can be connected or disconnected, connecting a `java.net.Socket` or a `java.net.URLConnection` to a host addressed via the return channel shall automatically setup a connection to the default connection target subject to the application having return channel permission for the default ISP and the return channel either being not connected or being connected to a different target but with the return channel resource reserved by another application with a lower priority. Such connections shall be automatically disconnected after a period of inactivity on that connection which it should be possible to define using the Navigator. This period shall be returned to applications in the `"dvb.returnchannel.timeout"` system property encoded in seconds as a decimal number.

See clause 11.10 "Java permissions" on page 300.

The class `org.dvb.net.DatagramSocketBufferControl` shall be supported see annex Q "(normative): Datagram Socket Buffer Control" on page 815.

NOTE: Support multicast of IP over the return channel is not required by clause 6.3 "Interaction Channel Protocols" on page 62. On MHP terminals not supporting this, the methods concerned will fail using one of their defined failure modes.

11.5.4 MPEG-2 Section Filter API

The MPEG-2 section filter API is defined in annex E of DAVIC 1.4.1p9 [3].

11.5.5 Mid-Level Communications API

See annex R "(normative): DVB-J Return Channel Connection Management API" on page 818.

On devices whose return channel can be connected or disconnected, when use of `java.net.Socket` or a `java.net.URLConnection` automatically sets up a connection, this shall be reported through this API to any applications listening for it.

Implementations shall automatically drop connections established using this API after the same period of inactivity as defined for automatically setup connections in clause 11.5.3 "Support for IP over the Return Channel" on page 281.

If an application which has reserved a `ConnectionRCInterface` and established a connection then releases the resource without disconnecting, the behaviour of the MHP terminal is implementation dependent.

If there are open sockets using that connection, the MHP terminal should keep the connection established until the time-out period defined in clause 11.5.3 "Support for IP over the Return Channel" on page 281 for automatically setup connections.

NOTE: On MHP terminals not including a return channel, this API must be present but will report that no `RCInterface` instances are visible to any application.

11.5.6 Persistent Storage API

- The API to persistent storage shall be the `javax.microedition.io` package, the `java.io` package and the extensions to it found in the `org.dvb.io.persistent` defined in annex K "(normative): DVB-J persistent storage API" on page 580.
- The `"dvb.persistent.root"` property which can be obtained from `java.lang.System.getProperty()` identifies the directory at the root of the file name space used for persistent storage. This value shall be the same for all applications.
- Accessing any files or directories in the parent directory of this root or directories above that shall throw a SecurityException as defined in the specification for the `java.io` package.
- Signed applications which are authenticated and which are granted the right to access persistent storage have the following privileges:

  - Read only access to the root directory (defined above).

  - Automatic read and write access to an "organization" sub-directory named <organisation_id>.

  - Automatic read and write access to an "application" sub-directory named <organisation_id> + <file.separator> + <application_id>.
- When the permission request file for an application requests access to persistent storage and this is granted, the MHP terminal shall be responsible for creating the necessary directories in which the application is allowed to read/write where these do not already exist. This shall be done shall be done no later than immediately prior to the first access (including existence checks such as `File.isDirectory()`) by that application instance to the directories concerned.

  For applications which are granted file access (see clause 12.6.2.7 "File Access" on page 339), the necessary directories are only its organization and application sub-directories. For applications which are granted a credential, (see clause 12.6.2.6 "Credentials" on page 336), the necessary directories are those defined by any filename elements in that credential up to but not including the first directory containing a wildcard.

  EXAMPLE: A filename element such as

  ```
  org0_id/appA_id/external/-
  ```

  creates

  ```
  org0_id/appA_id/external
  ```

  When the MHP terminal automatically creates an "application" sub-directory as part of the necessary directories defined above, it shall set the owner of the created sub-directory to the application whose name corresponds to that sub-directory and set read and write access to the application whose name corresponds to that sub-directory and no access for other applications. The MHP terminal shall set the owner of any additional automatically created necessary directories that reside below an "application" sub-directory to the application whose name corresponds to that "application" sub-directory and set read and write access to the application whose name corresponds to that "application" sub-directory and no access for other applications.

If at the time when an MHP terminal would create the "application" sub-directory (if it did not exist), that directory already exists but is owned by an application other than the one whose application_id is used as its name, the MHP terminal shall remove this directory and any contents of it and create an empty "application" sub-directory with the owner and access rights set as defined above.

- The owner of the "organization" directory shall be the platform and the directory itself shall always have organization read / write and world read access.
- All files in persistent storage shall store the 48 bit application identifier of their creator as the "owner" of the file. Only the owner of the file is entitled to change the file attributes and file access rights. The owner of a file cannot be changed once a file is created.
- Applications may only create files or directories in directories to which they have write access.
- The existing semantics for the java.io package are respected.
- See clause 14.5 "Text encoding of application identifiers" on page 398. The fields <organisation_id> and <application_id> are hexadecimal text encodings (without leading zeros) of the fields in the 48 bit application identifier of the application concerned as defined in clause 10.5 "Application identification" on page 226.
- All access to persistent storage shall be consistent with the security mechanism defined in clause 12 "Security" on page 316.

NOTE 1: As defined in clause 11.5.1 "Broadcast Transport Protocol Access API" on page 279, relative paths cannot be used to access persistent storage in an inter-operable way. NOTE 2:Unsigned applications have no access to persistent storage. See clause 12.6.2.7.1 "Unsigned applications" on page 339

The contents of a file placed in persistent storage shall persist at least until one of the following conditions occur.

a) There is not enough free persistent storage available to satisfy the persistent storage needs of a running application.

b) The file stored in persistent storage expires.

c) The file is cleared (i.e. deleted) by the creating application or an application with appropriate permissions.

d) The file is cleared as a result of an explicit request by the end user.

e) The persistent storage used by MHP applications exceeds 75 % of the value in table G.7 "Minimum requirements for other resources for conformance purposes" on page 549

NOTE 2: The behaviour of the MHP terminal when any of the above conditions occur is implementation specific except as follows.

Each organisation that has an MHP organisation_id may have one special file in persistent storage. This file is identified by having the name "prefs.bin" and being located in the sub-directory immediately below the root of the persistent file namespace whose name is the organisation_id of the organisation concerned. As long as the special file has a size less than or equal to 2 K bytes, the following shall apply:

a) MHP terminals shall not automatically delete these special files except when persistent storage is full and all files in persistent storage are these special files.

b) MHP terminals that offer the end-user a user interface to manage the contents of persistent storage should present these special files such that they are less likely to be deleted by the end-user than any files that are not special.

The terminal shall give priority to the retention of higher priority files over lower priority files within the scope of a specific(organization ID, application ID) pair. See `org.dvb.io.persistent.FileAttributes` for priorities.

The details regarding the release of cleared (i.e.deleted) or expired files are implementation dependent.

The MHP terminal shall have a means to clear at least the quantity of persistent storage defined in table G.7 "Minimum requirements for other resources for conformance purposes" on page 549. This mechanism shall be usable in conformance tests, and is not subject to the rules above.

Some MHP terminals may allow a file to be opened for writing by only one `FileOutputStream` (or other file-writing object) at a time. In such situations the constructors in `FileOutputStream`, `RandomAccessFile` and `FileWriter` will fail if the file involved is already open. Concurrently running applications writing to the same file(s) in persistent storage cannot rely on this mechanism and will need to co-ordinate access to persistent storage themselves.

11.5.7 File storage device access

11.5.7.1 Basic Specification

The API for access to file storage devices is the `org.ocap.storage` package defined in clause 13.3.7.5 and annex V of OCAP 1.0 [120].

11.5.7.2 DVB specific modifications

The following modifications apply to this specification in the context of the present document:

- The requirement that "Persistent storage device contained within or attached to a Host device SHALL be represented by a StorageProxy" does not apply in the present document. Only detachable and removable devices need be represented in this way.
- The class `MonitorAppPermission` is not defined in the context of the present document. Exceptions stated as being thrown for applications that do not have `MonitorAppPermission` shall always be thrown. Hence, the methods `StorageProxy.deleteVolume` and `StorageProxy.initalize` are not required to be implemented in MHP terminals. It is expected that the initialize feature would be provided by the MHP navigator in MHP terminals supporting access to memory cards.
- MHP persistent file systems are not required to support the extended attributes defined in the class `org.ocap.storage.ExtendedFileAccessPermissions`. The method `org.dvb.io.persistent.FileAttributes.setFileAttributes` shall throw an IOException when called for a file whose file system does not support these extended attributes.

11.6 Service Information and Selection APIs

11.6.1 DVB Service Information API

The DVB specific SI API is defined in annex M "(normative): SI Access API" on page 602.

11.6.2 Service Selection API

The service selection API is defined by the `javax.tv.service.selection` package from Java TV [51] and the `org.dvb.service.selection` package defined in Annex AK.

All instances of `ServiceContext` returned by the MHP terminal shall be instances of `DvbServiceContext`.

On the first occasion when a the JMF player is obtained for a specific service (either by ServiceContext.getServiceContentHandlers or HVideoDevice.getVideoController), any JMF players returned shall always be in the started state If they are presenting video, that video shall always be presenting on the background video device unless all of the following apply;

- the previous service presented in that service context contained video
- that video was presented in a Component (i.e. the ServiceMediaHandler presenting it was a component based player)
- the component continues to be displayed after the completion of the selection of the current service in the service context

If all of these conditions are met then the video of the new service shall be displayed in the same Component as the video of the previous service and the JMF player used shall be a component based player.

Applications shall re-acquire the list of service content handlers after a service selection completes. It is implementation dependent whether any previous handlers are re-used. JMF players which are not re-used are stopped and may be disposed by the platform. Where a JMF player is re-used, it shall be reset to a default condition as if it was not being reused. In particular the implementation shall cancel all listeners previously defined and reset previously defined characteristics such as audio language. If the video is presented in a background video device and no default video transformation is set for the service context then video scaling and positioning shall be reset.

The exception `javax.tv.services.selection.ServiceContextException` shall never be thrown by MHP terminals.

The default media player behaviour following service selection is defined under clause 11.4.2.3 "Default media player behaviour" on page 272.

The protected constructor of `ServiceContextFactory` is for implementation use. MHP applications shall not subclass `ServiceContextFactory`. Implementations are not required to behave correctly if they should do this.

Implementations of this API are required to perform tuning as part of implementing the `ServiceContext.select` methods where the new service to be selected is part of a transport stream known to the MHP terminal but not currently tuned to.

All the MHP applications running within the same service context shall have the ability to obtain and modify the state of the service component handlers for all service components being presented in that `ServiceContext`. For service component handlers which are JMF players, modifying the state includes changes to the settings of JMF controls in addition to the state machine of the JMF player itself.

Applications not running in that service context (e.g. the MHP navigator) shall not be able to modify the state of service component handlers unless they first inform the applications in the service context of this. For service component handlers which are JMF players, this informing shall be done by sending a `org.davic.media.ResourceWithdrawnEvent` to all applications which have currently registered listeners for ControllerEvents on the JMF player whose state will be modified.

Once a `ResourceWithdrawnEvent` has been sent, any changes made by applications inside the service context to the state of service component handlers will be ignored by the MHP terminal. Methods to query state shall return the actual state and methods to change the state shall silently fail. It is implementation dependent whether events related to JMF continue to be sent to applications.

If the application outside the service context ceases to need to make changes to the state of service component handlers, the applications inside the service context shall return to having that right exclusively. The applications inside the service context shall be informed of the return of this right. For service component handlers which are JMF players, this informing shall be done by sending a `org.davic.media.ResourceReturnedEvent` to all applications which have currently registered listeners for `ControllerEvents` on the JMF player which is returned to exclusive control.

Following receipt of a `ResourceReturnedEvent`, the MHP applications running in the service context are responsible for returning the configuration of all service component handlers to what they require. The MHP terminal is not required to automatically restore any configuration of any service component handler to any former value. In the case of a service component handler which is a JMF Player, the configuration is the set of writeable properties accessed through the `Controls` of that `Player`.

NOTE 1: Example properties include video scaling, video positioning and audio language choice.

NOTE 2: One situation where this may occur is where the end-user of the MHP terminal brings up the UI of the navigator, does some operation and then exits the navigator, returning control back to the MHP applications.

NOTE 3: There is no relationship required between the generation of these events and the Xlet state model. MHP terminals may chose to put all MHP applications which are in the Active state into the Paused state when the bring up the UI of the navigator however there is no requirement for this.

A running DVB-J application shall be considered as a component of the service being presented in the `ServiceContext` in which the application is running. It shall have a `ServiceContentHandler` which is intentionally not defined by the present document except that it shall not be a `ServiceMediaHandler`. The results of calling the `getServiceContentLocators` method on this `ServiceContentHandler` are implementation dependent, and there is no requirement for these Locators to be accepted as input by any method in this specification. If the `ServiceContext` in which a DVB-J application is running is stopped, the DVB-J application shall be stopped like all other service components being presented in that service context. `ServiceContentHandlers` for DVB-J applications shall not be shared between DVB-J applications if more than one application is running.

NOTE 4: An Xlet is not a `javax.tv.service.navigation.ServiceComponent`, the elementary stream(s) carrying the object carousel carrying the Xlet shall be represented by at least one of these.

NOTE 5: Services with only DVB-J applications and no media components will have no `ServiceMediaHandlers` but only `ServiceContentHandlers` representing the running DVB-J applications.

NOTE 6: The present document intentionally does not define any circumstances under which `SelectionFailedEvent(MISSING_HANDLER)` is required to be generated.

NOTE 7: Stopping all the components of a service (both media and Xlets) results in a service with no components being presented, the same as if a service with no components had been initially selected.

The following stream types (from `javax.tv.service.navigation.StreamType`) shall be selectable: AUDIO, VIDEO, SUBTITLES. Service components of these types shall have a `ServiceContentHandler` which may be shared between multiple service components of the same or different stream types. It is implementation-dependent whether other stream types are selectable, but failure when selecting a stream type that is not selectable is handled as defined in this specification. The effect of successfully selecting a stream type that is not in the preceding list is implementation-dependent.

If the selected service is a DVB NVOD reference service, MHP terminals shall make an implementation dependent choice from those NVOD time shifted service associated with that reference service and try to select the chosen time shifted service. The algorithm for the implementation dependent choice shall be automatic and not involve the end-user. Any failure shall be reported as specified through this API.

NOTE 8: Applications which wish to chose a specific time shifted service need to explicitly specify that service and not rely on the choice of the receiver.

This API shall support the following features on those MHP terminals which support the feature concerned.

- Internet clients (see clauses 9.7 "Lifecycle of internet access applications" on page 213, 11.14.1 "Internet client control APIs" on page 314).
- Stored services (see clauses 9.6.2 "Stored services" on page 211, 11.12.2.2 "Modified behaviour of MHP 1.0 APIs" on page 312).
- Services signalled over the interaction channel (see clauses 9.6.1 "Applications loaded from the interaction channel" on page 211, 11.11.12 "Support for the HTTP protocol in DVB-J" on page 311).

This API shall support the following features:

- Services whose locator is an instance of the `org.dvb.locator.FrequencyLocator` class.
- Service instances representing PSI-only services.

Service contexts shall not have any hard coded restrictions on the types of service that can be selected in them. For example, a service context which is at one point presenting a broadcast service may not fail to have a stored service selected in it for no other reason than the service to be selected being a stored service.

In the method ServiceContext.select(Locator[]):

- the language applying to Xlets shall apply to all MHP applications regardless of type
- Xlets can be listed using the application locator 14.1.7 "Application locator" on page 394
- any listed locators for applications not signalled as AUTOSTART or PRESENT shall be ignored

Subclasses of `javax.tv.service.selection.PresentationChangedEvent` shall be associated in time with the generation of a MediaPresentedEvent and not the JMF state change event which may have happened some seconds previously.

Re-selecting the currently selected service in a service context shall be as defined in the javax.tv.service.selection package with the additional clarification that running applications whose service_bound_flag is set to 1 shall not be killed and re-started if the Xlet is supposed to be running after the selection operation completes.

Completion of a service selection operation (whether reported via NormalContentEvent, AlternativeContentEvent or SelectionFailedEvent) shall be reported once all ServiceMediaHandler instances are in the started state, without waiting for any xlets to enter the active state.

11.6.3 Tuning API

The tuning API is defined in annex H of DAVIC 1.4.1p9 [3] apart from section H.4, (the `Locator` and `DvbLocator` classes) which are found in clause 11.7.6.

The following methods in this package shall throw `java.lang.SecurityException` where and only where the application does not have a `org.dvb.net.tuning.TunerPermission`:

- `NetworkInterfaceController.reserve.`
- `NetworkInterfaceController.reserveFor.`

The class `org.davic.net.tuning.dvb.DvbNetworkInterfaceSIUtil` is not required.

See also clause 11.8.3 "Additional permissions classes" on page 296.

Tuning automatically performed by other APIs in MHP shall be reported through the tuning API to any applications listening for it.

11.6.4 Conditional Access API

The conditional access API is defined in annex I of DAVIC 1.4.1p9 [3].

The following classes are not supported as defined in clause 11.2.2 - CA1Module, CA0Module, CA1Message, CA0Message, CA1ModuleResponseEvent and CA0ModuleResponseEvent.

Physical CI modules or embedded systems following the CI protocol can produce MMI messages. The API implementation, subject to security model, passes those to be presented by the application if the application is interested. Otherwise CA dialogs are generated.

The following methods in this API shall throw `java.lang.SecurityException` if the calling application does not have a CAPermission as defined in the description of the CAPermission class and shall not throw that exception if the calling application does have such a CAPermission.:-

- `CAModuleManager.addMMIListener.`
- `CAModule.queryEntitlement.`
- `CAModule.listEntitlements.`
- `CAModule.buyEntitlement.`
- `CAModule.openMessageSession.`

The sessionIDs used in CI message passing are unique to a single application and access shall fail if shared between applications.

See also clause 11.8.3 "Additional permissions classes" on page 296.

Host Control tune requests from a CI module cause service selections. Host Control replace / clear_replace has an equivalent effect to using javax.tv.media.MediaSelectControl.

11.6.5 Protocol Independent SI API

The protocol independent SI API is defined by the following packages from Java TV [51]:

- javax.tv.service.
- javax.tv.service.guide.
- javax.tv.service.navigation.
- javax.tv.service.transport.

The mapping of this onto the DVB-SI protocol is specified in annex O "(normative): Integration of the Java TV SI API and DVB SI" on page 738.

Cancellation shall fail if the request is no longer pending. It is implementation dependent if cancellation fails under any other circumstances. Implementations are not required to support cancellation of requests between when the requested SI data has arrived in the device and when execution of the notifySuccess method starts.

The interface javax.tv.service.ServiceMinorNumber is not required to be implemented by any object defined in the present document.

This API shall support the following features on those MHP terminals which support the feature concerned.

- Internet clients (see clauses 9.7 "Lifecycle of internet access applications" on page 213, 11.14.1 "Internet client control APIs" on page 314).
- Stored services (see clauses 9.6.2 "Stored services" on page 211, 11.12.2.2 "Modified behaviour of MHP 1.0 APIs" on page 312).

The method javax.tv.service.SIManager.getService(Locator) shall, if passed an instance of org.dvb.locator.FrequencyLocator or a "dvb:" locator referencing a PSI-only service, return an instance of javax.tv.service.Service representing the service concerned. The service returned shall have the following characteristics:

- the getName method shall return a string of length zero;
- the getServiceType method shall return UNKNOWN;
- the retrieveDetails method shall report notifyFailure with SIRequestFailureType(DATA_UNAVAILABLE).

Such services shall never be returned to an MHP application instance from a call to SIManager.filterServices.

A service of these characteristics shall be returned even if the service referenced by the FrequencyLocator is one in the service list of the receiver for which the name, type and details are known.

For the purposes of SIManager.getService(Locator) throwing an InvalidLocatorException, the FrequencyLocator shall be considered valid if and only if the MHP terminal has a NetworkInterface of the same type (cable/satellite/terrestrial) as the descriptor used to construct the Locator.

11.7 Common Infrastructure APIs

11.7.1 APIs to support DVB-J application lifecycle

This API is formed of the Java classes and interfaces found in the `javax.tv.xlet package` specified in Java TV [51]. In addition, the package `javax.microedition.xlet` contains similar classes. In either case, the `XletContext` passed to the `Xlet` shall implement both `javax.microedition.xlet.XletContext` and `javax.tv.xlet.XletContext`.

MHP terminals shall determine which xlet interface is implemented by the initial class of an application, and use the corresponding application management API. In the case where the initial class of an MHP application implements both `javax.tv.xlet.Xlet` and `javax.microedition.xlet.Xlet`, the MHP terminal shall use the `javax.tv.xlet` application management API.

11.7.1.1 Xlet properties

The following named Xlet properties shall be supported:

- `dvb.org.id`.
- `dvb.app.id`.
- `dvb.caller.parameters`.

They can be retrieved from an Xlet's XletContext by calling `getXletProperty` with the string name defined above.

All keys for `XletContext.getXletProperty` beginning `'dvb.'` are reserved for use in DVB project specifications.

The array of strings returned by `XletContext.getXletProperty(XletContext.ARGS)` shall be the array of strings defined in the DVB-J application descriptor (see clause 10.9.1) in the same order as specified in the signalling. Each entry in the loop of that descriptor shall be presented as one string in the array returned by this method, interpreted using the encoding as specified in clause 10.4.8 "Text encoding in AIT" on page 225. Zero-length strings in the signalling shall be represented as the empty string.

The "dvb.caller.parameters" XletProperty contains the array of Strings that can be passed to applications started via AppProxy. If this application was started by the system or by another application without passing parameters via DVBJProxy (using either the start or init methods), an empty array is returned as the value of this XletProperty.

The "dvb.org.id" and "dvb.app.id" Xlet properties shall be initialised from the application_identifier of the application.

Table 118: Property name / type / encoding mapping

Property Name	getXletProperty return type
dvb.app.id	String encoded as in clause 14.5 "Text encoding of application identifiers" on page 398.
dvb.org.id	String encoded as in clause 14.5 "Text encoding of application identifiers" on page 398.
dvb.caller.parameters	String[], no information to be indicated with an array of length zero.
dvb.installer.parameters	getXletProperty return type String[]

11.7.1.2 Actions for DVB-J applications to perform in their destroy method

Xlets shall perform at least the following in their `Xlet.destroyXlet` method and before calling `XletContext.notifyDestroyed`:

- Cause any threads that they have created to exit voluntarily.
- Stop, deallocate and close any JMF players that they have created.
- Stop and destroy any Java TV service selection ServiceContext objects that they created.
- Release any other scarce resources that they created, e.g. `NetworkInterfaceControllers` if they do any tuning.
- Flush any images using the `Image.flush()` method.
- Xlets shall not cause any unnecessary delay in their `Xlet.destroyXlet` method.
- De-register any event listeners.

If applications do not release these resources then the platform may do it for them.

Regardless of whether an application releases resources or whether the platform does it, the appropriate notifications shall be sent to all other MHP applications which are registered to receive these. For resources which are managed by an API using the `org.davic.resources` package, these notifications are specified by that API. For resources which are related to JMF players which are `ServiceMediaHanders`, if the MHP terminal implementation changes the configuration of these resources (e.g. to tidy-up), this shall be notified as defined in clause 11.6.2 "Service Selection API" on page 284 for "Applications not running in that service context".

NOTE: Applications must allow for tuning happening in parallel with the execution of their `destroyXlet` method. Hence implementations of that method should not rely on being able to load classes while executing as the carousel which the application was using may not be available.

11.7.2 Application discovery and launching APIs

This API is formed of the `org.dvb.application` package defined in annex S "(normative): Application Listing and Launching" on page 846.

The following properties are defined for use with the method `AppAttributes.getProperty`:

Table 119: Application attribute properties

Property name (note)	Return
dvb.j.location.base	Returns String containing base_directory_bytes from DVB-J application location descriptor.
dvb.j.location.cpath.extension	Returns String[] derived from classpath_extension_bytes of DVB-J application location descriptor with each array entry corresponding to a pathname entry as defined for classpath_extension_bytes.
dvb.transport.oc.component.tag	Returns Integer containing the component_tag from the selector bytes of a transport protocol descriptor with protocol_id 0x0001. If more than one transport protocol descriptor with protocol_id 0x0001 is in the AIT for a remote application, it is implementation dependent which of them is returned.
dvb.ait.descriptors	See clause 11.7.8 "Plug-in APIs" on page 294.
dvb.transport.oc.locator	An org.davic.net.Locator that identifies the object carousel. This shall be a Locator that is suitable for the ServiceDomain.attach(Locator) method. This shall be the Locator for the component specified by the "dvb.transport.oc.component.tag" property, in the service identified by getServiceLocator().
NOTE: Property names beginning "dvb." are reserved for future use.	

Where a property is specified as either containing a value from a particular descriptor or being derived from a particular descriptor, the property shall not be returned for applications for which that descriptor is not signalled. Where a property is specified as containing a value from a transport protocol descriptor with a particular protocol_id, the property shall not be returned for applications for which a transport protocol descriptor with that protocol_id is not signalled.

NOTE: The three properties `dvb.j.location.base`, `dvb.j.location.cpath.extension` and `dvb.transport.oc.component.tag`, defined above, are specific to transport via an MHP object carousel. They may not be available if other transport is used in other specifications, e.g. in a GEM terminal specification (see GEM) or a future version of this specification.

The following table defines the source of the information which shall be used for methods returning information from entries in the application database for an application signalled in an AIT. This shall apply to both AITs delivered via MPEG-2 broadcast and ones delivered as an AIT file (see clause 10.4.9 "AIT file" on page 226). This shall also apply to applications running as part of a stored service using information stored at the time when the application itself was stored.

Table 120: Information source for methods on AppAttributes

Method	Information source
getName()	One of the names that can be found in the application name descriptor.
getName(String ISO639code)	A name of the application from the application name descriptor corresponding to the specified language.
getNames()	All of the names for the application which can be found in the application name descriptor and their ISO 639 language code.
getProfiles()	The set of profiles signalled in the application profile field of the application descriptor.
getPriority()	The contents of the application_priority field of the application descriptor.
getVersions(String profile)	The values version.major, version.minor and version.micro for the specified profile from the application descriptor.
getIsServiceBound()	True if the service_bound field in the application descriptor is set to 1. Otherwise false.
isStartable()	There is no information source for this method, the return value is derived as specified in the method description. For the purpose of the method description, remote applications are defined to be those signalled as such in the transport protocol descriptor.
getIdentifier()	The contents of the application_identifier field of the application information section.
getServiceLocator()	An application shall be considered to be transmitted on a remote connection only where the application control code in the signalling is REMOTE. The locator for a remote application shall encapsulate the values found in the selector bytes of the transport protocol descriptor.
getType()	Returns the application_type field from the AIT section in which the application was signalled.
isVisible()	True if the visibility field in the application descriptor is set to 11. False otherwise.

.

Table 121: Information source for methods on AppIcon

Method	Information source
getLocator()	The bytes carried in the application_locator_byte of the application icons descriptor appended to either the base directory of the application (where the application type from the application information section is zero, from the DVB-J application location descriptor) or the physical root (where the application type from the application information section is 1, from the DVB-HTML application location descriptor).
getIconFlags()	The icon_flags field of the application_icon_descriptor.

Applications signalled in an AIT shall be considered to be externally authorized where their only signalling in that AIT is by an External application authorization descriptor.

`CurrentServiceFilter` shall behave as defined in its specification for stored services and services signalled over the interaction channel in addition to broadcast service as defined in its specification.

11.7.3 Inter-Application and Inter-Xlet communication API

This API is formed of the packages `java.rmi` and `javax.microedition.xlet.ixc` as specified in PBP 1.1 [116] plus the package `org.dvb.io.ixc`.

Two named xlet properties are introduced: dvb.org.id and dvb.app.id. They can be retrieved from an xlet's XletContext by calling `getXletProperty("dvb.org.id")` and `getXletProperty("dvb.app.id")`, respectively.

The package `org.dvb.io.ixc` provides an access mechanism for the registry for registering and looking up remote objects for inter-xlet communication. This mechanism implicitly provides the organisation ID and application ID of an object when exported, but requires the caller to provide these values when importing an object. The `org.dvb.io.ixc` registry shall be mapped to the `javax.microedition.xlet.ixc` registry as follows:

Table 122: ixc registry name mapping

Type of access	MHP Registry Name	J2ME Registry Name
GLOBAL scope	name	dvb:/signed/organisation_id/application_id/name
GLOBAL scope	name	dvb:/unsigned/organisation_id/application_id/name
GLOBAL scope	/organisation_id/application_id/name	dvb:/signed/organisation_id/application_id/name
GLOBAL scope	/organisation_id/application_id/name	dvb:/unsigned/organisation_id/application_id/name
SERVICE scope	name	dvb:/service/service_context_id/signed/organisation_id/application_id/name
SERVICE scope	name	dvb:/service/service_context_id/unsigned/organisation_id/application_id/name
SERVICE scope	/organisation_id/application_id/name	dvb:/service/service_context_id/signed/organisation_id/application_id/name
SERVICE scope	/organisation_id/application_id/name	dvb:/service/service_context_id/unsigned/organisation_id/application_id/name

Organisation_id and application_id refer to the organisation_id and application_id of the calling xlet (see clause 10.5.1), and shall be formatted as specified in `org.dvb.io.ixc.IxcRegsitry.lookup()`. In the above table, service_context_id is a unique platform generated opaque name that identifies the service context for the purpose of SERVICE scope inter-xlet communication. The same name shall be used by all applications running in that service context.

The javadoc for the `org.dvb.io.ixc` package is provided in annex Y "(normative): Inter-application and Inter-Xlet communication API" on page 962. An example is provided in clause W.2 "Example of exporting an object for inter-application communication" on page 945.

NOTE: Due to the security policy in clauses 12.6.2.14.1 and 12.6.2.14.2, all xlets can also import and export objects in the PBP registry under the "dvb:/ixc/*" namespace. See clause W.6 for an example of how two xlets can securely verify each others' identities.

11.7.4 Basic MPEG Concepts

This API is formed of the Java classes defined in annex G of DAVIC 1.4.1p9 [3]:

- `ApplicationOrigin`.
- `ElementaryStream`.
- `Service`.
- `TransportStream`.
- `DvbElementaryStream`.
- `DvbService`.
- `DvbTransportStream`.

Methods returning instances of elementary stream. service or transport stream shall return instances of the dvb specific subclass (`DvbElementaryStream` etc.).

11.7.5 Resource Notification

The resource notification API is defined in annex F of DAVIC 1.4.1p9 [3].

- The `notifyRelease()` method shall be called for all `ResourceClients` where the corresponding resource has been removed without the application releasing it. The `release()` method shall be called for specific resources where time to cleanup is of practical use considering the specific resource in question. The only one of these in the present document is connection oriented return channels.
- The `requestData` parameter of the `requestRelease` method shall implement the `java.rmi.Remote` interface. In APIs using the `ResourceProxy` interface, where the method to reserve the resource has a parameter 'requestData', this parameter shall also implement `the java.rmi.Remote` interface or be `null`. Use of other values shall result in `null` being used when `requestRelease()` is called. Implementing the Remote interface does not force java.rmi to be used when the current owner of the resource is in the same application as code requesting ownership.
- The `resourceProxy.getClient()` method shall always return the `ResourceClient` provided to the platform by the application when that instance of a `ResourceProxy` was created or reserved. The `ResourceClient` for the current owner of a resource is only returned when this method is called on the `ResourceProxy` which currently holds the resource concerned.

  This text clarifies the DAVIC javadoc with respect to multiple simultaneous applications. Interpretations of the DAVIC javadoc which are inconsistent with this are excluded.

11.7.6 Content Referencing

This API is formed of the classes found in section H.4 of annex H of DAVIC 1.4.1p9 [3] - the `Locator` and `DvbLocator` classes. It also includes the `javax.tv.locator` package as defined in Java TV [51]. It also includes the `org.dvb.locator.package` defined in Annex AL.

The signature of the `org.davic.net.Locator` class will be extended with:

```
"implements javax.tv.locator.Locator"
```

The `createFactory()` method of `javax.tv.locator.LocatorFactory` shall always return `org.davic.net.Locator(s)` which implement the `javax.tv.locator.Locator` interface when provided with DVB URLs as input (as defined in clause 14.1 "Namespace mapping (DVB Locator)" on page 393).

In the present document, methods whose signature has a return type of `org.davic.net.Locator` or `javax.tv.locator.Locator` shall return an instance of `org.davic.net.dvb.DvbLocator` (or a platform defined subclass of that) where the locator returned can be represented by the DVB locator syntax described in DAVIC 1.4.1p9 [3]. In this case, the DvbLocator returned shall contain the numeric identifiers of a DVB service (see clause 14.9 "Service identification" on page 401).

In `javax.tv.locator.Locator.toExternalForm()`, the canonical form of a DVB locator is defined as follows:

- For instances of `org.davic.net.dvb.DvbNetworkBoundLocator` or `org.dvb.locator.FrequencyLocator`, the syntax of this string is implementation dependent. However, the resulting string shall be sufficient to recreate an equivalent Locator (e.g. using Java TV's `LocatorFactory`) or `MediaLocator` at a later time. The same string shall be valid even if stored by the Xlet (e.g. in persistent storage) and used at a later time.
- For instances of `org.davic.net.dvb.DvbLocator` which are not instances of the above sub-class and reference a service or more detailed parts of a service, this shall be the format defined in the MHP specification. If the optional transport_stream_id was provided when the instance was built, it shall form part of the external form otherwise it shall not.
- For instances of `org.davic.net.dvb.DvbLocator` which are not instances of the above sub-class and reference only a transport stream but not a service, this shall be the format defined in the MHP specification, including the transport stream id.

NOTE: Because optional extensions (e.g. component tag, event id) are part of the external form, they are considered in a comparison thus if they are not equally present in both locators then the comparison will fail.

The protected constructor of `LocatorFactory` is for implementation use. MHP applications shall not subclass `LocatorFactory`. Implementations are not required to behave correctly if they should do this.

11.7.7 Common Error Reporting

This API is formed of the interface and exceptions defined in annex G of DAVIC 1.4.1p9 [3]:

- `NotAuthorizedInterface`.
- `NotAuthorizedException`.
- `ObjectUnavailableException`.
- `ResourceException`.
- `TuningException`.

11.7.8 Plug-in APIs

The plug-in API is defined in annexes AF "(normative): Plug-in APIs" on page 1033 and AE "(normative): Inner Applications" on page 1018 of the present document.

MHP inter-operable plug-ins signalled with the delegated application descriptor (see clause 10.13.3) shall implement the `org.dvb.application.plugins.Plugin` interface. Failure to implement this interface shall result in the plug-in being ignored. Plug-ins which only execute "delegated" applications signalled in the AIT do not need to implement the `javax.tv.xlet.Xlet` interface as part of the initial entry point from the application manager to the plug-in. Plug-ins which can execute both AIT and natively signalled "delegated" applications shall implement both the Plug-in and the Xlet interfaces.

The semantics of the method `org.dvb.application.AppAttributes.getProperty()` are extended such that when it is called with the string "dvb.ait.descriptors", an array of bytes containing the application_descriptors_loop shall be returned.

Each running instance of a plug-in shall execute in a single logical VM instance as defined in clause 11.2.1 "Basic Considerations" on page 261. Hence all delegated application Xlets returned by the initApplication method are all executed in the same logical VM instance. It is the responsibility of the plug-in to ensure the presence or absence of shared context between instances of delegated application Xlets in the same logical VM instance.

11.7.9 Provider API

11.7.9.1 API framework

This is the org.dvb.spi and org.dvb.spi.util packages.

11.7.9.2 SelectionProvider

This is the org.dvb.spi.selection package.

Table 123: Mapping from javax.tv.service.Service to provider APIs

Method	Mapping
getLocator	ServiceReference.getLocator
getName	ServiceDescription.getLongName
getServiceType	ServiceDescription.getServiceType
hasMultipleInstances	Calculated by the receiver, returns true if and only if there are multiple services with the same transport independent locator.
retrieveDetails	SelectionProvider.getServiceDescriptions, either when the Java TV method is called or previously if the results have been cached and are still valid.

Table 124: javax.tv.navigation.ServiceDetails

Service	Mapping
addServiceComponentChangeListener	None needed.
removeServiceComponentChangeListener	
retrieveComponents	Not defined in the present document
getDeliverySystemType	ServiceDescription.getDeliverySystemType
getLongName	ServiceDescription.getLongName
getProgramSchedule	No mapping defined in the present document.
getService	Indirect – implementation must maintain enough information to lookup the service for a ServiceDetails
getServiceType	ServiceDescription.getServiceType
retrieveServiceDescription	Same as for DVB-SI in MHP 1.0 – always fails.

11.8 Security

11.8.1 Basic Security

The MHP platform shall always install a `SecurityManager` before starting any DVB-J applications.

In MHP terminals where the `mhp.smartcard.reader` property is known and has the value "SUPPORTED", MHP applications shall be able to use a Provider installed by an MHP application as defined in Annex AJ in those methods in the `java.security` package which have a Provider as an input parameter.

11.8.2 APIs for return channel security

This API is defined in the J2ME Security (JSSE) Optional Package Specification v1.0 which is found in FP 1.1 [121]. It includes the package `javax.microedition.io`.

NOTE: JSSE is optional in PBP 1.1 [116].

Cipher suites listed in table 139 "Profile of cipher suites that implementations are required to support" on page 357 shall have the name found in the "cipher suite" column of that table with "TLS_" replaced by "SSL_". If other cipher suites from TLS RFC 2246 [63] are supported, it is implementation dependent whether their names start with "TLS_" or "SSL_ ".

Also see clause 12.10 "Security on the return channel" on page 357.

In MHP terminals where the `mhp.smartcard.reader` property is known and has the value "SUPPORTED", MHP applications shall be able to use a Provider installed by an MHP application as defined in Annex AJ in both KeyManagerFactory and TrustManagerFactory.

11.8.3 Additional permissions classes

See annex T "(normative): Permissions" on page 884.

11.8.4 General security issues

Unless otherwise specified, sub-classes of `java.security.Permission` are not required to check the input parameters to their constructors. When an MHP platform constructs these, it is responsible for creating them with legal values. The behaviour of an MHP platform if an application creates such an instance with illegal values is intentionally not specified.

11.8.5 Cryptographic API

This API is defined in the J2ME Security (JCE) Optional Package Specification v1.0 part of FP 1.1 [121].

NOTE: The JCE optional package is optional in PBP 1.1 [116].

In MHP terminals where the mhp.smartcard.reader property is known and has the value "SUPPORTED", MHP applications shall be able to use a Provider installed by an MHP application as defined in Annex AJ.

MHP terminals shall include a default provider for the `javax.crypto.Cipher` class as follows:

- In all MHP terminals, the RSA algorithm shall be supported.
- In MHP terminals implementing clause 12.10.2, the algorithms listed in that clause shall additionally be supported.

11.8.6 DVB Extensions for Cryptography

11.8.6.1 Introduction (informative)

The most recent version of "Java2 Standard Edition" includes new APIs providing the ability to use PKCS11 tokens (such as smart cards) in Java applications. These new APIs simplify the way in which Java applications can handle removable smart cards. They are also needed to login into PKCS11 token for non-key related operations such as encryption and decryption.

The present document is based on J2ME Personal Basis Profile (PBP 1.1 [116]) which does not provide these new APIs. For this reason, the following new packages are defined in the present document, see Annex AI.

- org.dvb.security
- org.dvb.auth.callback
- org.dvb.net.ssl
- org.dvb.security.pkcs11

11.8.6.1.1 The org.dvb.security package

This package provides the AuthProvider class which is needed to log into a PKCS11 token for non key related operations. In that case, there is no other way for a java application to send the PIN code.

It also provides the KeyStoreBuilder class to install a callback handler which is called when a PIN code is required to create a KeyStore.

This class is a convenience feature to simplify applications and there is also a method to give a password when a KeyStore is instantiated. Thus it is possible for an application to log into the token for key operations without using a KeyStoreBuilder.

11.8.6.1.2 The org.dvb.auth.callback package

This package is required to support the KeyStoreBuilder mechanism. Applications are responsible for asking the end-user for the PIN code. Applications will request the PIN code by implementing the interface CallbackHandler from this package. This handler will receive a PasswordCallback object when the implementation requires the PIN code.

NOTE: In order to prevent other applications listening in, it is recommended that applications use org.dvb.event to obtain exclusive access to the number keys when asking for the PIN code.

11.8.6.1.3 The org.dvb.net.ssl package

During the SSL handshake, the SSL engine uses TrustManagers to make sure the certificate chain received from the server is trusted. If client authentication is enabled, the SSL engine will use KeyManagers to find a certificate chain and a private key according to the CertificateRequest message from the server. The CertificateRequest message gives a list of acceptable CA for the server.

In J2SE 5.0 the classes TrustManagerFactory and KeyManagerFactory can be initialized with a set of KeyStoreBuilder where keys and certificate material can be found. To have the same functionality in MHP, the classes DVBTrustManagerFactory and DVBKeyManagerFactory have been defined. The method init in these classes is used by applications to provide a set of KeyStoreBuilders to these factory classes.

Without these two classes, applications can only provide the PIN code at the time the KeyManagerFactory is created. Hence if the token is replaced, the existing KeyManagerFactory cannot be used and the application would need to create a new instance to use with the new token.

11.8.6.1.4 The org.dvb.security.pkcs11 package

In J2SE 5.0, the Sun PKCS11 provider is configured via a text configuration file. This file is used, to indicate which PKCS11 slot is associated with the provider. For MHP, it may be useful for an application to select a particular slot (if there are several slots and tokens). The methods getSlotList and getTokenInfo of the class DVBPKCS11Provider can be used to get the list of slots and tokens available. The default slot used will be defined by the java property "dvb.security.pkcs11.defaultSlotId". If an application needs to use another slot, it should call the method DVBPKCS11Provider.setSlotId(int slotId) to change the slot used by the provider. The slot can only be changed when the provider is not logged into the token.

11.8.6.2 Specification

This API is formed of the following package and is defined in Annex AI.

- org.dvb.security
- org.dvb.security.pkcs11
- org.dvb.auth.callback
- org.dvb.net.ssl

Installation of cryptographic service providers shall be supported as defined in Annex AJ.

11.9 Other APIs

11.9.1 Timer Support

This API is formed of the Timer API defined in Java TV [51] in the javax.tv.util package.

Implementations are required to meet the following specifications:

- Minimum repeat interval less than or equal to 40 ms.
- Granularity less than or equal to 10ms.

The only condition defined in the present document where `TVTimer.scheduleTimerSpec` may throw `TVTimerScheduleFailedException` is if the MHP terminal is unable to provide any more timers. See table G.6 "Minimum requirements for other resources" on page 549.

11.9.2 User Settings and Preferences API

This API is defined in annex L.

The preferences listed below shall be accessible to all applications.

- User Language.
- Parental Rating.
- Country Code.
- Default Font Size.

Other preferences shall only be accessible where a `UserPreferencePermission` for "read" has been granted (see clause 11.10.2.8 "org.dvb.user.UserPreferencePermission" on page 303).

11.9.3 Profile and version properties

Applications can discover the supported profile and the version of the profile (and thus, what functionality is supported) by retrieving profile and version properties. If a particular profile is not supported then the related version properties shall return null.

More specifically, the properties listed in table 125 shall be included in the property set of the `java.lang.System` class. Thus these properties can be retrieved using `java.lang.System.getProperty()`. Since this API returns a string, numeric return values shall be encoded as defined by `java.lang.Integer.toString(int)`.

Table 125: System properties for profile and version interrogation (Sheet 1 of 2)

Property	Semantics	Possible values	Example
mhp.profile.enhanced_broadcast	Indicates whether the enhanced broadcast profile is supported	"YES"	"YES"
mhp.profile.interactive_broadcast	Indicates whether the interactive broadcast profile is supported	"YES", null	null
mhp.profile.internet_access	Indicates whether the internet access profile is supported	"YES", null	null
mhp.eb.version.major	Major version number of the supported enhanced broadcast profile	Non-negative integer value	"1"
mhp.eb.version.minor	Minor version number of the supported enhanced broadcast profile	Non-negative integer value	"0"
mhp.eb.version.micro	Micro version number of the supported enhanced broadcast profile	Non-negative integer value	"0"
mhp.ib.version.major	Major version number of the supported interactive broadcast profile	Non-negative integer value	"1"
mhp.ib.version.minor	Minor version number of the supported interactive broadcast profile	Non-negative integer value	"0"

Table 125: System properties for profile and version interrogation (Sheet 2 of 2)

Property	Semantics	Possible values	Example
mhp.ib.version.micro	Micro version number of the supported interactive broadcast profile	Non-negative integer value	"0"
mhp.ia.version.major	Major version number of the supported internet access profile	Non-negative integer value	"1"
mhp.ia.version.minor	Minor version number of the supported internet access profile	Non-negative integer value	"0"
mhp.ia.version.micro	Micro version number of the supported internet access profile	Non-negative integer value	"0"
NOTE: In previous versions of the present document, "NO" might be returned instead of null for profiles which are not supported.			

The properties for querying the version of a profile which is not supported by the MHP terminal shall not be supported. Hence, calling `System.getProperty()` for these properties shall return null.

11.9.3.1 Information on options

Clause 15 "Detailed platform profile definitions" on page 404 defines what is mandatory and optional for each profile. In order to give an application information about which options a particular MHP implementation supports, a property string is defined for each option (with the same granularity as in clause 15).

An MHP implementation supports an option if and only if the corresponding property is known and its value is "SUPPORTED". The properties are part of the property set of the java.lang.System class.

The general syntax of the properties that indicate whether a certain feature is supported or not is:

```
mhp.option.<the optional feature>.
```

The table 126 lists the currently defined options.

Table 126: System properties for optional feature interrogation

Option	Property
IP Multicast over Broadcast Channel	mhp.option.ip.multicast
HTTP 1.1 over the interaction channel	mhp.option.http.1.1
DSMCC user-to-user over the interaction channel	mhp.option.dsmcc.uu
DVB-HTML	mhp.option.dvb.html
Does this MHP receiver have a smart card reader accessible to applications through the smart card reader API?	mhp.smartcard.reader
Memory for stored services (see clause 9.6.2 "Stored services" on page 211) is greater than zero. (note)	mhp.stored.services
Memory card access (see clause 11.5.7)	mhp.option.memory.card
OpenType (see clauses 7.4.2 and 11.4.1.5.2)	mhp.option.opentype
High Definition (see clauses 7.2.2 and G.1.1.3 "High definition" on page 543)	mhp.option.highdef
Buffered animation (see org.dvb.ui.BufferedAnimation)	mhp.option.buffered.animation
NOTE 1: The available memory may be insufficient to store a particular application and hence requests to add applications to stored services may fail even though this property is both known and "SUPPORTED".	

11.9.4 Non-CA smart card API

The API for access to non-conditional smart cards shall be comprised of the following:

- the "SATSA-APDU" optional package defined by SATSA [106]
- the class `javax.microedition.apdu.APDUPermission` defined in clause B.1.2.1 of that document.
- the org.dvb.smartcard package defined in Annex AM "(normative): Smart card reader API" on page 1151.

NOTE 1: For MHP terminals without a non-CA smart card reader, the failure mode is defined by SATSA [106].

The present document does not require support for U(SAT).

NOTE 2: SATSA's Generic Connection Framework calls for opening a Connection to a Java Application, identified by an ID (the AID). At the time of this writing, many of the smart cards of interest are standards based but are not Java cards. Although an Application ID could be set on these cards, it is not mandatory and rarely available.

NOTE 3: Any method call of the form Connector.open("apdu...;target=a0.00...") issued against such cards returns a ConnectionNotFound exception. This is because the card has neither an AID set nor is a Java Card with such application listening.

NOTE 4: Any method call of the form Connector.open("apdu...;target=SAT") may also fail as this is normally used on (U)SIM as defined per SIM Application Toolkit mode.

In order to open the APDUConnection with this kind of smartcards, the method openDefaultConnection() in org.dvb.smartcard.SmartCardReader must be used.

In these APDUConnection instances, the Application Selection (SELECT FILE by DF NAME) and MANAGE CHANNEL commands are allowed.

NOTE 5: To open the APDUConnection when the smart card contains AID or it is a (U)SIM, the GCF method can still be used. In this case, Application Selection (SELECT FILE by DF NAME) and MANAGE CHANNEL commands are not allowed.

11.9.5 XML parsing API

The XML parsing API is defined in clause 2, "JAXP Subset", of JSR-172 [117].

11.10 Java permissions

This clause explains how the permissions that are defined to be included in the sandbox that is available to unsigned applications and the permissions that can be requested in the permission request file are mapped to the Permission objects in the Java platform.

11.10.1 Permissions for unsigned applications

The MHP security policy includes a set of resources that are always guaranteed to be granted to applications, if the application is executed. Unsigned applications have access to only these resources.

This clause defines the mapping of those resources to the Java Permission objects.

11.10.1.1 java.awt.AWTPermission

This control access to sensitive parts of AWT which is not needed for MHP applications. This shall be denied for both unsigned and signed applications.

11.10.1.2 java.net.SocketPermission:

Because access to return channel is not within the sandbox, this is not required for unsigned applications.

11.10.1.3 java.util.PropertyPermission

For unsigned applications, a read permission shall be granted for all properties defined in the present document except for those explicitly identified as only available for signed applications. The permission shall be denied for the action string "write".

A read permission may also be granted for other properties except for those explicitly identified as only available for signed applications.

11.10.1.4 java.lang.RuntimePermission

This permission shall be denied for both unsigned and signed applications.

11.10.1.5 java.io.SerializablePermission

This permission shall be denied for both unsigned and signed applications.

11.10.1.6 java.io.FilePermission

A read permission shall be granted for the subtree under which the implementation mounts the object carousels.

11.10.1.7 javax.tv.media.MediaSelectPermission

The Media API (i.e. JMF) is within the sandbox, so all applications shall be granted a javax.tv.media.MediaSelectPermission with a locator string "*" that indicates access to all media streams.

11.10.1.8 javax.tv.service.ReadPermission

Access to Service Information is within the sandbox, so all applications shall be granted a javax.tv.service.ReadPermission with a locator string "*"

11.10.1.9 javax.tv.service.selection.ServiceContextPermission

All applications shall be granted a `javax.tv.service.selection.ServiceContextPermission` with a name string `"getServiceContentHandlers"` and action string `"own"`.

`ServiceContextPermission( "access", "own" )` shall be granted to all MHP applications.
`ServiceContextPermission( "access", "*" )` shall not be granted.

11.10.1.10 java.util.Locale.setDefault

This method shall throw a security exception.

11.10.1.11 Applications signalled in AIT file

Applications signalled in an AIT file clause 10.4.9 "AIT file" on page 226 shall have an instance of `SocketPermission` for each combination of host and port number listed in all transport protocol descriptors with the protocol ID value 0x0003 in both their AIT entry and in the "common" descriptor loop. Each permission shall have the "connect" action only.

11.10.1.12 javax.microedition.xlet.ixc.IxcPermission

Unsigned applications shall be granted:

- IxcPermission("dvb:/unsigned/*", "lookup")
- IxcPermission("dvb:/unsigned/organisation_id/application_id/*", "bind")
- IxcPermission("dvb:/ixc/organisation_id/application_id/*", "bind")
- IxcPermission("dvb:/ixc/*", "lookup")
- IxcPermission("dvb:/service/service_context_id/unsigned/*", "lookup")
- IxcPermission("dvb:/service/service_context_id/unsigned/organisation_id/application_id/*", "bind")

Organisation_id and application_id refer to the organisation_id and application_id of the application being granted the permission (see clause 10.5.1 "Encoding" on page 226), and shall be formatted as specified in org.dvb.io.ixc.IxcRegistry.lookup() and service_context_id is the platform generated opaque name of the service context (see 11.7.3 "Inter-Application and Inter-Xlet communication API" on page 292).

11.10.2 Additional Permissions for signed applications

Signed applications can additionally request to get more permissions. These permissions are requested using the permission request file (clause 12.6 "Security policy for applications" on page 330). This clause defines the mapping from the items in the permission request file to the Java Permissions that may be granted by the MHP terminal in response to the request.

11.10.2.1 java.util.PropertyPermission

For signed applications, a read permission shall be granted for all properties for unsigned applications and `dvb.persistent.root`.

11.10.2.2 java.io.FilePermission

A read permission shall be granted for the subtree under which the implementation mounts the object carousels.

The following occurs when the permission request file requests the permission to access persistent storage and this is granted:

1) A `FilePermission` that permits access to the persistent storage directory subtree is created.

NOTE 1: The `FilePermission` created shall comply with the access rights defined in clause 12.6.2.7.2 "Policy for signed applications" on page 339.

2) Where an MHP terminal supports access to memory cards (see clause 11.5.7), the implementation shall create instances of `java.io.FilePermission` allowing access to the locations where the file systems for a memory card will appear in its file system namespace.

When there is a persistent file credential in the permission request file and this is granted, `FilePermissions` are created as follows:

- file path = value of `dvb.persistent.root` property + filename from the credential.
- action = string containing "read" if "read" is indicated in the credential; or string containing "write, delete" if "write" is indicated in the credential".

NOTE 2: A single instance of `FilePermission` is not sufficient to express the limitations on accessing files and directories through credentials required by clause 12.6.2.6 "Credentials" on page 336. Implementations are responsible for enforcing those requirements and cannot rely on a single instance of `FilePermission` to achieve this.

11.10.2.3 org.dvb.net.ca.CAPermission

When the permission request file requests the permission to communicate with a CA system and this is granted, a `CAPermission` is created as follows:

The CA system ID string from the permission request file is directly used as the first part of the string used for the `CApermission` constructor, this is concatenated with a colon character and the list of the attribute strings based on the attributes listed as true in the permission request file.

11.10.2.4 org.dvb.application.AppsControlPermission

When the permission request file requests the permission to have additional permissions to control the lifecycle of applications and this is granted, an `AppsControlPermission` is created.

11.10.2.5 org.dvb.net.rc.RCPermission

When the permission request file requests the permission to communicate through the return channel and this is granted, an `RCPermission` is created as follows:

- for the default ISP item, the `RCPermission` is created with "target:default" string.
- for items with phone numbers in them, the string is "target:" + the phone number prefix in the permission request file + "*".

On `org.dvb.net.rc.ConnectionRCInterface`, the method `getCurrentTarget` shall always throw a `SecurityException`. The method `setTarget` shall throw a security exception where the application doesn't have the permission to use the target specified. The method `setTargetToDefault` shall throw a security exception where the application doesn't have either "target:default" or "target:*" permissions.

11.10.2.6 org.dvb.net.tuning.TunerPermission

When the permission request file requests the permission to access the Tuning API and this is granted, an `TunerPermission` is created.

11.10.2.7 javax.tv.service.selection.SelectPermission

By default a `SelectPermission` is created with a locator "*" and action string "own" and a `ServiceContextPermission` is created with a name "*" and action string "own", unless denied by an entry in the permission request file.

11.10.2.8 org.dvb.user.UserPreferencePermission

When the permission request file requests the permission to read and/or write user preferences and this is granted, a `UserPreferencePermission` is created as follows:

- When the permission request file includes "true" for the "read" attribute and this is granted, a `UserPreferencePermission` is created with the string "read".
- When the permission request file includes "true" for the "write" attribute and this is granted, a `UserPreferencePermission` is created with the string "write".

11.10.2.9 java.net.SocketPermission

When the permission request file requests the permission to communicate with remote hosts and this is granted, `SocketPermissions` are created with the host and action as indicated in the permission request file.

These permissions shall not be granted in MHP terminals where all return channels are represented by instances of `org.dvb.net.rc.ConnectionRCInterface` (i.e. where all return channels are connection oriented) unless an instance of `org.dvb.net.rc.RCPermission` is also granted.

11.10.2.10 org.dvb.media.DripFeedPermission

When the permission request file requests the permission to use the drip feed feature and this is granted, a `DripFeedPermission` shall be created.

11.10.2.11 org.dvb.application.storage.ApplicationStoragePermission

When the permission request file requests the permission to store applications and this is granted, a ApplicationStoragePermission is created. This permission class is defined in annex AG "(normative): Stored application APIs" on page 1045.

11.10.2.12 javax.microedition.apdu.APDUPermission

When the permission request file requests the permission to access the smart card API and this is granted, an instance of `javax.microedition.apdu.APDUPermission` is created with the name "aid".

11.10.2.13 ServiceContextPermission

On MHP terminals supporting the internet access profile, all applications which are granted a SelectPermission (see clause 11.10.2.7 "javax.tv.service.selection.SelectPermission" on page 303) shall be granted instances of `javax.tv.service.Selection.ServiceContextPermission` with names:

- "create";
- "destroy";
- "stop";

all of these to have the actions string "own".

11.10.2.14 javax.microedition.xlet.ixc.IxcPermission

Signed applications shall be granted:

- IxcPermission("dvb:/signed/*", "lookup")
- IxcPermission("dvb:/signed/organisation_id/application_id/*", "bind")
- IxcPermission("dvb:/ixc/organisation_id/application_id/*", "bind")
- IxcPermission("dvb:/ixc/*", "lookup")
- IxcPermission("dvb:/service/service_context_id/signed/*", "lookup")
- IxcPermission("dvb:/service/service_context_id/signed/organisation_id/application_id/*", "bind")

Organisation_id and application_id refer to the organisation_id and application_id of the application being granted the permission (see clause 10.5.1 "Encoding" on page 226), and shall be formatted as specified in org.dvb.io.ixc.IxcRegistry.lookup() and service_context_id is the platform generated opaque name of the service context (see 11.7.3 "Inter-Application and Inter-Xlet communication API" on page 292).

11.10.2.15 org.dvb.spi.ProviderPermission

Where the permission request file requests the right to install providers and this is granted, an instance of ProviderPermission shall be created for the classname listed. If the scope attribute of the request is "application" then the action of the permission shall be "xlet". If the scope attribute of the request is "system" then the action of the permission shall be "system".Permissions with the action "system" shall only be granted to privileged applications.

11.11 Content referencing

The following mapping shall be used between the types of locator defined in table 144 "Addressable entities, locators and their text representation" on page 400 and the DVB-J methods defined in this clause. It lists the Java methods and constructors which accept or return (as defined by their method signature) instances of `org.davic.net.Locator`, `javax.tv.locator.Locator`, `javax.media.MediaLocator` or their sub-classes. The external form of these locators shall be the text representation defined in the table 144 "Addressable entities, locators and their text representation" on page 400 for the corresponding entity being referenced. Where the same method is listed as accepting multiple forms of locator, then it is required to accept all forms listed in this clause.

Where a method listed below is defined (in its specification) to check its input then it shall only accept the forms of locator listed below as being valid for that method from among those defined in the present document. Other forms of locator from among those defined in the present document shall be rejected as specified for the method concerned. If a method does not specify a means of rejecting inappropriate locators then it shall fail silently apart from Exceptions and Events which do not check their input and where it is the responsibility of the platform to use correct locators when constructing them. The present document does not prevent methods accepting other forms of locator which are not defined in the present document.

The clauses below apply equally to locators including and not including the network_id, i.e. for methods accepting a locator including the network_id, the network id shall be matched against the corresponding field in the NIT.

11.11.1 Transport stream

The following methods used in the present document shall accept or return instances of Objects which describe an MPEG transport stream. Methods which accept a locator for a transport stream as an input parameter shall also accept all other DVB locators which include the information to identify a transport stream. If present, service_id, component_tag, event_id and path_segments shall be retained but not used except where there is both a method that accepts such a locator and a query method specified to return that input. In this case the specified semantics of the query method shall be respected.

- `javax.tv.service.transport.TransportStream.getLocator()`.
- `javax.tv.service.transport.TransportStreamCollection.retrieveTransportStream()`

NOTE 1: This requirement holds only if the terminal supports `TransportStreamCollection` objects.

- `org.davic.net.tuning.StreamTable.getTransportStreams()`.
- `org.davic.net.tuning.NetworkInterfaceController.tune()`.
- `org.davic.net.tuning.NetworkInterface.getLocator()`.
- `org.davic.net.tuning.NetworkInterfaceController.reserveFor()`.
- `org.davic.net.tuning.StreamTable.listTransportStreams()`.
- `org.dvb.si.SITransportStream.getDvbLocator()`.

NOTE 2: The numeric identifiers in the locator are matched in the DVB-SI tables as defined in clause 14.1.5 "dvb_entity = dvb_transport_stream" on page 394.

Additionally, `org.davic.net.tuning.NetworkInterface.getLocator()` shall return a DvbNetworkBoundLocator for the network to which the NetworkInterface is connected.

11.11.2 Network

The following methods used in the present document shall accept or return instances of Objects which describe a DVB network.

- `javax.tv.service.transport.NetworkCollection.retrieveNetwork()`.
- `javax.tv.service.transport.Network.getLocator()`.

11.11.3 Bouquet

The following methods used in the present document shall accept or return instances of Objects which describe a DVB bouquet.

- `javax.tv.service.transport.BouquetCollection.retrieveBouquet()`.
- `javax.tv.service.transport.Bouquet.getLocator()`.

11.11.4 Service

11.11.4.1 MPEG/DVB specific service

The following methods used in the present document shall accept or return instances of Objects which describe DVB services and PSI-only services. Methods which accept a locator for a MPEG/DVB service as an input parameter shall also accept all other DVB locators which include the information to identify a service. If present, component_tag, event_id and path_segments shall be retained but not used except where there is both a method that accepts such a locator and a query method specified to return that input. In this case the specified semantics of the query method shall be respected.

- `org.davic.net.ca.CAModule.buyEntitlement()`.
- `org.davic.net.ca.CAModule.queryEntitlement()`.
- `org.dvb.si.SIDatabase.retrieveSIService()`.
- `org.dvb.si.SIDatabase.retrievePMTService()`.
- `org.dvb.dsmcc.DSMCCStream.getStreamLocator` where the method `isMPEGProgram` returns true.
- `org.dvb.dsmcc.ServiceDomain.attach()`.
- `org.dvb.dsmcc.ServiceDomain.getLocator()`.
- `org.dvb.si.PMTService.getDvbLocator()`.
- `org.dvb.si.SIBouquet.getSIServiceLocators()`.
- `org.dvb.si.SIService.getDvbLocator()`.
- `org.davic.net.ca.TuneRequestEvent` - constructor.
- `org.davic.net.ca.TuneRequestEvent.getLocator()`.
- `org.dvb.application.AppAttributes.getServiceLocator()` where the service is a MPEG / DVB service.
- `org.dvb.dsmcc.ServiceXFRReference` - constructor where the service is a MPEG / DVB service.
- `org.dvb.dsmcc.ServiceXFRReference.getLocator()` - where the service is a MPEG / DVB service.

NOTE: The numeric identifiers in the locator are matched in the DVB-SI tables as defined in see clause 14.1.1 "dvb_entity = dvb_service" on page 394.

11.11.4.2 Generic service

The following methods used in the present document shall accept or return instances of Objects which reference generic services. These methods are also required to accept or return the same locators as in the previous clause.

- `javax.tv.service.navigation.LocatorFilter` - constructor.
- `javax.tv.service.navigation.LocatorFilter.getFilterValue()`.
- `javax.tv.service.SIManager.getService()`.
- `javax.tv.service.navigation.ServiceDetails.getLocator()`.
- `javax.tv.service.Service.getLocator()`.
- `javax.tv.service.SIManager.retrieveServiceDetails()`.
- `javax.tv.service.navigation.ServiceList.findService()`.
- `org.dvb.application.AppAttributes.getServiceLocator()` - where the service is not a MPEG / DVB specific one.
- `org.dvb.dsmcc.ServiceXFRReference` - constructor where the service is not a MPEG / DVB specific one.
- `org.dvb.dsmcc.ServiceXFRReference.getLocator()` where the service is not a MPEG / DVB specific one.
- `org.dvb.dsmcc.ServiceXFRException` - constructor.
- `org.davic.media.MediaLocator` -constructor.
- `javax.media.MediaLocator` - constructor.
- `org.dvb.locator.NetworkInterfaceBoundMediaLocator` - constructor.
- `javax.media.Manager.createPlayer(MediaLocator)`.
- `javax.media.Manager.createDataSource(MediaLocator)`.
- Constructor of various JMF events consumes JMF `MediaLocators`:

  `org.dvb.media.CAStopEvent, org.dvb.media.PresentationChangedEvent, org.dvb.media.ServiceRemovedEvent, org.dvb.media.NoComponentSelectedEvent.`
- Various JMF events return JMF `MediaLocators` which were passed into their constructors:

  `org.dvb.media.CAStopEvent, org.dvb.media.PresentationChangedEvent, org.dvb.media.ServiceRemovedEvent,org.dvb.media.NoComponentSelectedEvent.`
- `StoredApplicationService.getLocator` - return value.
- `InternetClient.getServiceContentLocators` - return value.

11.11.4.3 Stored services

The following methods used in this specification shall accept or return instances of Objects which describe a stored service.

- `org.dvb.application.storage.StoredApplicationService.getLocator`
- `javax.tv.service.Service.getLocator` - when the Service is a `StoredApplicationService`

11.11.4.4 Internet client services

The following methods used in this specification shall accept or return instances of Objects which describe a internet client application.

- `org.dvb.internet.InternetClient.getServiceContentLocators`
- `javax.tv.service.Service.getLocator` - when the Service is an `InternetClientService`

11.11.5 DVB event

The following methods used in the present document shall accept or return instances of Objects which describe a DVB event.

- `javax.tv.service.guide.ProgramEvent.getLocator()`.
- `javax.tv.service.SIManager.retrieveProgramEvent()`.
- `org.davic.net.ca.CAModule.buyEntitlement()`.
- `org.davic.net.ca.CAModule.queryEntitlement()`.
- `javax.tv.service.guide.ProgramSchedule.retrieveProgramEvent()`.
- `org.dvb.si.SIEvent.getDvbLocator()`.

11.11.6 MPEG elementary stream

The following methods used in the present document shall accept or return instances of Objects which describe a MPEG elementary stream. Methods below which accept as an input parameter an array of locators shall also accept DVB locators including multiple component tags.

- `javax.tv.net.InterfaceMap.getLocalAddress()`.
- `javax.tv.service.selection.InvalidServiceComponentException` - constructor.
- `javax.tv.media.MediaSelectControl` - all methods accepting or returning instances of javax.tv.locator.Locator.
- `javax.tv.media.MediaSelectEvent` and subclasses - constructor.
- `javax.tv.media.MediaSelectPermission` - constructor.
- `javax.tv.service.selection.ServiceContext.select()`.
- `org.dvb.si.SIDatabase.retrievePMTElementaryStreams()`.
- `org.dvb.si.PMTElementaryStream.getDvbLocator()`.
- `org.dvb.dsmcc.ServiceDomain.attach()`.
- `org.dvb.dsmcc.ServiceDomain.getLocator()`.
- `javax.tv.media.MediaSelectControl.getCurrentSelection()`.
- `javax.tv.service.navigation.ServiceComponent.getLocator()`.
- `javax.tv.media.MediaSelectEvent.getSelection()` (also subclasses).
- `org.davic.net.ca.DescramblingStoppedEvent.getServiceLocator()`.
- `org.davic.net.ca.DescramblingStartedEvent.getServiceLocator()`.
- `org.davic.media.MediaLocator` - constructor - shall also accept multiple component tag "dvb:" locator.
- `org.dvb.locator.NetworkInterfaceBoundMediaLocator` - constructor - shall also accept multiple component tag "dvb:" locator.
- `javax.media.MediaLocator` - constructor - shall also accept multiple component tag "dvb:" locator.
- `javax.media.manager.createPlayer( MediaLocator )` - shall also accept multiple component tag "dvb:" locator.
- `javax.tv.service.selection.InvalidServiceComponentException.getInvalidServiceComponent()`.
- `javax.tv.service.selection.ServiceContentHandler.getServiceContentLocators()`.

NOTE: The numeric identifiers in the locator are matched in the DVB-SI tables as defined in see clause 14.1.2 "dvb_entity = dvb_service_component" on page 394.

Methods which accept a locator or an array of locators for a MPEG elementary stream as an input parameter shall also accept all other DVB locators which include the information to identify a MPEG elementary stream. If present, event_id and path_segments shall be retained but not used except where there is both a method which accepts such a locator as input and a query method specified to return that input. In this case, the specified semantics of the query method shall be respected.

11.11.7 File

The following methods used in the present document shall accept or return locators which reference files.

- `org.davic.media.MediaLocator` -constructor - for audio files intended to be played from memory.
- `javax.media.MediaLocator` - constructor - for audio files intended to be played from memory.
- `javax.media.Manager.createPlayer(MediaLocator)` - for audio files intended to be played from memory.
- `javax.media.Manager.createDataSource(MediaLocator)` - for audio files intended to be played from memory.
- `org.dvb.dsmcc.ServiceDomain.getURL(Locator)` - instances of "dvb:" locator including dvb_abs_path.

Apart from the above, all file references shall be encapsulated in instances of java.net.URL.

11.11.8 Directory

The following method shall return an instance of the "dvb:" locator referencing a directory.

- `org.dvb.application.AppIcon.getLocator()`.

11.11.9 Drip feed decoder

The following methods used in the present document shall accept or return locators which reference the "drip feed" decoder.

- `javax.media.MediaLocator` - constructor.
- `javax.media.Manager.createDataSource(MediaLocator)`.

11.11.10 Methods with no defined requirements

The following methods used in the present document which accept Locators according to their signature have no requirement to have locator types specified for them in the present document:

- javax.tv.service.ReadPermission, all applications shall have this permission with "*", see clause 11.10.1.8 "javax.tv.service.ReadPermission" on page 301.
- javax.tv.service.selection.SelectPermission, applications shall either have this permission with "*" or not to have it at all, see clause 11.10.2.7 "javax.tv.service.selection.SelectPermission" on page 303.

11.11.11 Methods working on many Locator types

The following methods used in the present document work on many locator types. The locator types which each method is required to support are listed for each of the methods concerned.

- javax.tv.locator.LocatorFactory.transformLocator - transforms a transport independent locator into a transport dependent one.

  Required to accept instances of org.davic.net.dvb.DvbLocator.

  Required to return instances of org.davic.net.dvb.DvbNetworkBoundLocator.

- javax.tv.locator.LocatorFactory.createLocator - creates a locator from a string.

  When passed the appropriate text representation, required to return locators for all entities defined to be addressable by Locators in table 144 "Addressable entities, locators and their text representation" on page 400 except for "Drip feed decoder".

NOTE: Where no text representation is defined, a String in the appropriate format can of course be obtained by calling Locator.toExternalForm on a Locator for the appropriate entity.

- javax.tv.service.SIManager.registerInterest - accepts a locator referencing one or more SIElements as input.
- javax.tv.service.SIManager.retrieveSIElement - accepts a locator referencing one or more SIElements as input.

  Both these methods are required to accept locators referencing:-Bouquet, Network, Event, ElementaryStream, Service, TransportStream.
- javax.tv.service.SIElement.getLocator.

  Returns a locator for "this SIElement" as specified by the Java TV specified sub-interfaces, no other SIElements exist.

11.11.12 Support for the HTTP protocol in DVB-J

In MHP terminals where an HTTP protocol (clause 6.3.7.1 "HTTP 1.1" on page 63 or clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63) is supported, the following classes and methods shall support the HTTP protocol concerned. In MHP terminals where the HTTPS protocol (clause 6.3.7.3 "HTTPS" on page 64) is supported, the following class and methods shall support that protocol.

- The constructor for javax.media.MediaLocator - for referencing audio files intended to be played from memory.
- methods on javax.media.Manager accepting javax.media.MediaLocator as input parameters - for constructing JMF players for audio files intended to be played from memory.
- Methods in the present document which accept instances of java.net.URL are required to accept instances which encapsulate an "http" URL and behave according to their specification. - e.g org.havi.ui.HSound.load(java.net.URL).
- On MHP terminals supporting applications downloaded over the interaction channel as defined in clause 9.6 "Services and applications not related to conventional DVB services" on page 211, the method `LocatorFactory.createLocator(String)` shall additionally accept Strings containing URLs using the "http" and "https" protocols as being valid and return a corresponding Locator. This method shall only validate the string to the extent that this is possible without network access.
- On MHP terminals supporting applications downloaded over the interaction channel as defined in clause 9.6 "Services and applications not related to conventional DVB services" on page 211, the method `SIManager.getService(Locator)` shall accept such Locators as being valid and return a corresponding `javax.tv.service.Service`. This method shall only validate the locator to the extent that this is possible without network access.

When HTTP URLs are used with instances of DVBClassLoader to load DVB-J classes over the interaction channel in a signed application, the requirements of the MHP security model shall be complied with before a class is allowed to be successfully loaded from such a URL.

11.11.13 MHP applications

The following methods used in the present document shall accept or return instances of Locators which identify an MHP application:

- javax.tv.service.selection.ServiceContext.select(Locator [])

11.12 Stand-alone applications

11.12.1 Common behaviour

The extended MHP application model allows several forms of applications to execute in a stand-alone mode independent of any broadcast services. The environment of these stand-alone applications shall be as follows:

- Instances of `org.dvb.si.SIDatabase` may not return any SI objects if the corresponding network interface isn't tuned to anything. It is implementation dependent whether some network interfaces are left tuned to some previously used transport stream.

For DVB-J applications, the behaviour defined in clause 9.6.4 "Common behaviour" on page 213 shall mean the following:

- The method `ServiceContext.getServiceContentHandlers` shall not return a `ServiceContentHandler` for any such existing video or audio for a stand-alone stored application.
- A stand-alone application creating and starting a JMF player shall receive a higher priority for resources than the presentation of any previously existing video and audio.

11.12.2 Stored services

The MHP specification supports two forms of stored applications as defined in clause 9.1.9 "Cached applications" on page 193 and clause 9.6.2 "Stored services" on page 211.

11.12.2.1 Stored application APIs

This is defined in annex AG "(normative): Stored application APIs" on page 1045 of the present document.

11.12.2.2 Modified behaviour of MHP 1.0 APIs

The following APIs defined in MHP 1.0 shall have extended semantics to support listing and launching of stored services as defined in clause 9.6.2 "Stored services" on page 211. The modifications to these APIs are as follows:-

- The class javax.tv.service.navigation.ServiceTypeFilter when used with a ServiceType "`org.dvb.application.StoredApplicationServiceType.STORED_APPLICATION_SERVICE`' shall return a `ServiceList` containing all currently installed stored services when passed to SIManager.`filterServices`.

NOTE: Implementations may choose to expose other installed services (e.g. manufacturer resident ones) through this API.

- Instances of `javax.tv.service.Service` returned from such a `ServiceList` shall be instances of `org.dvb.application.StoredApplicationService` with the modified semantics as defined for that interface.
- The method `ServiceContext.select(Service selection)` shall accept instances of `org.dvb.application.StoredApplicationService` and attempt to start the stored application service concerned subject to the MHP security model.
- Attempting to select a stored application service which contains no autostart applications shall fail with a `SelectionFailedEvent` with reason code `CONTENT_NOT_FOUND`.
- The file system APIs shall see a file system comprised of the files defined in the application description file as needing to be stored for this application. Calling new `DSMCCObject(".")` or new `java.io.File(".")` shall instantiate the directory object that refers to the outermost (top level) directory listed in the application description file (see clause 10.14.3 "Application description file" on page 257) when the application was stored. Other file system behaviour shall be as defined in clause 9.6.2 "Stored services" on page 211.
- The `org.dvb.dsmcc.DSMCCObject` class shall work for access to files within a stored application. The methods with modified semantics in these circumstances are as follows:

  `abort()` - shall always throw a `NothingToAbortException`.

`asynchronousLoad(AsynchronousLoadingEventListener)` - if the file exists, succeeds immediately (with `SuccessEvent` being generated) otherwise fails with `InvalidPathNameException`.

`isObjectKindKnown()` - always returns true.

`isStream()` - always returns false.

`isStreamEvent()` - always returns false.

`loadDirectoryEntry(AsynchronousLoadingEventListener)` - always succeeds immediately with `SuccessEvent` being generated.

`prefetch(both signatures)` - always returns false.

`setRetrievalMode(int)` - silently ignored.

`synchronousLoad()` - if the file exists, succeeds immediately, otherwise fails with `InvalidPathnameException`.

Additionally:

- `ObjectChangeEvents` shall not be generated.
- The `unload()` method shall not be considered as removing stored files from where they are stored.
- Access to files shall not fail for reasons of a service domain not being in an attached state, even though a stored filesystem cannot be represented by a DSMCC Service Domain.
- `File.getCanonicalPath()` and `File.getAbsolutePath()` cannot be relied upon to be return the same strings for the broadcast and stored cases.
- Within a single application instance, the absolute paths returned by `java.io.File.getAbsolutePath()` shall be accepted by constructors for `java.io.File` and sub-classes to reference the same underlying file as the one on which `getAbsolutePath()` was called.

11.12.2.3 Permissions

11.12.2.3.1 FilePermission

A read permission shall be granted for the subtree corresponding to the outermost (top level) directory listed in the application description file and recursively all directories below that.

11.13 Support for DVB-HTML

11.13.1 Document object model APIs

11.13.1.1 Framework

The required document object model APIs are defined in the following:

- From Document Object Model (DOM) Level 2 Core Specification [96], that part of annex D, "Java Language Binding" corresponding to the "Fundamental Interfaces" as specified in section 1.2 of that specification.
- From Document Object Model (DOM) Level 2 Events Specification [98], annex B, "Java Language Binding", only those parts corresponding to the interfaces listed as required in clause 8.9.1.1 "Fundamental interfaces" on page 135 and clause 8.9.1.2 "Event interfaces" on page 135.
- From Document Object Model (DOM) Level 2 Views Specification [100], annex B, "Java Language Binding".
- From Document Object Model (DOM) Level 2 Style Specification [99], annex B, "Java Language Binding" the interface org.w3c.dom.css.CSS2Properties is required.

11.13.1.2 DVB defined extensions

The DVB defined DOM extensions are defined in annex AD "(normative): Support for DVB-HTML" on page 999 of the present document see also clause AD.1 "Java bindings to DVB extensions" on page 999.

11.13.1.3 Read Only Access to DOM

Where a DVB-J application only has or requests read-only access to the DOM, calling methods in the DOM APIs whose result would be to modify the DOM shall result in an `org.w3c.dom.DOMException` with exception code `NO_MODIFICATION_ALLOWED_ERR` being thrown.

11.13.2 Embedded Xlets in a DVB-HTML Page

Below is a list of the semantic differences in MHP APIs between DVB-J applications and xlets embedded in a DVB-HTML page of a DVB-HTML application.

- Xlets shall not use the HAVi HScene APIs to get the "primary" Container that is managed by the enclosing DVB-HTML document. The method `javax.tv.graphics.TVContainer.getRootContainer(javax.tv.xlet.XletContext)` or `javax.microedition.xlet.XletContext.getContainer()` shall be used for this purpose. The object returned shall be a subclass of `java.awt.Container` implementing the following interfaces.

  - `org.havi.ui.HComponentOrdering.`

  - `org.dvb.application.inner.DVBScene.`

  It may be an instance of org.havi.ui.HScene or a subclass of that but is not required to be either of these.

- Embedded Xlets are only guaranteed to be able to perform actions using the Document Object Model APIs when they are in the active state. The results of calling methods on `org.dvb.dom.bootstrap.DocumentFactory` when the embedded xlet is in any other state are implementation dependent. They may include a RuntimeException being thrown or the Document passed to `DocumentAction.run()` being null. If the state of an application changes from the active state to another state between when a method on `DocumentFactory` is called and when the `run()` method of the specified `DocumentAction` is called then the results of this are also implementation dependent.

- If the Xlet is in the active state or if the `startXlet` method is executing, and the width and height are > 0, then `getRootContainer()` shall return a valid `Container` instance. If the width or height are ≤ 0, `getRootContainer` shall return `null`. In all other cases, situations and xlet states, the value returned is implementation dependent.

Any "param" elements of the <object> used to define an embedded xlet shall be accessible to the embedded xlet. The sequence of these arguments is mapped to `XletContext.ARGS` and shall be available to the Xlet, in the form of an array of Strings, by calling:

```
javax.tv.xlet.XletContext.getXletProperty(XletContext.ARGS)
```

11.14 Internet access

11.14.1 Internet client control APIs

These are defined in the `org.dvb.internet` package (see annex AH "(normative): Internet client APIs" on page 1077).

Internet clients accessible to MHP applications shall appear in the list of services maintained by the `SIManager` which is returned by calls to the method `SIManager.filterServices`. For each accessible internet client, the corresponding sub-class of `InternetClientService` shall be returned from calls to that method both when passed an instance of `ServiceTypeFilter` constructed with the type `InternetServiceType.INTERNET_CLIENT` and when passed null.

The method `ServiceContext.select(Service selection)` shall accept instances of `InternetClientService` and its sub-classes returned by the mechanism described above as being valid input.

NOTE 1: When a internet client application is selected in the same service context as an MHP application, the mechanism by which that internet client application terminates is implementation dependent. Examples of termination may include the end-user closing the browser (by some mechanism), the

end user selecting a broadcast TV service using the navigator or the end user selecting a broadcast TV service by selecting a link to a "dvb:" URL in a WWW page or email. See also clause 9.7 "Lifecycle of internet access applications" on page 213.

MHP terminals capable of supporting MHP applications and internet client applications simultaneously shall support the creation of a second service context by MHP applications using `ServiceContextFactory.createServiceContext()` in addition to the one used for "normal" MHP applications. This second service context need only support the selection of instances of `InternetClientService`. Selection of other services in this second service context would fail with a `SelectionFailedEvent` with reason code `INSUFFICIENT_RESOURCES`.

NOTE 2: This does not prevent MHP terminals with multiple independent video outputs supporting a service context per video output capable of supporting MHP services however in this case, these service contexts would be created by the MHP navigator.

NOTE 3: Support of multiple service contexts on the same video output each allowing presentation of MHP services is not excluded in the present document but is not fully specified here.

11.14.2 Internet applet support

Internet applet support is defined as follows.

11.14.2.1 HTML tags

Internet applets shall be supported using the "<applet>" and "<object>" tag with the semantics defined in HTML 4 [104].

11.14.2.2 Java Platform

The Java platform for Internet applets shall be PP 1.1 [118].

11.14.2.3 Void

11.14.2.4 Void

11.14.2.5 Security

The present document does not require support for signed applets or for the code signing mechanism and APIs as defined in PP 1.1 [118].

If applets can access Java APIs defined as part of clause 11 "DVB-J Platform" on page 261, apart from those listed in clause 11.14.2 "Internet applet support" on page 315, they shall have the permissions required to be available to unsigned MHP applications. Of the permissions available to signed MHP applications, they shall have only the following:

- `java.util.PropertyPermission` to `"read"` all properties defined for the `java.lang.system.getProperties()` method.
- `java.net.SocketPermission` to `"connect"` to all ports on the server from which the applet was originally downloaded.

12 Security

12.1 Introduction

This clause covers the following areas of security:

- Authentication of applications.
- Security policies for applications.
- Authentication and privacy of the return channel communications.
- Certificate management.

12.1.1 Overview of the security framework for applications

The security framework enables a receiver to authenticate the source of application code or other files. In the case of application code files, the authentication advises the receiver what access rights should be granted to an application for sensitive resources, see clause 12.6 "Security policy for applications" on page 330 for more detail.

The system uses 3 different authentication messages:

- Cryptographic hash codes.

  This provides a summary of a quantity of data - typically a subset of the total set of data under consideration.

- Signatures.

  These deliver a master hash code (computed over all of the appropriate data) that has been "signed" by an authorising organization. The signing process securely associates the master hash code with the signatory. The hash code process shows that the data has not been tampered with since it was signed by the signatory.

- Certificates.

  These provide a "chain of trust" from the authorising organization up to some trusted third party (the root certificate authority) that is well known to the receiver.

The messages are delivered within files of the file system so this authentication scheme is applicable to any hierarchical file system whether operating over the broadcast or return channels.

Applications that are signed shall be identified with an application_id from the signed applications range (see table 77 "Value ranges for application_id" on page 227). Applications that are unsigned shall be identified with an application_id from the unsigned applications range. An application with an application_id from the signed applications range but that is not signed is considered to have failed authentication. An application with an application_id from the unsigned applications range is treated as unsigned even if the files might be transmitted with signatures.

12.1.2 Overview of return channel security

In this version of the specification general purpose protocols and a standard cryptographic suite derived from internet standards are used.

12.2 Authentication of applications

12.2.1 Overview of authentication messages

Three different message types are used: "Hash codes", "Signatures" and "Certificates". Each message is placed in a file. The placement of the files depends on their function and is specified under the appropriate headings under clause 12.4 "Detail of application authentication messages" on page 319.

12.2.1.1 Hash codes

The present document describes application of hash codes to the following types of information:

- Files.
- Directories.

The hash computation considers the content and attributes of the objects rather than transport specific information. As a result, the authentication is independent of the underlying transport protocol.

In the case of a directory the hash value depends on the hash values of the objects bound to it, and so provides a hash of all of the objects to be authenticated in the "tree" below it.

12.2.1.2 Signatures

The data authenticated is a hierarchical file system (for example DSM-CC OC). The root of an authenticated "tree" carries one or more signatures. This allows one or more organizations to sign a set of information.

The root of the authenticated "tree" can be the root directory of the file system or the "top" directory of a "subtree".

The signature:

- References a certificate containing the public key required to decode the signature.
- Identifies the hash algorithm used.
- And the value of the signature.

12.2.1.3 Certificates

The certificate provides a public key that can be used to decode a hash code contained in a signature and so enable a tree/subtree to be verified. The certificate itself is signed by a higher certification authority.

To correctly authenticate a subtree there must be a valid "chain" of certificates from the signature to a root certificate as is illustrated in figure 19.

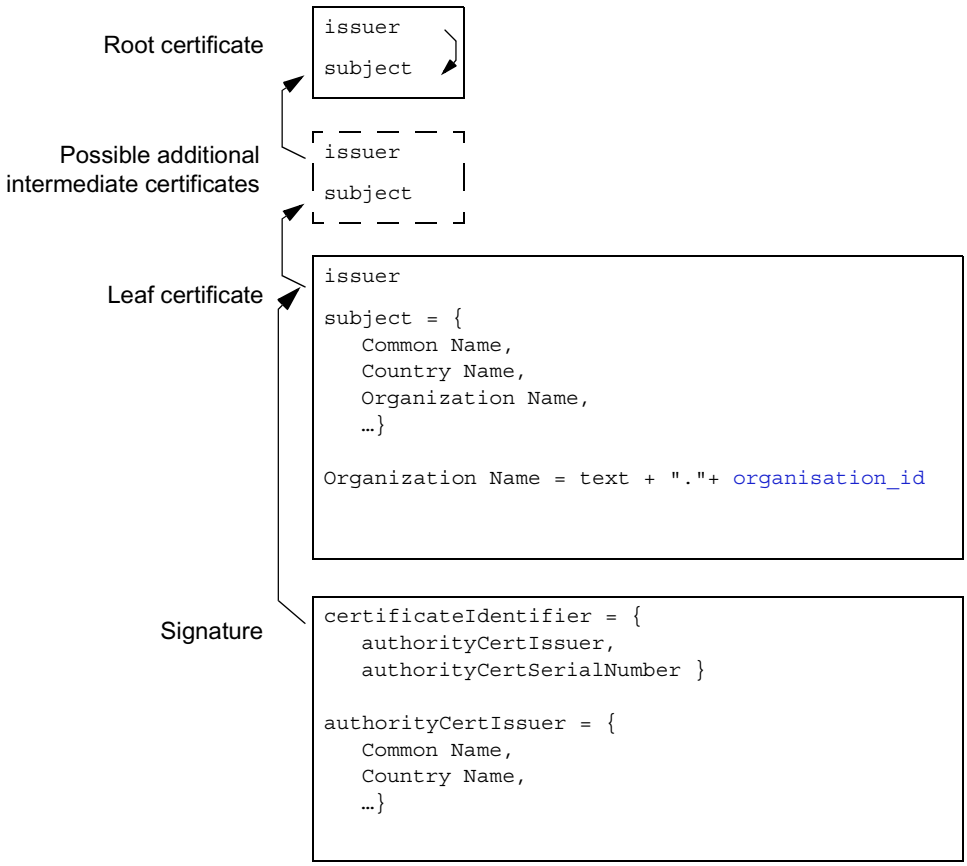


Figure 19: Certificate chain illustrated

12.2.1.4 Authentication of hierarchical file systems

The solution here is based on authentication of a hierarchical structure of objects. Hashcodes are computed systematically and accumulatively across some or all of the objects in the hierarchy. A signature at the top of the hierarchy identifies the source of the objects.

The framework provides a flexible and non-time consuming method enabling the authentication of subtrees of a file system with a single signature. Since checking signature is far more time-consuming than checking hashcode values, this mechanism is more efficient than signing each object of a subtree.

Further, only the objects that are loaded need real-time hashcode checking.

This mechanism does NOT mandate that the whole subtree is authenticated.

NOTE: The broadcaster can choose which files in the file system are authenticated. For example code files might be authenticated and asset files might be left without authentication.

Finally, this framework embraces key distribution by specifying a certificate mechanism, the aim of this is to certify that the key used to compute the signature is valid and used by a certified service provider. See clause 12.8 "MHP certification procedures" on page 350.

12.3 Message transport

The authentication messages are transported in files.

In no cases shall a service transfer be required to access the file content. In the case that the file system is an object carousel this means that the IOR for the authentication message files shall always use a BIOP profile body and never a Lite options profile body.

12.4 Detail of application authentication messages

Three data structures are defined for communicating authentication information:

- HashFile.
- SignatureFile.
- CertificateFile.

These are placed in files in the file system. The location of the file depends on its function.

12.4.1 HashFile

12.4.1.1 Description

The HashFile lists all of the elements of the current directory except itself, and possibly except signature files as described in the following. On transport protocols supporting the listing of files in a directory (e.g. Object Carousel), signature files shall either all be listed with a digest type of non-authenticated or shall all be omitted. On transport protocols not supporting the listing of files in a directory (e.g. HTTP), signature files shall be listed and shall have a digest_type of non-authenticated.Those elements to be authenticated are associated with hashcodes. The syntax of the HashFile is shown in table 127.

Table 127: Syntax of the Hashfile

Syntax	Num. Bits	Format
Hashfile () {		
digest_count	16	uimsbf
for(i=0; i<digest_count; i++) {		
digest_type	8	uimsbf
name_count	16	uimsbf
for(j=0; j<name_count; j++) {		
name_length	8	uimsbf
for(k=0; k<name_length; k++) {		
name_byte	8	bslbf
}		
}		
for(j=0; j<digest_length; j++) {		
digest_byte	8	bslbf
}		
}		
}		
Other data may follow but can be ignored by implementations conforming to this profile.		

digest_count: This 16 bit value identifies the number of digest values in this hash file.

digest_type: This 8 bit value identifies the digest computation rules and the digest algorithm, if any, used for the associated objects. Table 128 lists the allowed values for this field. The digest computation rules are defined in clause 12.4.1.3 "Digest value computation rules" on page 320.

Table 128: Values of digest_type

value	digest len.	algorithm
0	0	Non authenticated
1	16	Digest computation rules without prefix and with MD-5 as defined in RFC 1321 [38]
2	20	Digest computation rules without prefix and with SHA-1 as defined in FIPS-180-1 [62]
3	20	Digest computation rules with prefix and with SHA-1 as defined in FIPS-180-1 [62].
Other values		Reserved for future use

name_count: This 16 bit value identifies the number of object names associated with the digest value. The value of this field shall be greater than zero.

name_length: This 8 bit value identifies the number of bytes in the object name.

name_byte: This 8 bit value holds one byte of the object name.

Each name shall be the name of an object in the directory that contains the HashFile. So, file names are the names of files in the directory and directory names are the names of direct sub-directories of the directory. No path information shall be included in the name.

The names carried by this field are binary identical to the payload part of names in the file system. So, any name matching process can be binary and ignorant of character encoding, letter case etc. Also, terminating null characters are not considered to be part of the file name.

digest_length: This integer value gives the number of bytes in each digest value. It depends upon the digest type as tabulated in table 128. MHP terminals shall support all digest algorithms.

NOTE: Non-authenticated objects have a zero length digest.

digest_byte: This 8 bit value holds one byte of the digest value. See clause 12.4.1.3 "Digest value computation rules" on page 320.

12.4.1.2 HashFile location and naming conventions

An application comprises files containing data that can be spread across various directories and is contained within a subtree of the file hierarchy. A HashFile will be put in each directory containing objects that need to be authenticated.

The name of the HashFile shall be:

```
"dvb.hashfile"
```

There shall only be one instance of HashFile per directory that contains authenticated resources.

See clause 12.7 "Example of creating an application that can be authenticated" on page 347.

12.4.1.3 Digest value computation rules

The digest value is computed over the objects named in the HashFile in the order listed in the HashFile. The length of the list of objects associated with each digest value may be one or more.

Each list of objects may contain an arbitrary mix of different object types (e.g. a mixture of file and directory names). The digest value is computed by first initialising the digest algorithm in an algorithm specific way and then applying the relevant data for each object to the algorithm in order. The relevant data for each object depends on its type (File or Directory) and on the value of digest_type and is specified in table 129.

Table 129: Data required for digest value computation

Object type	Digest type	entry_type	Relevant data
File	1 or 2	not applicable	The entire content of the file
Directory			The content of the HashFile of the named directory
File	3	1	A prefix concatenated with the entire content of the file. The prefix is made of the entry_type encoded as a 32 bit uimsbf and concatenated with the file length in bytes encoded as a 32 bit uimsbf.
Directory		0	A prefix concatenated with the content of the HashFile of the named directory. The prefix is made of the entry_type encoded as a 32 bit uimsbf and concatenated with the file length in bytes encoded as a 32 bit uimsbf.
NOTE: All other values of entry type are reserved for future use			

12.4.1.3.1 Example

Consider two files `file1` and `file2` and one directory `dir1`. Using digest type 3, the digest value of `file1` + `file2` + `dir1` is equal to:

```
SHA-1 ( (uimsbf 32) 1 + (uimsbf 32) FileLength ( file1) + contents of file1
+ (uimsbf 32) 1 + (uimsbf 32) FileLength(file2) + contents of file2
+(uimsbf 32) 0 +(uimsbf 32) FileLength(HashFile(dir1))
+ contents of HashFile(dir1) ).
```

12.4.1.4 Warning concerning grouping of objects under a single digest (Informative)

Broadcasters should be made aware that during the construction of the object carousel, grouping objects under one digest can significantly and adversely affect the performance and memory requirements of an application on a terminal. For example, if 3 objects are grouped under the same digest, implementations must load all 3 objects even if only one is needed.

The present document in general recommends that while setting up a signed application for broadcast, only one digest be associated with each object requiring authentication. Grouping of multiple files under one hash value should only be employed if those files must always be loaded together and simultaneously. Additionally, the rate of change of the contents of an object should be carefully considered because grouping a rapidly changing object with more slowly changing objects for the purposes of hashing will negatively impact performance. When attempting such grouping, the resource limits of the MHP terminal should always be carefully considered.

12.4.1.5 Special authentication rules

a) For objects which are directories, if the digest_type is non-zero there shall be a HashFile in the sub-directory listed. If the HashFile is absent then the authentication fails.

b) Each HashFile shall provide a complete list of all the objects named in the directory except itself and any possible signature files mentioning each name exactly one time. The behaviour varies depending on the ability of the transport protocol to support directory listing.

- On transport protocols supporting the listing of files in a directory (e.g. Object Carousel), the authentication shall fail if the set of objects listed in the HashFile is different to the set of objects in the directory.

- On transport protocols that don't support the listing of files in a directory (e.g. HTTP), the set of names in the HashFile acts as a filter for the set of objects that can be accessed. Attempts to access a file neither named in the HashFile nor the HashFile itself, nor the signature files shall fail (that is behave as if the file is not available). The file system for loading applications from the interaction channel via HTTP is a case of such a file system, see clause 6.4.1.4.

These rules apply regardless of the value of digest_type associated with the object.

c) If the digest_count is equal to 0, the file HashFile shall be ignored. Every entry in the directory will be non authenticated.

d) If a name_length is equal to zero (or if a name is not found in the directory containing the HashFile), all the names associated with the current digest value shall be considered as incorrectly authenticated. It means the authentication checking will fail for these entries.

e) If the object is a Stream or StreamEvent then the digest_type shall be zero.

f) Objects associated with a digest_type that the receiver does not support shall be treated by that receiver as if the value of digest_type was zero (not authenticated).

g) There is no requirement for certificates files to have a digest_type other than zero (not authenticated). However, if they do have a non-zero digest_type they don't receive exceptional treatment.

NOTE: There is no security benefit in including a certificate file with a digest_type other than zero.

h) When a permission request file exists, its entry in the HashFile cannot have a digest type of 0. MHP terminals shall ignore a permission request file with a digest type of 0.

12.4.2 SignatureFile

12.4.2.1 Description

The SignatureFile is a File containing one digital signature. It contains the following ASN.1 DER structure:

```
Signature  ::=  SEQUENCE  {
   certificateIdentifier                    AuthorityKeyIdentifier,
   hashSignatureAlgorithm                   OBJECT IDENTIFIER,
   signatureValue                           BIT STRING  }
```

certificateIdentifier : As defined in the ITU-T Recommendation X.509 [54] extension for the AuthorityKeyIdentifier field. It identifies the certificate that carries the certified public key that is used to check the signature.

```
AuthorityKeyIdentifier ::= SEQUENCE {
   keyIdentifier                            [0] KeyIdentifier OPTIONAL,
   authorityCertIssuer                      [1] GeneralNames OPTIONAL,
   authorityCertSerialNumber                [2] CertificateSerialNumber OPTIONAL }
```

Implementations are not required to use the possibly present `keyIdentifier` element of the `AuthorityKeyIdentifier`. The `AuthorityKeyIdentifier` structure shall contain both the `authorityCertIssuer` and `authorityCertSerialNumber` elements.

The `authorityCertIssuer` shall contain the field "`directoryName`", this field shall be equal to the `issuerName` of the certificate that carries the public key used to check the signature.

hashSignatureAlgorithm: this field identifies the hash algorithm that is used.

NOTE: The encryption algorithm used to compute the signature is already described in the SubjectKeyInfo field of the certificate that certifies this key, and thus that only the identification of the hash algorithm is needed. The supported algorithms are MD5 and SHA-1.

```
md5 OBJECT IDENTIFIER ::=
   { iso(1) member-body(2) US(840) rsadsi(113549)
   digestAlgorithm(2) 5 }

sha-1 OBJECT IDENTIFIER ::=
   { iso(1) identified-organization(3) oiw(14) secsig(3)
   algorithm(2) 26 }
```

signatureValue: See clause 12.11.1.3 "signatureValue" on page 359.

12.4.2.2 SignatureFile location and naming conventions

The SignatureFile is located in the root directory of the subtree that it signs. There can be several SignatureFiles, as there can be several entities that sign the structure. See clause 12.4.4 "Integration" on page 325.

By convention, the name of a SignatureFile is:

```
"dvb.signaturefile."<x>
```

where the <x> is a textual representation of an integer decimal number without leading zeroes. The range of values represented in any single directory shall start with 1 and increment in steps of 1. The first unused integer value in the ascending sequence indicates the end of the range.

The purpose of this x is to allow the hash file of an authenticated subtree to be signed by more than one entity. It is equal to the x value in the file name of the corresponding certificate file. See clauses 12.4.3.5 "CertificateFile location and naming conventions" on page 324 and 12.4.4 "Integration" on page 325.

12.4.2.3 Supported algorithms

Signing data is a two-step process:

a) First a hash is computed over the data.

b) The resulting hashvalue is then encrypted using an encryption algorithm.

As indicated in clause 12.4.1 the present document defines two possible hash algorithms: MD5 and SHA-1.

The encryption algorithm used to compute the signature is indicated in the certificate that carries this key.

12.4.2.4 Signature computation rules.

The hash is computed over the content of the HashFile contained in this root directory.

NOTE: This is the same principle as for the classical hash computation described in clause 12.4.1.3 "Digest value computation rules" on page 320.

12.4.2.5 Authentication rules

See signatureValue on page 323.

12.4.3 CertificateFile

12.4.3.1 Description

The CertificateFile contains all of the certificates in the certificate chain up to, and including, the root certificate. The leaf certificate is placed first in the file. The last certificate in the file is the root certificate. The root certificate is included in this file only for consistency. How the MHP terminal determines its policy related to this root CA is implementation dependent. The encoding of the certificate is defined in ITU-T Recommendation X.509 [54]. Below is defined the profile of ITU-T Recommendation X.509 [54] for use in authenticating MHP applications. This profile is based on RFC 2459 [58].

The syntax of the CertificateFile is shown in table 130.

Table 130: Syntax of the CertificateFile

Syntax	Num. Bits	Format
`Certificatefile () {`		
`  certificate_count`	16	uimsbf
`  for( i=0; i<certificate_count; i++ ) {`		
`  certificate_length`	24	uimsbf
`  certificate()`		
`  }`		
`}`		

certificate_count: This 16-bit integer carries the number of certificates in the certificate file.

certificate_length: This 24-bit integer specifies the number of bytes in the certificate.

certificate(): This field carries a single g data structure as defined by ITU-T Recommendation X.509 [54]. See clause 12.11.1 "Main part of the certificate" on page 359.

12.4.3.2 ASN.1 encoding

The basic specification of the ASN.1 DER encoding used in RFC 2459 [58] is given in ASN.1 [57]. However, RFC 2459 [58] defines some extensions which are required to implement the present document.

12.4.3.3 Supported algorithms

There are various algorithm identifiers in the certificate structure. The OID of the algorithm used in the SubjectPublicKeyInfo structure shall be RSA.

The values for AlgorithmIdentifier used both in the certificate structure and in the TBSCertificate structure that are supported in the present document are listed under clause 12.5.1 "signatureAlgorithm" on page 326.

12.4.3.4 Name matching

The only allowed encoding of attributes of distinguished names shall be UTF8String.

NOTE: The use of this encoding allows name matching to be a binary comparison.

12.4.3.5 CertificateFile location and naming conventions

As described in clause 12.2.1.3 "Certificates" on page 318, a key can be authenticated through a "certificate chain".

A certificate chain is a hierarchy of certificates that enable the implementation to verify the validity of the key used to check a signature. In the MHP environment, the root certificate is embedded in the MHP. However, for consistency, the file shall carry all of the certificate chain up to, and including, the root certificate.

The certificate file that leads to the public key of a signature shall be placed in the same directory as that signature file.

The name of a CertificateFile is:

```
'dvb.certificates.'<x>
```

where the <x> corresponds to the x value in the file name of the signature file verified by this certificate. Hence in the root directory of an authenticated subtree there shall be one certificate file for each signature file. See clauses 12.4.2.2 "SignatureFile location and naming conventions" on page 323 and 12.4.4.

12.4.3.6 Authentication rules

Certificates are considered to be the same if they have bitwise identical contents.

Where an MHP application is authenticated by multiple signature file / certificate file pairs, the MHP terminal shall check all the signature file / certificate file pairs before deciding that a file fails authentication. It is dependant on receiver policy whether additional signature file / certificate file pairs are checked once one satisfactory pair has been found.

12.4.4 Integration

Logically a file is authenticated as follows:

a) Confirm that the file is listed in the hash file located in the same directory as the file to be authenticated.

b) Verify that the file contents and the corresponding digest value are consistent.

c) Recursively ascend the directory hierarchy checking that the hash file in each directory is authenticated by the hash file in its parent directory until a directory is found that contains one or more signature files.

   Such a directory is termed the root directory of an authenticated subtree.

NOTE 1: This means that there is no requirement to progress above the root of the authenticated subtree to examine further hash files. If such a directory has a digest type other than "Non authenticated" in its parent directory, this is only significant when verifying the hash file of the parent directory.

NOTE 2: The presence of more than one signature file enables more than one set of organizations to authenticate a subtree.

NOTE 3: When authenticating a signed application, an MHP terminal can select any one of these certificates to use to authenticate all subsequent classes or files loaded.

Where an MHP terminal trusts more than one of these certificates, it should attempt to select the most trusted of these. Apart from this, the mechanism used to make this selection is implementation dependent.

d) For a signature file locate the corresponding certificate file (where the x portion of the signature file's file name identifies the certificate file to be used).

e) If the root certificate in the corresponding certificate file is unknown to the MHP receiver, return to step (d) and repeat for the other signature files.

f) Use the corresponding certificate file to verify that the signature correctly signs the hash file.

g) Verify that the attributes of the Subject field include content that matches the signalling information as per the requirements of clause 12.5.6.

h) Follow the certificate chain contained within the certificate file verifying each link in the chain until the link to the root certificate is found.

i) If the identified root certificate and all the intermediate certificates leading to it are "satisfactory", accept the files as being authenticated.

   "satisfactory" depends on the policies implemented in the receiver and other constraints expressed in the present document. In particular the requirements in clause 11.2.3 "Class Loading" on page 262 for using the "same" leaf certificate to authenticate DVB-J class files shall be observed.For HTML applications the definition of "satisfactory" is given in clause 8.12 "Security of DVB-HTML applications" on page 170.

j) If the identified root certificate or any of the intermediate certificates leading to it are not "satisfactory", return to step (d) and repeat for the other signature files.

k) Dependant on receiver policy return to step (d) and repeat for other signature files.

NOTE 4: The above is a logical description of the process and does not constrain implementations to perform these steps in this exact order. E.g. hash files may be verified when descending an directory hierarchy rather than ascending one.

A file system may contain several independent authenticated subtrees, each tree with its own subtree root directory.

NOTE 5: For the method `org.dvb.dsmcc.DSMCCObject.getSigners`, the semantics defined in that method take precedence over these rules where there are conflicts.

12.5 Profile of X.509 certificates for authentication of applications

This clause identifies how ITU-T Recommendation X.509 [54] is profiled when used for authentication of broadcast MHP applications. This profile is a variation (in general a sub-set) of the internet profile defined in RFC 2459 [58]. This clause identifies the differences from the profile in RFC 2459 [58]. Clause 12.11 "The internet profile of X.509 (informative)" on page 359 summarizes the profile in RFC 2459 [58].

12.5.1 signatureAlgorithm

The present document supports 2 signature algorithms: MD5 with RSA and SHA-1 with RSA.

12.5.1.1 MD5 with RSA

The signature algorithm with MD5 and the RSA encryption algorithm is defined in RFC 2313 [56]. As defined in RFC 2313 [56], the ASN.1 OID used to identify this signature algorithm is:

```
md5WithRSAEncryption OBJECT IDENTIFIER ::= {
   iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1) pkcs-1(1) 4 }
```

12.5.1.2 SHA-1 with RSA

The signature algorithm with SHA-1 and the RSA encryption algorithm is implemented using the padding and encoding conventions described in RFC 2313 [56]. The message digest is computed using the SHA-1 hash algorithm. The ASN.1 object identifier used to identify this signature algorithm is:

```
sha-1WithRSAEncryption OBJECT IDENTIFIER ::= {
   iso(1) member-body(2) us(840) rsadsi(113549) pkcs(1) pkcs-1(1) 5 }
```

12.5.1.3 parameters

For both of the 2 supported algorithms the parameters component shall be the ASN.1 type NULL.

12.5.2 signatureValue

The RSA signature generation process and the encoding of the result is described in detail in RFC 2313 [56].

12.5.3 version

The version field of the certificate shall signal v3. All implementations shall support the v3 extensions as required by clause 12.5.9 "Extensions" on page 328.

12.5.4 issuer

12.5.4.1 minimum requirement

For the present document at least a Common Name attribute shall be provided. The text value of the attribute shall be non-empty. It shall be suitable for direct presentation to the user.

12.5.4.2 certificate authority responsibility

The senior certificate authority who signs a certificate shall oversee the attribute information to ensure that the information is suitable.

12.5.5 validity

The only allowed format for encoding time in the validity field is GeneralizedTime.

12.5.6 subject

The subject field is a "distinguished name". The following requirements are specified by the present document:

- The only allowed encoding attributes of the subject is `UTF8String` (see clause 12.4.3.4 "Name matching" on page 324)
- The minimum set of attributes that shall be present in the subject are:

  - `commonName`.

  - `countryName`.
- If the certificate is a "leaf certificate" (see figure 19 "Certificate chain illustrated" on page 318) then the subject shall also contain an `organizationName`.
- When encoded the `organizationName` carries organization specific text post fixed by the organisation_id of the authenticated files. This integer value is represented as a fixed length 8 character hexadecimal string (with leading zeros where required). So the `organizationName` takes the form:

  ```
  text + "." + organisation_id
  ```

  Except for the presence of leading zeros, this is the same as clause 14.5 "Text encoding of application identifiers" on page 398.

  This field reproduces the organisation_id value from the application's application identifier, see clause 10.5.1 "Encoding" on page 226. Before the application starts executing, the value of the organisation_id of at least one of the leaf certificates used in the authentication of the application's root subdirectory must match that in the application identifier. If this is not true, then the application is considered to have failed authentication. Applications which fail authentication at this point shall not be started on MHP terminals.

If the certificate is a "leaf certificate" then the subject may also contain up to 4 `organizationalUnitName` entries.

When encoded each `organizationalUnitName` entry carries a comma separated list of up to 5 original network identifiers each entry of which is a fixed length 5 character hexadecimal string encoded as follows:

- The first character is a network type identifier encoded as a single hexadecimal digit with one or more bits set and with the bits having the following meanings:

xxx1	terrestrial network
xx1x	cable network
x1xx	satellite network
1xxx	internet

- The next four characters are a hexadecimal representation, including leading zeros where necessary, of the original_network_id as defined in EN 300 468 [4].

Before the application starts executing, the network type and the original_network_id of the service carrying the application shall be matched against the entries in the comma separated lists in the `organizationalUnitName` entries in each of the leaf certificates used in the authentication of the application's root directory. The original_network_id of the service, shall be found by first looking in the transport_stream_loop of the NIT for the transport stream carrying the service and only if the service is not listed in that loop, looking in the SDT.

Certificates where none of the entries match shall not be used to authenticate applications. If no match is found in any of these leaf certificates then the application is considered to have failed authentication. Applications that fail authentication at this point shall not be started on MHP terminals.

NOTE: Where a particular original_network_id is uniquely used in a particular market, this feature enables certificate authorities to apply market specific policies when deciding which organisations are entitled to have certificates issued to them for that market. The extent to which this provides real additional real security depends on factors outside the scope of this specification.

12.5.7 SubjectPublic Key Info

The present document supports a single public key algorithm (RSA) for the subject public key.

The key lengths that implementation are required to support are addressed in annex G "(normative): Minimum Platform Capabilities" on page 541.

12.5.7.1 rsaEncryption

The OID rsaEncryption identifies RSA public keys:

```
rsaEncryption OBJECT IDENTIFIER ::= { pkcs-1 1}

pkcs-1 OBJECT IDENTIFIER  ::=  { iso(1) member-body(2) us(840)
                                                    rsadsi(113549) pkcs(1) 1 }
```

The parameters field shall have ASN.1 type NULL.

12.5.7.2 subjectPublicKey

The RS subjectPublicKey BIT STRING shall be encoded using the ASN.1 type RSAPublicKey:

```
RSAPublicKey ::= SEQUENCE {
   modulus                 INTEGER, -- n
   publicExponent          INTEGER -- e -- }
```

The semantics of the modulus (n) and the public exponent (e) are defined in RFC 2313 [56].

12.5.8 Unique Identifiers

X.509 defines the `issuerUniqueID` and `subjectUniqueID` extensions.

CAs conforming to this profile shall not generate certificates with unique identifiers.

MHP terminals conforming to this profile are not required to be capable of parsing unique identifiers and making comparisons.

12.5.9 Extensions

The following restrictions and semantics are placed on the use of certificate extensions when used to authenticate applications.

Table 131: Profile for standard certificate extensions (Sheet 1 of 2)

Extension	In broadcasts	In implementations	Semantic
Authority key identifier	Opt.	Opt.	Shall not be marked critical
Subject key identifier	Opt.	Opt.	Shall not be marked critical

Table 131: Profile for standard certificate extensions (Sheet 2 of 2)

Extension	In broadcasts	In implementations	Semantic
Key usage	Mand.	Mand.	If the keyUsage extension is marked critical, for the leaf certificate the bit digitalSignature shall be set, for other certificates the bit keyCertSign shall be set. If these bits are not set then the certificate shall be ignored by the implementation.
Private key usage period	Opt.	Opt.	Shall not be marked critical
Certificate policies	Opt.	Opt.	Shall not be marked critical
Policy mappings	Opt.	Opt.	Shall not be marked critical
Subject Alternative Name	Mand.	Opt.	Shall not be marked critical The subject name unambiguously identifies the subject. It is recommended that DVB MHP implementations can read rfc822Name (email address)
Issuer Alternative Name	Mand.	Opt.	Shall not be marked critical The issuer name unambiguously identifies the issuer. It is recommended that DVB MHP implementations can read rfc822Name (email address).
Subject Directory attributes	Opt.	Opt.	Shall not be marked critical
Basic Constraints	Opt.	Mand.	May be marked critical
Name Constraints	Opt.	Mand.	May be marked critical. DVB MHP decoders shall be able to recognize name constraints when GeneralName are either directoryName or rfc822 names.
Policy Constraints	Opt.	Opt.	Shall not be marked critical
Extended key usage field	Opt.	Opt.	Shall not be marked critical
CRL Distribution points	Opt.	Opt.	Shall not be marked critical

Table 132: Key for table 131

Keyword	When applied to …	
	broadcasts	receivers
Mandatory	Certificates shall include these extensions.	Receivers shall observe the semantic for this information when provided.
Optional	Certificates may or may be not include these extensions. The MHP specification does not define the use of these extensions and hence broadcasters should not use them.	Receivers can ignore these extensions if present.
Critical / not-critical	Broadcasters should not mark the receiver optional extensions as critical.	Certificates containing unrecognized critical extensions shall be considered as invalid. Receivers should recognize all the extensions that can be critical.

12.6 Security policy for applications

12.6.1 General principles

This clause specifies the resource access policy for the downloaded applications. The resource access policy depends on two factors

- The access rights requested by the broadcaster through the signalling.
- The access rights granted by the user.

The ultimate access rights that are granted to the applications are the intersection of the access rights requested by the broadcaster and the access rights granted by the user.

Unsigned applications have limited access to platform resources.

Unless specified elsewhere in the present document, signed applications have the same access rights as unsigned applications. An application broadcaster can request additional permissions to access specific resources by providing a signed "Permission Request File" along with the application. The syntax and semantics of the Permission Request File are defined in the following clauses. The permission request file may also contain a credential that indicates that a persistent file owned by another organization may be accessed. If the "Permission Request File" is not correctly authenticated the application is not granted any additional permissions but is not prevented from starting for this reason.

The way the user grants rights to the downloaded applications is implementation dependant and is not addressed by the present document.

For DVB-J applications, accessing a resource consists of method calls. Each method call that results in accessing the resource shall throw a security exception as defined in clause 11.10 "Java permissions" on page 300 and the specifications of the java APIs concerned. For each resource subject to access restriction, the application can test whether it has been granted permissions to access it by using the corresponding java Permission class (see clause 11.8 "Security" on page 295).

For a DVB-J application to be correctly authenticated, all the class files that the application consists of need to be signed, the signatures need to verify (see clause 12.4.4 "Integration" on page 325) and the application_id needs to be from within the range allocated to signed applications (see Table 77 "Value ranges for application_id" on page 227). If, during the loading or execution of the application the MHP detects a signed file containing a class that failed to pass the authentication process (e.g. because its actual hash value does not match the expected hash value), then the class shall be considered as not available.

When an application requests to retrieve data from a signed file, and the MHP terminal attempts to authenticate that file, and the authentication process fails, then the API concerned shall fail in a manner consistent with the defined behaviour of that API when the file exists but has no content in it.

NOTE 1: In order to be efficient, if a directory D contains objects that are likely to frequently change, it is advised to put a signature file in this directory D and to mark the directory D as non authenticated in the hashfile located in the parent directory of D. By doing so, it will limit the propagation of modifications to just one directory.

The authentication of a file is evaluated each time that the file is loaded from a transport connection. File version information in the transport system cannot be assumed to be secure.

Applications authors should be aware that deciding whether to grant a permission or not may, depending on the implementation, involve prompting and asking the end user. The latest point in time when the implementation must decide if an application has a permission or not is when the application either queries the presence of this permission for the first time or when it invokes an action that requires the permission for the first time. Application authors should be aware that in these situations, an implementation may prompt and ask the user. Depending on the implementation, this prompting (if necessary) can also happen at any point in time prior to this (e.g. at the application start up time).

An MHP terminal is required to be able to operate in a mode where it grants permission to provide access to all of the functionality required by the profiles and options that it supports when appropriately requested (e.g. via the permission request file). The mechanism for causing the terminal to operate in this mode is implementation-dependent. The granting of permissions for accessing functionality outside of the claimed MHP profile and options is not required.

NOTE 2: In the case of permissions represented by a Java class in DVB-J, this means that it will be possible to have such a permission granted if the corresponding class is required in the given profile, and it can be requested in the permission request file.

NOTE 3: This means that, for example, it must be possible to grant the permission associated with dialling a phone number on a terminal that supports the interactive broadcast profile, even if the terminal implements the interaction channel using a cable modem. In this case, the dialling APIs will fail in a manner consistent with the present document.

12.6.2 Permission request file

12.6.2.1 File encoding

12.6.2.1.1 XML

The Permission Request File is an XML File. Its syntax is defined by the following DTD. The `Name` used in the document type declaration shall be "permissionrequestfile".

12.6.2.1.2 MHP 1.0

The `PublicLiteral` to be used for specifying this DTD in document type declarations of the XML files is:

```
"-//DVB//DTD Permission Request File 1.0//EN"
```

and the URL for the SystemLiteral is:

"http://www.dvb.org/mhp/dtd/permissionrequestfile-1-0.dtd".

The DTD is:

```
<!ELEMENT permissionrequestfile
   (file?,capermission?,applifecyclecontrol?,returnchannel?,tuning?,
   servicesel?,userpreferences?,network?, dripfeed?, persistentfilecredential*)>
<!ATTLIST permissionrequestfile
 orgid CDATA #REQUIRED
 appid CDATA #REQUIRED
>

<!ELEMENT file EMPTY>
<!ATTLIST file
   value               (true|false) "true"
>
<!ELEMENT capermission (casystemid)+>
<!ELEMENT casystemid EMPTY>
<!ATTLIST casystemid
   entitlementquery    (true|false) "false"
   id                  CDATA #REQUIRED
   mmi                 (true|false) "false"
   messagepassing      (true|false) "false"
   buy                 (true|false) "false"
>

<!ELEMENT applifecyclecontrol EMPTY>
<!ATTLIST applifecyclecontrol
   value               (true|false) "true"
>

<!ELEMENT returnchannel (defaultisp?,phonenumber*)>
<!ELEMENT defaultisp EMPTY>
<!ELEMENT phonenumber (#PCDATA)>

<!ELEMENT tuning EMPTY>
<!ATTLIST tuning
   value               (true|false) "true"
>
```

```
<!ELEMENT servicesel EMPTY>
<!ATTLIST servicesel
   value                (true|false) "true"
>

<!ELEMENT userpreferences EMPTY>
<!ATTLIST userpreferences
   write                (true|false) "false"
   read                 (true|false) "true"
>

<!ELEMENT network (host)+>
<!ELEMENT host (#PCDATA)>
<!ATTLIST host
   action               CDATA #REQUIRED
>

<!ELEMENT dripfeed EMPTY>
<!ATTLIST dripfeed
   value                (true|false) "true"
>

<!ELEMENT persistentfilecredential (grantoridentifier,expirationdate,filename+,signature,
certchainfileid)>
<!ELEMENT grantoridentifier EMPTY>
<!ATTLIST grantoridentifier
   id                   CDATA #REQUIRED
>
<!ELEMENT expirationdate EMPTY>
<!ATTLIST expirationdate
   date                 CDATA #REQUIRED
>
<!ELEMENT filename (#PCDATA)>
<!ATTLIST filename
   write                (true|false) "true"
   read                 (true|false) "true"
>
<!ELEMENT signature (#PCDATA)>
<!ELEMENT certchainfileid (#PCDATA)>
```

12.6.2.1.3 MHP 1.1

The `PublicLiteral` to be used for specifying this DTD in document type declarations of the XML files is:

```
"-//DVB//DTD Permission Request File 1.1//EN"
```

and the URL for the SystemLiteral is:

"http://www.dvb.org/mhp/dtd/permissionrequestfile-1-1.dtd".

The DTD is:

```
<!ELEMENT permissionrequestfile
   (file?,capermission?,applifecyclecontrol?,returnchannel?,tuning?,
   servicesel?,userpreferences?,network?, dripfeed?, persistentfilecredential*,
   applicationstorage?,smartcardaccess?,provider?)>

<!ATTLIST permissionrequestfile
 orgid CDATA #REQUIRED
 appid CDATA #REQUIRED
>

<!ELEMENT file EMPTY>
<!ATTLIST file
   value                (true|false) "true"
>

<!ELEMENT capermission (casystemid)+>
<!ELEMENT casystemid EMPTY>
<!ATTLIST casystemid
```

```
   entitlementquery     (true|false) "false"
   id                   CDATA #REQUIRED
   mmi                  (true|false) "false"
   messagepassing       (true|false) "false"
   buy                  (true|false) "false"
>

<!ELEMENT applifecyclecontrol EMPTY>
<!ATTLIST applifecyclecontrol
   value                (true|false) "true"
>

<!ELEMENT returnchannel (defaultisp?,phonenumber*)>
<!ELEMENT defaultisp EMPTY>
<!ELEMENT phonenumber (#PCDATA)>

<!ELEMENT tuning EMPTY>
<!ATTLIST tuning
   value                (true|false) "true"
>

<!ELEMENT servicesel EMPTY>
<!ATTLIST servicesel
   value                (true|false) "true"
>

<!ELEMENT userpreferences EMPTY>
<!ATTLIST userpreferences
   write                (true|false) "false"
   read                 (true|false) "true"
>

<!ELEMENT network (host)+>
<!ELEMENT host (#PCDATA)>
<!ATTLIST host
   action               CDATA #REQUIRED
>

<!ELEMENT dripfeed EMPTY>
<!ATTLIST dripfeed
   value                (true|false) "true"
>

<!ELEMENT persistentfilecredential (grantoridentifier,expirationdate,filename+,signature,
certchainfileid)>
<!ELEMENT grantoridentifier EMPTY>
<!ATTLIST grantoridentifier
   id                   CDATA #REQUIRED
>
<!ELEMENT expirationdate EMPTY>
<!ATTLIST expirationdate
   date                 CDATA #REQUIRED
>
<!ELEMENT filename (#PCDATA)>
<!ATTLIST filename
   write                (true|false) "true"
   read                 (true|false) "true"
>
<!ELEMENT signature (#PCDATA)>
<!ELEMENT certchainfileid (#PCDATA)>


<!-- ..................... new elements in MHP 1.1 ................ -->
<!ELEMENT applicationstorage (applicationstorageorg)*>
<!ATTLIST applicationstorage
   manageservice (true|false) "false"
   createservice (true|false) "false"
   deleteservice (true|false) "false"
   managecache (true|false) "false"
>
```

```
<!ELEMENT applicationstorageorg EMPTY>
<!ATTLIST applicationstorageorg
   orgid CDATA #REQUIRED
   storeservice (true|false) "false"
   removeservice (true|false) "false"
   storecache (true|false) "false"
   removecache (true|false) "false"
>

<!ELEMENT smartcardaccess EMPTY>

<!ELEMENT priviligedrce EMPTY>
<!ATTLIST privilegedrce
   value (internal|external) "internal"
>
<!ELEMENT provider (name)+ >

<!ELEMENT name (#PCDATA)>
<!ATTLIST name
   scope (application|system) "application"
>
```

12.6.2.1.4 Number representation

12.6.2.1.4.1 Hex

Unless stated otherwise (e.g. clause 14.5 "Text encoding of application identifiers" on page 398) each hexadecimal value has the following form "0x" Nhex where "N" specifies the fixed number of significant digits in the value and hex is specified by the following BNF:

```
hex = digit | "A" | "B" | "C" | "D" | "E" | "F" | "a" | "b" | "c" | "d" | "e" | "f"
digit = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```

12.6.2.2 File integrity

If the permission file is not parsable as defined by the XML parsing rules (see clause 14.3 "XML notation" on page 395) it shall be ignored and hence no additional permissions are granted (or not granted in the case of `SelectPermission`).

12.6.2.3 Example

```
<?xml version="1.0"?>
<!DOCTYPE permissionrequestfile PUBLIC "-//DVB//DTD Permission Request File 1.0//EN"
"http://www.dvb.org/mhp/dtd/permissionrequestfile-1-0.dtd">
<permissionrequestfile orgid="0x000023d2" appid="0x4020">

   <file value="true"></file>

   <capermission>
      <casystemid
         id="0x1111" messagepassing="true"
         entitlementquery="true" mmi="false">
      </casystemid>
   </capermission>

   <applifecyclecontrol value="true"></applifecyclecontrol>

   <returnchannel>
      <defaultisp></defaultisp>
      <phonenumber>+3583111111</phonenumber>
      <phonenumber>+3583111112</phonenumber>
      <phonenumber></phonenumber>
   </returnchannel>

   <tuning value="false"></tuning>
```

```
   <servicesel value="true"></servicesel>

   <userpreferences read="true" write="false"></userpreferences>

   <network>
      <host action="connect">hostname</host>
   </network>

   <persistentfilecredential>
      <grantoridentifier id="0x05"></grantoridentifier>
      <expirationdate date="24/12/2032"></expirationdate>
      <filename read="true" write="false">5/15/dir1/scores</filename>
      <filename read="true" write="false">5/15/dir1/names</filename>
      <signature>02320329329293293292149314392942394329423943294239432
      </signature>
      <certchainfileid>3</certchainfileid>
   </persistentfilecredential>

   <provider>
      <name scope="application"> 00000B.EMV_PK11.VISA_REVOLVER </name>
   </provider>

</permissionrequestfile>
```

12.6.2.4 Permission request file name and location

The format for the permission request file name is:

```
   'dvb.'<application name>'.perm'
```

The prefix "dvb" identifies this as a well known file specified by the present document. The portion "application name" carries the file name of the initial file of the application excluding any file name extension or suffix. The initial file depends on the application type as is shown in table 133 for the types defined in the present document.

Table 133: Application name for different application types

Application type		Path from which file name shall be extracted
Value	Meaning	
0x0001	DVB-J	The name initial_class_byte, see table 102
0x0002	DVB-HTML	The name initial_path_bytes, see table 104

This file shall be located in the same directory as the initial file.

12.6.2.5 Permission request file

12.6.2.5.1 Minimum permissions

If the permission file does not contain a valid permissionrequestfile element it shall be ignored and hence no additional permissions are granted (or not granted in the case of `SelectPermission`).

12.6.2.5.2 Syntax and semantics

```
<!ATTLIST permissionrequestfile
   orgid CDATA #REQUIRED
   appid CDATA #REQUIRED
>
```

orgid: This attribute is a hexadecimal string (hex_string) that conveys the organisation id of the associated application. The encoding of this value is specified in clause 14.5 "Text encoding of application identifiers" on page 398.

appid: This attribute is a hexadecimal string (hex_string) that conveys the application id of the associated application. The encoding of this value is specified in clause 14.5 "Text encoding of application identifiers" on page 398.

12.6.2.5.3 Defaults

NOTE: As defined by XML 1.0 [65], the defaults for attributes defined in the DTD (see clause 12.6.2.1 "File encoding" on page 331) only apply when the element is present but the attribute concerned is omitted.

12.6.2.6 Credentials

A credential contains a resource description and is used to allow the owner of this resource (the grantor) to grant to the permission request file's application the right to access it. In the present document, the only resource that can be contained in a credential is a file (or a set of files of a directory). Credentials shall not grant access to directories, only files within them. This type of credential is named `persistentfilecredential` in the XML DTD. The credential contains an expiration date that allow the grantor to grant access to its resource for a limited duration. The credential is signed by the grantor. The signature checking is done by the implementation by getting the certificate of the grantor. The certificate can be found thanks to the information contained in the `certchainfileid` element.

The certificate file that leads to the public key of the signature shall be placed either in the same directory as the permission request file containing the credential or in one of its parent directories. The directory containing the permission request file shall be searched first and then recursively ascend the directory hierarchy checking certificate files until one is found with the file name matching the contents of the `certchainfileid` field of the credential. If the root of the file system is reached without finding a matching certificate then the file access shall not be granted.

The grantoridentifier in the `persistentfilecredential` shall match the organisation_id contained in the Subject organisationName field of the leaf certificate for file access to be granted. The grantoridentifier shall match the organisation id of the owner of the file to which access is granted by this `persistentfilecredential`. If either of these is untrue, access shall not be granted.

The persistent file credential is transmitted using the following XML DTD syntax:

```
<!ELEMENT persistentfilecredential (grantoridentifier,expirationdate,filename+,signature,
certchainfileid)>
<!ELEMENT grantoridentifier EMPTY>
<!ATTLIST grantoridentifier
   id CDATA #REQUIRED
>
<!ELEMENT expirationdate EMPTY>
<!ATTLIST expirationdate
   date CDATA #REQUIRED
>
<!ELEMENT filename (#PCDATA)>
<!ATTLIST filename
   write (true|false) "true"
   read (true|false) "true"
>
<!ELEMENT signature (#PCDATA)>
<!ELEMENT certchainfileid (#PCDATA)>
```

The following table provide more information about the different elements:

Table 134

Elements	Comments
grantoridentifier	This element contains the 32 bit organization id identifying the grantor organization. The encoding of the CDATA attribute id of this element is “0x” followed by the encoding defined in 14.5 "Text encoding of application identifiers" on page 398.

expirationdate	This element contains the expiration date of this credential.The implementation should ignore the certificate if the date has expired. The CDATA attribute date shall follow the following BNF syntax:
	`2dec "/" 2dec "/" 4dec ; e.g. "01/12/2001"`
	where:
	`dec = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"`
	Where the first 2 digits are the day number in the month, the second two digits are the month number in the year and the last 4 digits are the year. All values are in accordance with the Gregorian calendar.
	NOTE: Numbers start counting from one and not zero unlike the java.util.GregorianCalendar class.

filename	This element contains the filename path and the read/write access rights that are granted on the file. The element consists of a CDATA string following the following BNF syntax:
	`filename = persistentfilename`
	`| persistentpath "/" persistentfilename`
	`| persistentpath "/" "*"`
	`| persistentstpath "/" "-"`
	
	where
	
	"/" is the file separator
	"*" used at the end of a pathname indicates all files contained in that directory
	"-" used at the end of a pathname indicates all files contained in that directory and existing subdirectories recursively at the time the permission request file is parsed.
	
	persistentpath, persistentfilesubstring and persistentfilename are defined in clause 14.6.1 "Persistent storage" on page 398.
	
	The file path is relative to the path obtained from the dvb.persistent.root property.
	
	Receivers are required to support the same restrictions on the lengths of persistentfilesubstrings and persistentfilesuffixes as specified in clause 14.6.1 "Persistent storage" on page 398.
	
	The file path shall not start with a "/". It is relative to the path obtained from the dvb.persistent.root property.
	The element has two attributes read and write that can take the value "true" or "false".

Elements	Comments
signature	This element contains a signature from the grantor. Signature structure is as defined in clause 12.4.2 "SignatureFile" on page 322. The signature is encoded using the Base64 content transfer encoding as specified in section 6.8 of RFC 2045 [64].
certchainfileid	This element contains the identifier of the leaf certificate, i.e.the "x" in the file name "dvb.certificates.x".

The signature is computed on the binary concatenation of the following fields in the following order:

Table 135

Fields	Binary content
grantee_identifier.organization_id	32 bits
grantee_identifier.application_id	16 bits
grantor_identifier (organization_id)	32 bits
expiration_date	10 characters (e.g. "10/12/2001") in ASCII

filenames and actions (in the order they appear in the XML document) i.e.:
 	
for (i=0;i<filenumber;i++) {
read
write
filepath
 	
}
	
	4 or 5 char ("true" or "false")
	4 or 5 char ("true" or "false")
	string in ASCII (without any string termination character)

The implementation will check the validity of the credential by checking the signature with the grantor's public key that can be found in the grantor's certificate. Certificates are carried by the grantee in the file format defined clause 12.4.3 "CertificateFile" on page 324. Certification chain authenticates grantor's certificate. This chain shall derive from one of the root authorities embedded in the MHP.

The right to access a file shall not include the right to create it.

12.6.2.7 File Access

12.6.2.7.1 Unsigned applications

Have no access to the persistent storage

12.6.2.7.2 Policy for signed applications

No access to the persistent storage, unless otherwise indicated in the Permission File.

Applications may request access to persistent storage either by credentials or the “file” element or both. These two mechanisms are independent. Once an application has access to a file granted by one mechanism, the other mechanism need not be considered further. Specifically, once a credential to access a file is granted to an application, the permissions for the file encapsulated by FileAccessPermission are no longer relevant.

NOTE: The intended use-case for this is a file containing an end-user’s credit card details which may be intended to only be accessed by applications with a credential, e.g. from a bank. For this use-case, the application that put the credit card details in the file needs to set all the FileAccessPermissions to false in order to achieve the desired result.

When the permission request file requests access to persistent storage and this is granted, the file access policy is derived from the policy used in the Unix world.

An application owns the files it has created. The root directory of the persistent file namespace is defined by the 'dvb.persistent.root' property as described in clause 11.5.6 "Persistent Storage API" on page 282. The files owned by an application shall be located in sub-directories below this directory, specifically one of the following two choices:

a) The sub-directory whose name is the organisation_id of the application concerned.

b) A sub-directory of the immediately previously defined directory whose name is the application_id of the application concerned.

The encodings of the organisation identifier and application identifier are as defined in clause 14.5 "Text encoding of application identifiers" on page 398. By default, files created by an application will have owner read/write access only.

An Application can modify the access rights to a file it owns as follows:

- It can grant a read-only access, a write-only access or a read-write access to all applications having the same organisationId value.
- It can grant a read-only access, a write-only access or a read-write access to all applications.
- Write access to a directory is required to add or remove an entry in a directory.
- Read access to a directory is required to list the contents of a directory or access any of the files contained within in it.
- To read the contents of a file or directory, permission to read that file or directory and all directories on the path to the root of the persistent file system is required.

An application shall be granted access to a file if it qualifies for such access by application, organization or world access permissions.

See org.dvb.io.persistent see annex K "(normative): DVB-J persistent storage API" on page 580.

12.6.2.7.3 Permission request syntax

```
<!ELEMENT file EMPTY>
<!ATTLIST file
 value (true|false) "true"
>
```

12.6.2.8 CA API

12.6.2.8.1 Unsigned applications

An unsigned application cannot access the following methods:

- `CAModule.buyEntitlements.`
- `CAModule.openMessageSession.`
- `CAModuleManager.addMMIListener.`
- `CAModule.queryEntitltements.`
- `CAModule.listEntitlements.`

12.6.2.8.2 Signed applications

By default, an application has limited access to the CA API functions (same default rights as an unsigned application)

In particular, the following method calls are not accessible to an unsigned application:

- `CAModule.buyEntitlements.`
- `CAModule.openMessageSession.`
- `CAModuleManager.addMMIListener.`
- `CAModule.queryEntitltements.`
- `CAModule.listEntitlements.`

The permission request file requests the MHP to grant additional rights to the application with the ConditionalAccess Permission described below.

12.6.2.8.3 Conditional Access Permission syntax

The ConditionalAccess Permission is optional. When not present, the application has the default access rights. When present, the permission request file overrides the default rights for this application.

```
<!ELEMENT capermission (casystemid)+>
<!ELEMENT casystemid EMPTY>
<!ATTLIST casystemid
   entitlementquery     true|false) "false"
   id                   CDATA #REQUIRED
   mmi                  (true|false) "false"
   messagepassing       (true|false) "false"
   buy                  (true|false) "false"
>
```

The string specifying the CA system IDs has the following syntax:

```
CAIds          =  CASystemId | "[" CASystemId "-" CASystemId "]" | "*"
CASystemId     =  "0x" 4hex
```

See clause 12.6.2.1.4.1 "Hex" on page 334.

12.6.2.9 Application lifecycle control policy

Applications shall not launch broadcast applications that are not signalled in the currently selected service for the service context in which the application wishing to do the launching is running.

12.6.2.9.1 Unsigned applications

An unsigned broadcast application can launch any application visible in the listing API that is signalled in the currently selected service for the service context in which the application wishing to do the launching is running.

An unsigned application can control (pause, stop, resume) the lifecycle of an application it has launched.

An unsigned application cannot control the lifecycle of an application it has not launched.

12.6.2.9.2 Default policy for Signed applications

By default, a signed application has the same rights as an unsigned application as concerns the application lifecycle control policy.

These default rights can be overridden by the permission request file as described below.

12.6.2.9.3 Syntax

```
<!ELEMENT applifecyclecontrol EMPTY>
<!ATTLIST applifecyclecontrol
 value (true|false) "true"
>
```

value: When the boolean value is set to `true`, this means that the application can control the lifecycle of all the applications signalled in the currently selected service for the service context in which the application wishing to do the launching is running. When set to `false` the policy is as in clause 12.6.2.9.2 "Default policy for Signed applications" on page 341.

12.6.2.10 Return channel access policy

12.6.2.10.1 Unsigned applications

An unsigned application may not use the return channel.

12.6.2.10.2 Signed applications

By default, a signed application may not access the return channel, unless otherwise specified by the permission request file. The syntax of the return channel permission is so that it describes the phone numbers that the application may try to dial.

12.6.2.10.3 Return channel permission syntax

```
<!ELEMENT returnchannel (defaultisp?,phonenumber*)>
<!ELEMENT phonenumber (#PCDATA)>
<!ELEMENT defaultisp EMPTY>
```

The syntax of the phone number string is as defined below.

```
phonenumber    = "+" digit digits | digits
digits         = "" | digit digits
digit          = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
```

The presence of the `defaultisp` tag indicates that the application is allowed to use the default ISP connection. If this tag is not present, then the application shall not be able to specify connecting to the default target except where the connection parameters for that target are explicitly specified by the application and are included in the phone number string.

When a phone number is given, this number defines a prefix of the allowed phone numbers and applications are allowed to call to all numbers that start with one of the prefixes defined in the permission request file, subject to the MHP terminal granting this right (see clause 12.6.1 "General principles" on page 330).

NOTE: By defining an empty phone number tag (i.e. empty string as the prefix), the application could try to call to any phone number.

12.6.2.11 Tuning access policy

12.6.2.11.1 Unsigned applications

An unsigned application may not tune using the Tuning API.

12.6.2.11.2 Signed applications

By default, a signed application may not tune using the Tuning API. However, the right to tune can be requested with the Tuning permission that can be put in the permission request file.

12.6.2.11.3 Tuner Permission syntax

The syntax of this permission is as follows:

```
<!ELEMENT tuning EMPTY><

<!ATTLIST tuning
 value (true|false) "true"
>
```

The value true requests the permission to tune using the Tuning API.

12.6.2.12 Service selection policy

12.6.2.12.1 Unsigned applications

Unsigned applications may not select a new service.

12.6.2.12.2 Signed applications

By default, signed applications can select any new service, unless otherwise specified in the permission request file.

Service selection might require return channel access. If an application attempts to do a service selection using a locator that refers to an AIT file delivered over the return channel, and a return channel has not already been established or the application does not have permission to establish a connection via the default isp (see clause 12.6.2.10 "Return channel access policy" on page 341), then the service selection shall fail in a manner consistent with the defined failure mode for service selection when a security violation is encountered (e.g. a DVB-J application using the service selection API shall be thrown a SecurityException).

NOTE: See also clause 12.14.1 "Permission for application loading from the return channel" on page 368

12.6.2.12.3 Service Selection Permission

The syntax of the service selection permission is as follows:

```
<!ELEMENT servicesel EMPTY>

<!ATTLIST servicesel
 value (true|false) "true"
>
```

If no service selection permission is present in the permission request file, the application has the default right, i.e. it can select any service.

The value "false" in this item in the permission request file, denies the right to select a new service.

12.6.2.13 Media API access policy

The media API is inside the sandbox.

12.6.2.14 Inter-application communication policy

12.6.2.14.1 Unsigned applications

Unsigned applications are allowed to communicate with each other through the inter-application communication API. However, unsigned and signed applications shall only be able to communicate with each-other using the inter-application communication API in the "dvb:/ixc/" namespace.

12.6.2.14.2 Signed applications

Signed applications signalled in the same service are allowed to communicate with each other through the interapplication communication API. Signed applications shall only be able to communicate with unsigned applications using the inter-application API in the "dvb:/ixc/" namespace.

12.6.2.15 User Setting and Preferences access policy

12.6.2.15.1 Unsigned applications

Read access to:

- User Language.
- Parental Rating.
- DefaultFontSize.
- Country Code.

An unsigned application cannot access (neither read nor write) other preferences

12.6.2.15.2 Signed applications

By default, same as unsigned applications. The permission request file may include items that request read access to all user preferences and/or write access to all user preferences.

12.6.2.15.3 Permission syntax

```
<!ELEMENT userpreferences EMPTY>

<!ATTLIST userpreferences
 write (true|false) "false"
 read (true|false) "true"
>
```

True value in the write and read attribute means that the permission for writing and reading, respectively, is requested.

12.6.2.16 Network permissions

12.6.2.16.1 Unsigned applications

Unsigned applications can not have access to the return channel and therefore can not access remote network hosts.

12.6.2.16.2 Signed applications

For signed applications, the permission request file can contain a set of permissions that specify the hosts and actions for which permissions are requested.

12.6.2.16.3 Permission syntax

```
<!ELEMENT network (host)+>
<!ELEMENT host (#PCDATA)>
<!ATTLIST host
 action CDATA #REQUIRED
>
```

The two strings that specific the host and the action shall be formatted as specified in the `java.net.SocketPermission` class as defined in clause 11.8 "Security" on page 295.

12.6.2.17 Dripfeed permissions

12.6.2.17.1 Unsigned applications

Has no access to drip feed mode.

12.6.2.17.2 Default policy for signed applications

No access to drip feed mode unless otherwise indicated in the Permission file. When an application is granted access to the drip feed mode, it is able to instantiate a `DripFeedDataSource`.

12.6.2.17.3 Permission request syntax

```
<!ELEMENT dripfeed EMPTY>
<!ATTLIST dripfeed
   value (true|false) "true"
>
```

12.6.2.18 Privileged Runtime Code Extension Permission

NOTE 1: DVB-J prohibits runtime code extension from data sources less secure than the original program code by virtue of the fact that interoperable DVB-J applications cannot directly create a ClassLoader, so this permission does not apply to DVB-J. See clause 11.10.1.4 "java.lang.RuntimePermission" on page 301 and DVBClassLoader in annex I "(normative): DVB-J fundamental classes" on page 552.

NOTE 2: In ECMAscript, code executed via runtime code extension has the same permission level as the enclosing application. Thus, granting an unsigned application the ability to do runtime code extension with string data does not give the application the ability to execute a string as privileged code.

12.6.2.18.1 Unsigned Applications

Unsigned applications shall be permitted to do runtime code extension with string data from any source.

12.6.2.18.2 Signed applications with no permission request file

Signed applications with no permission request file shall be permitted to do runtime code extension with string data from any source.

12.6.2.18.3 Signed applications with a permission request file

By default, a signed application with a permission request file is prohibited from doing any runtime code extension from a string. The permission request file may include items that request the ability to do runtime code extension with internal strings only, or with both internal an external strings.

12.6.2.18.4 Permission request syntax

```
<!ELEMENT priviligedrce EMPTY>
<!ATTLIST privilegedrce
   value (internal|external) "internal"
>
```

12.6.2.19 Application storage

12.6.2.19.1 Unsigned applications

Have no permission to store applications

12.6.2.19.2 Default policy for signed applications

By default signed applications do not have permission to store any applications.

Permission to store applications can be requested using the permission request file.

12.6.2.19.3 Permission request syntax

```
<!ELEMENT applicationstorage (applicationstorageorg)*>
<!ATTLIST applicationstorage
   manageservice: (true|false) "false"
   createservice: (true|false) "false"
   deleteservice: (true|false) "false"
   managecache: (true|false) "false"
>
```

manageservice: When set to "true", requests a permission to manage a stored application service with the organization ID of the current application. If set to false, this permission is not requested.

createservice: When set to "true", requests a permission to create a stored application service with the organization ID of the current application. If set to false, this permission is not requested.

deleteservice: When set to "true", requests a permission to remove a stored application service with the organization ID of the current application. If set to false, this permission is not requested.

managecache: When set to "true", requests a permission to manage an application cache with the organization ID of the current application. If set to false, this permission is not requested.

```
<!ELEMENT applicationstorageorg EMPTY>
<!ATTLIST applicationstorageorg
   orgid CDATA #REQUIRED
   storeservice (true|false) "false"
   removeservice (true|false) "false"
   storecache (true|false) "false"
   removecache (true|false) "false"
>
```

orgid: The organization_id of the organization whose application and stored services this permission request concerns. This field is encoded in hexadecimal form as specified in clause 14.5 "Text encoding of application identifiers" on page 398. Alternatively, this field may be set to "*" to indicate all organization IDs.

storeservice: When set to "true", requests a permission to store applications of the organization identified by the organization_id into a stored service. If set to false, this permission is not requested.

removeservice: When set to "true", requests a permission to remove applications of the organization identified by the organization_id from a stored service. If set to false, this permission is not requested.

storecache: When set to "true", requests a permission to store applications of the organization identified by the organization_id into a cache. If set to false, this permission is not requested.

removecache: When set to "true", requests a permission to remove applications of the organization identified by the organization_id from a cache. If set to false, this permission is not requested.

12.6.2.20 Non-CA smart card access

12.6.2.20.1 Unsigned applications

Have no permission to access smart cards

12.6.2.20.2 Default policy for signed applications

By default signed applications do not have permission to access smart cards.

Permission to access smart cards can be requested using the permission request file.

12.6.2.20.3 Permission request syntax

```
<!ELEMENT smartcardaccess EMPTY>
```

When the smartcardaccess element is included in the permission request file, the permission to access smart cards is requested. If the element is not included in the permission request file, this permission is not requested.

12.6.2.21 Provider Management

12.6.2.21.1 Unsigned applications

Have no permission to install or remove providers.

12.6.2.21.2 Signed applications

By default, signed applications have no permissions to add or remove providers.

Permission to insert or to remove a provider can be requested by requested using the permission request file.

An application shall only be granted permissions to insert or to remove providers that have the same organisation identifier as the application.

12.6.2.21.3 Permission request syntax

```
<!ELEMENT provider (name)+ >
<!ELEMENT name (#PCDATA)>
<!ATTLIST name
   scope (application|system) "application"
>
```

The provider name shall be prefixed with the MHP organisation identifier of the organisation which is in charge of it. The syntax for the MHP orgId shall be compliant with the paragraph 12.6.2.1.4.1.

The provider name can be "MHP_orgId.Provider_name.Card_name". For example "0x0000000B. EMV_PK11.VISA_ REVOLVER".

12.6.3 Specific issues for telephone based return channels

MHP terminals with a telephone based return channel shall not connect to any phone number other than that of the default isp without the explicit approval, at least once, of the end-user for the exact phone number concerned. This permits both implementations which always ask the end user and implementations which cache approved phone numbers in a "white list". For DVB-J applications, approval shall be requested when the application calls the `ConnectionRCInterface.connect()` method and failure reported by a `ConnectionFailedEvent`.

If an MHP terminal is going to identify the source of an MHP application to the end-user, it should present to the end-user at least the organisation specific text from the OrganisationName field within the Subject Distinguished Name from the leaf certificate used by the terminal to authenticate that application.

12.7 Example of creating an application that can be authenticated

12.7.1 Scenario Example

This clause is informative and gives an example of how a file system carrying an application can be organized.

In this example, the file system carries single signed application Xlet1.

The main class of the application is the file `root/Xlet1/classes/Xlet1.class`, other files comprising the application are the following classes:

- `root/Xlet1/classes/foo1.class.`
- `root/Xlet1/classes/subclasses/sub1.class.`
- `root/Xlet1/classes/subclasses/sub2.class.`

Xlet1 consumes data located in the file `root/Xlet1/data/Xlet1.dat`. This file is not authenticated.

Each subdirectory that contains signed files contains a hashfile.

Assumptions in this example:

- All the *.class files are signed.
- The file `root/Xlet1/data/Xlet1.dat` is not signed.
- The only digest algorithm used is MD5.

The file structure is shown below:

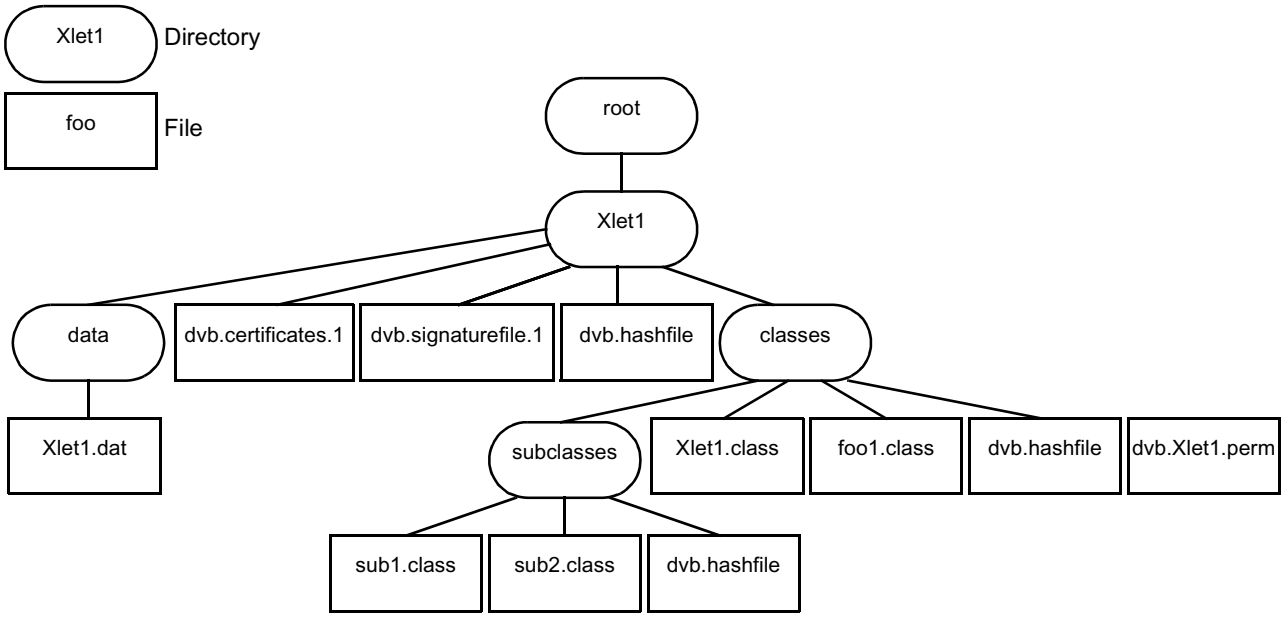


Figure 20: Example of an authenticated file tree

12.7.2 Hashes and signature computations:

12.7.2.1 Computation of the hashes of the root/Xlet1/classes/subclasses directory

a) Initialize the MD5 algorithm.

b) Apply the contents of the file "`root/Xlet1/classes/subclasses/sub1.class`" to the MD5 algorithm then apply the contents of the file "`root/Xlet1/classes/subclasses/sub2.class`" to the MD5 algorithm. The cumulative result from these two files is the result H0.

c) Construct the contents of the hash file for the directory `root/Xlet1/classes/subclasses/` as follows:

Table 136: root/Xlet1/classes/subclasses/dvb.hashfile

Field	Comment
1	One digest
1	Type of digest algorithm = MD5
2	Number of entries over which a MD5 hash has been computed
`sub1.class`	List of names of entries
`sub2.class`	
H0	MD5 hash of files `sub1.class` and `sub2.class`

NOTE: In this example we have chosen that the digests for this directory result from processing the concatenation of the contents of the files in the directory.

d) Create the hash file "`root/Xlet1/classes/subclasses/dvb.hashfile`" with the above contents.

12.7.2.2 Computation of the hashes of the of root/Xlet1/classes directory

e) Initialize the MD5 algorithm, compute the MD5 hash H2 using the contents of the file "`root/Xlet1/classes/subclasses/dvb.hashfile`".

f) Initialize the MD5 algorithm, compute the MD5 hash H3 using the contents of the file "`root/Xlet1/classes/Xlet1.class`".

g) Initialize the MD5 algorithm, compute the MD5 hash H4 using the contents of the file "`root/Xlet1/classes/foo1.class`".

h) Initialise the MD5 algorithm, compute the MD5 hash H5 using the contents of the file "`root/Xlet1/classes/dvb.Xlet1.perm`".

i) Construct the contents of the hash file for the directory `root/Xlet1/classes/` as follows:

Table 137: root/Xlet1/classes/dvb.hashfile

Field	Comment
3	Three digests
1	Type of digest algorithm = MD5
1	Number of entries over which a MD5 hash has been computed
`subclasses`	List of names of entries
H2	MD5 hash of `subclasses` directory
1	Type of digest algorithm = MD5
1	Number of entries over which a MD5 hash has been computed
`Xlet1.class`	List of names of entries
H3	MD5 hash of file `Xlet1.class`
1	Type of digest algorithm = MD5
1	Number of entries over which a MD5 hash has been computed
`foo1.class`	List of names of entries

Table 137: root/Xlet1/classes/dvb.hashfile

Field	Comment
H4	MD5 hash of file `foo1.class`
1	Type of digest algorithm = MD5
1	Number of entries over which a MD5 hash has been computed
`dvb.Xlet1.perm`	List of names of entries
H5	MD5 hash of file `dvb.Xlet1.perm`

NOTE: In this example we have chosen to individually hash each object in this directory.

j) Create the hash file `"root/Xlet1/classes/dvb.hashfile"` with the above contents.

12.7.2.3 Computation of the hashes of the of root/Xlet1 directory

k) Initialize the MD5 algorithm, compute the MD5 hash H5 using the contents of the file `"root/Xlet1/classes/dvb.hashfile".`

l) Construct the contents of the hash file for the directory `root/Xlet1/classes/` as follows:

Table 138: root/Xlet1/dvb.hashfile

Field	Comment
3	Three digests
1	Type of digest algorithm = MD5
1	Number of entries over which a MD5 hash has been computed
`classes`	List of names of entries
H5	MD5 hash of the `classes` directory
0	Type of digest algorithm = non authenticated data
1	Number of entries over which a MD5 hash has been computed
`data`	List of names of entries
<no digest in this case>	
0	Type of digest algorithm = non authenticated data
1	Number of entries over which a MD5 hash has been computed
dvb.certificates.1 List	List of names of entries
<no digest in this case>	

NOTE: the `root/Xlet1/classes` entry is the only authenticated entry of the `root/Xlet1` directory

m) Create the hash file `"root/Xlet1/dvb.hashfile"` with the above contents.

12.7.2.4 Computation of the signature

n) Initialize the MD5 algorithm, compute the MD5 hash H6 using the contents of the file `root/Xlet1/dvb.hashfile.`

o) RSA-encrypt H6 with the private key corresponding to the public key that can be found in the leaf certificate in the file `"root/Xlet1/dvb.certificates.1"`. In this example this has serial number 0123456.

p) ASN.1 encode the following structure:

- AuthorityCertIssuerName: Name of the CA.
- AuthorityCertSerialNumber: 0123456.
- HashSignatureAlgorithm: MD5.
- SignatureValue: result of step (o).

q) Put this structure into the signature file `"root/Xlet1/dvb.signaturefile.1"`.

NOTE: The file system could contain other Xlets in their own authenticated sub-trees. If these use the same certificate chain as Xlet1 (above) then logically the certificates file is replicated at the root of each of the authenticated sub-trees. Some file systems support symbolic links. These may in some cases improve the efficiency of the broadcast.

12.8 MHP certification procedures

The MHP certification procedures are outside of the scope of the present document.

12.9 Certificate management

12.9.1 Certificate Revocation Lists

12.9.1.1 Introduction (informative)

Certificates may be revoked prior to their expiration time, e.g. if the broadcaster's private key is assumed to be compromised, or the broadcaster is no longer to be certified by the CA. Each CA publishes a list of revoked certificates, called a CRL (Certificate Revocation List). This contains the list of the serial number of revoked certificates.

During the validation process of a certificate chain, the CRL of each certification authority on the certification path is checked.

The number of CRLs to be supported per level is defined in annex G "(normative): Minimum Platform Capabilities" on page 541.

12.9.1.2 Distribution of CRLs (informative)

Two routes from the broadcaster to the MHP terminal can be envisaged:

- Via the return channel.
- In the broadcast MPEG stream.

12.9.1.2.1 Distribution via return channel

In the certificate extension fields, there is an optional field called "CRL Distribution points". This field can hold a URL pointing to a crlFile which can be downloaded.

This approach is suitable for obtaining CRLs relating to TLS authentication of return channel exchanges. It is not suitable for delivering CRLs for broadcast application authentication as:

- Not all MHP profiles require return channel support.
- MHP terminals may be able to receive broadcast applications when not connected to a return channel.
- It would not be acceptable to require a return channel session to authenticate each broadcast application.

12.9.1.2.2 Distribution via MPEG stream

For an MHP terminal without a working return channel, the only way to deliver CRLs is via the broadcast MPEG Transport Stream.

12.9.1.3 CRL retention

12.9.1.3.1 Requirement

MHP terminals shall retain CRLs or the information they contain (including serial numbers) in persistent storage because:

- This enhances security as it defends against attacks with signals that filter out the CRL and use a revoked certificate.
- It is more efficient to cache CRLs rather than downloading the CRLs for authentication of each application.

12.9.1.3.2 Storage requirement

The minimum amount of persistent storage required to store CRLs is addressed in clause 12.12 "Platform minima" on page 367.

12.9.1.3.3 Storage management

The broadcast CRL and RCMM signalling (see clause 12.9.2 "Root certificate management" on page 354) manages the use of the persistent storage.

If the CRL of a non-root certificate CA becomes too large the CA's certificate itself can be revoked by its parent CA who adds it to their CRL. For root certificates, the RCMM mechanism can be used.

12.9.1.4 CRL file location and naming convention

For CRLs that are authenticated by a non-root certificate the format of the name of files carrying CRLs shall be:

```
"dvb.crl.x"
```

In this case the "x" portion of the filename corresponds to the "x" portion of a certificate filename for the certificate file that authenticates the CRL.

For CRLs that are authenticated by a root certificate the format of the name of files carrying CRLs shall be:

```
"dvb.crl.root.x"
```

In this case the "x" portion of the filename is just a discriminator to ensure non-collision of CRL file names in the event that there is more than one in this directory.

The CRL filename may not be constant through time or across broadcasts. So, implementations shall not rely on this filename when caching the CRL.

All CRL files shall be located in a subdirectory of the root of the file system called "dvb.crl". The location of certificate files authenticating the CRL files shall follow the same rules as for the location of certificates relative to a signature file. That is the certificate files shall either be in the dvb.crl directory or in the root directory. See clause 12.4.3.5 "CertificateFile location and naming conventions" on page 324.

12.9.1.5 Operational model

Receivers are expected to inspect the set of CRL files periodically and cache the revocation information for future use. This inspection process can assume that a file system will not normally carry certificates revoked by CRL files carried in the same file system. So, inspection of the CRL set in a file system is not a precondition to authenticating other files in that file system.

The present document does not address the reliability with which implementations are required to consider certificate revocations when authenticating files.

12.9.1.6 Examples

12.9.1.6.1 Revocation of a broadcaster's certificate

If the broadcaster B's certificate is compromised:

a) The certification authority CA01 adds the serial number of broadcaster B's certificate to its CRL.

b) CA01 then sends the new CRL file to the broadcasters that use CA01.

c) These broadcasters (broadcaster A for instance) broadcast the new CRL file.

As soon as an MHP terminal has downloaded the new CRL file (after selecting one of broadcaster A's channel), the MHP terminal's CRL cache in persistent storage is updated. The MHP terminal is then protected against any malicious usage of the compromised certificate.

To continue authenticating applications broadcast "B" will require a new certificate.

12.9.1.6.2 Revocation of a CA's certificate.

If the CRL of CA01 becomes too big, CA01's certificate could be revoked:

a) The root certification authority RCA0 adds the serial number of CA01's certificate to its CRL.

b) RCA0 sends the new CRL file to the broadcasters that use RCA0.

c) These broadcasters broadcast the new CRL file.

As soon as an MHP terminal has downloaded the new CRL file, its CRL cache in persistent storage for RCA0 is updated and CA01's CRL is removed from the cache (as CA01 has been revoked).

12.9.1.7 CRL format

Each CRL file contains the CRL of one certification authority.

The encoding of the CRL is defined in the ITU-T Recommendation X.509 [54] is reproduced below for information. The fields Version, Time, CertificateSerialNumber correspond to fields with the same names in the certificate see clause 12.11 "The internet profile of X.509 (informative)" on page 359:

```
CertificateList ::= SEQUENCE {
      tbsCertList                          TBSCertList,
      signatureAlgorithm                   AlgorithmIdentifier,
      signatureValue BIT STRING }

TBSCertList ::= SEQUENCE {
      version                              Version OPTIONAL,
                                           -- if present, shall be v2
      signature                            AlgorithmIdentifier,
      issuer                               Name,
      thisUpdate                           Time,
      nextUpdate                           Time OPTIONAL,
      revokedCertificates                  SEQUENCE OF SEQUENCE {
      userCertificate                      CertificateSerialNumber,
      revocationDate                       Time,
      crlEntryExtensions                   Extensions OPTIONAL
                                           -- if present, shall be v2
      } OPTIONAL,
      crlExtensions                        [0] EXPLICIT Extensions OPTIONAL
                                           -- if present, shall be v2
 }
```

12.9.1.8 Profile of CRL

The profile of fields that correspond to fields in the certificate follow the profile in clause 12.5 "Profile of X.509 certificates for authentication of applications" on page 326. This applies to the following fields:

signatureAlgorithm : follows clause 12.5.1 "signatureAlgorithm" on page 326.

signatureValue: follows clause 12.5.2 "signatureValue" on page 326.

version: follows clause 12.5.3 "version" on page 326.

signature: follows clause 12.5.1 "signatureAlgorithm" on page 326.

issuer: follows clause 12.5.4 "issuer" on page 326.

thisUpdate: Publication date of this CRL. Follows the encoding of Time used for validity. See clause 12.5.5 "validity" on page 327.

nextUpdate: Publication date of the next version of the CRL. Follows the encoding of Time used for validity. See clause 12.5.5 "validity" on page 327.

userCertificate: SerialNumber of the revoked certificate. It is used to identify the revoked certificate.

The serial number shall be unique for a given CA. So, the pair [issuerName, serialNumber] shall be unique.

revocationDate: Date of revocation for a given certificate. Follows the encoding of Time used for validity. See clause 12.5.5 "validity" on page 327.

crlExtensions: The syntax of the Extensions element is reproduced in clause 12.11.1.13 "Extensions" on page 363. This element allows multiple extension elements to be carried. The set of extensions defined for certificates and CRLs is reproduced at clause 12.11.2 "Standard certificate extensions" on page 363.

The following crlExtension shall be supported:

- AuthorityKeyIdentifier as defined in clause 12.4.2.1.

  This extension identifies the certificate that is needed to check the signature of the CRL.

  The crlExtension `AuthorityKeyIdentifier` shall be included in every CRL. MHP implementations shall use the `AuthorityKeyIdentifier` to find the certificate that carries the public key that is used to check the signature of the CRL and ignore any CRLs where this check fails or where the AuthorityKeyIdentifier is not present.

Other crlExtensions are optional.

12.9.1.9 CRL Processing

CRLs, or the information they contain (including serial numbers), shall be kept in persistent storage in the MHP terminal.

When an MHP terminal finds a file with the file name format given in clause 12.9.1.4 "CRL file location and naming convention" on page 351, it shall do the following sequence:

a) Get the field thisUpdate and compare it with the last update for the CRL. If thisUpdate is not after the last update, ignore the CRL.

b) The signature of the CRL is verified and the signing certificate is verified to be from a trusted source. If the certificate cannot be trusted, the CRL is ignored. For CRLs which are authenticated by a non-root certificate, the certificate shall be trusted only if the chain from that certificate to the root in its certificate file is verified and the root certificate is one of those resident in the MHP receiver. For CRLs which are authenticated by a root certificate, the certificates which can be trusted shall be the root certificates resident in the MHP receiver.

c) Process the content of the CRL message:
- Store the list of serial numbers of revoked certificates in persistent storage.
- Update the stored value of thisUpdate with the value from the CRL.

d) If a CA's certificate has been revoked, remove its CRL (or the information which that CRL contained) if it was stored in the MHP terminal.

During the validation process of a certificate chain, the CRL of each certification authority on the certification path is checked.

12.9.2 Root certificate management

12.9.2.1 Introduction

Every compliant MHP terminal will have to maintain a set of X.509 root certificates in persistent storage. These root certificates will be placed in the MHP terminal by its manufacturer during the manufacturing process.

It could be necessary to update the set of root certificates for MHP terminals that are already deployed. Possible reasons that could require such an update include:

- A root certificate becoming compromised.
- Technical developments (such as the emergence of factorization algorithms) that require the use of greater key lengths in root certificates to provide adequate security.
- Retirement of a certificate due to its age.

So, It is necessary to have a standard mechanism to update this set.

NOTE: A manufacturer specific mechanism could require a different message for each manufacturer and so would be more expensive in terms of broadcast bandwidth.

The mechanism specified here uses messages called RCMM (Root Certificate Management Messages). These messages contain a set of new root certificates to add and a reference to the root certificates to remove.

12.9.2.2 Security of RCMM

RCMM are authenticated by multiple signatures. An RCMM message will be accepted by an MHP terminal if and only if it has at least N signatures.

The initial value of N and the maximum value of N that MHP terminals will ever be asked to support are specified in clause 12.12 "Platform minima" on page 367.

The use of multiple signatures guarantees that the set of root certificates can be updated securely even if one of the root certificates has been compromised.

RCMM can update the number of signatures required for future RCMM using the nextNbOfSignature field.

The RCMM message shall be signed with the key of the certificates to be removed.

12.9.2.3 Format of RCMM

The encoding of RCMM is ASN.1 DER (see ASN.1 [57]):

```
URCMM ::= SEQUENCE {
      issuer                                Name,
      thisUpdate                            Time,
      nextNbOfSignatures                    INTEGER OPTIONAL,
      addedCertificates                     SET OF Certificate
      removedCertificates                   SET OF CertificatesReference }

CertificatesReference::= SEQUENCE {
      issuerName                            Name,
      serialNumber                          CertificateSerialNumber }
```

issuer: Identification of the certification authority which has issued the message.

thisUpdate: Date of the issue of the message.

nextNbOfSignatures: This field could be used to change the minimum number of valid signatures required for an RCMM message. This value will be applied to the next RCMMs not to itself!

addedCertificates: List of root certificates to be added in persistent storage

removedCertificates: Reference of the root certificates to be removed from persistent storage

```
RCMM   ::= SEQUENCE {
      uRcmm                                URCMM,
      signatures                           SET OF SignatureInfo }

SignatureInfo ::= SEQUENCE {
      signerName                           Name,
      signatureAlgorithm                   AlgorithmIdentifier,
      signatureValue                       BIT STRING }
```

NB: The signatures are computed on the whole content of uRCMM.

issuerName: Name of the issuer of the root certificate to remove (for a self signed root certificate this field is equal to the subject name).

serialNumber: Serial number of the root certificate to remove.

12.9.2.4 Distribution of RCMM

RCMM are distributed to the MHP terminals in the broadcast MPEG Transport Stream. The RCMM from a particular CA are supplied to at least the broadcasters that use that CA.

The most recent RCMM shall be placed in a file named:

```
"dvb.rcmm"
```

The RCMM files are inserted on a sample basis specified by the CA. These files shall be located in root directories of the object carousels broadcast.

Older RCMMs shall be placed in files named `"dvb.rcmm."<x>` where `x` is a textual representation of an integer decimal number without leading zeroes. The range of values represented in any single directory shall start with 1 and increment in steps of 1.The first unused integer value in the ascending sequence indicates the end of the range. RCMMs shall be sorted in chronological order with the oldest RCMM in `dvb.rcmm.1`. The RCMM signalled as `"dvb.rcmm"` shall not be duplicated in the `"dvb.rcmm."<x>` sequence.

12.9.2.5 RCMM Processing

When an MHP terminal finds RCMM messages in a root directory, it shall perform the following sequence of operations:

a) If there has never been any RCMM processing (last update to be stored in the receiver not initialized), then process sequentially according to steps (b) to (j) all `dvb.rcmm.<x>` messages in ascending order including the `dvb.rcmm` message as the final step. Otherwise, identify the `dvb.rcmm.<x>` message whose field thisUpdate is the closest after the last update and process sequentially according to steps (b) to (j) all following `dvb.rcmm.<x>` in ascending order including the `dvb.rcmm` message as the final step. If the field thisUpdate from the `dvb.rcmm` message is not after the last update, ignore the messages.

For each RCMM message identified in step (a), perform the following:

b) If there is a nextNbOfSignatures in the RCMM, and if nextNbOfSignatures will be greater than the number of remaining root CAs (i.e. the number of root CA that would remain if the RCMM was processed), ignore the RCMM.

c) Get the number signatures from the RCMM, if this number is lower than the minimum required, ignore the message.

d) If the RCMM contains references to root certificates to remove, check this RCMM is signed with the keys belonging to the certificates to be removed. If at least one of these signatures is missing, ignore the RCMM message.

e) Check all the signatures of the RCMM. If any of the signatures is invalid, ignore the message.

f) Process the content of the RCMM message, add and remove root certificates according to the RCMM message.

g) Store in persistent storage the date of thisUpdate as the date of the last update.

h) If a root certificate is removed, the CRLs associated are also removed.

i) If there is a nextNbOfSignatures in the RCMM, replace the minimum number of signature required by the nextNbOfSignatures.

j) Since this process will permanently modify the terminal behaviour and is highly sensitive for security, this is allowed to have an implementation dependent enabling / confirmation step prior to performing the action (e.g. it may prompt the end user for verification). Such an enabling / confirmation step is allowed to reject this RCMM action.

The implementation shall ensure the following:

- The integrity of the persistent storage shall be kept if the power supply fails for any reason during the processing of any RCMM message in a `dvb.rcmm.<x>` file or the `dvb.rcmm` file. i.e. If the power is switched off during the processing of the RCMM message, the set of root certificates shall remain as if processing of that RCMM message had not started.

  I.e. If the power is switched off during the processing of the RCMM message, the set of root certificates shall remain as if processing of the RCMM message had not started.

- The minimum amount of persistent storage reserved to store the list of root certificate is specified in clause 12.12 "Platform minima" on page 367. If there is not enough persistent storage available to process an RCMM message, it shall be ignored (to prevent inconsistencies).

NOTE: The present document is intentionally silent about the impact of RCMM processing on MHP applications which are already running.

12.9.2.6 Example: Renewal of a root certificate

Let's assume the root certification authority RCA has two certificates in each MHP termninal:RC0 and RC1. If RC0 is compromised, RCA may wish to renew this certificate using the following steps:

a) RCA generates a new key pair and a new self signed certificate RC2.

b) RCA provides new certificates signed by RC1 to all the entities authenticated by RCA.

c) Wait until all entities authenticated by RCA have switched to the new certificates and have stopped using RC0.

d) RCA generates an RCMM message to add RC2 and to remove RC0. This RCMM will be double signed by RC0 and RC1 keys.

e) RCA will delivers this RCMM message to the broadcasters to update the MHP terminals.

   (The broadcasting period should be long enough to update almost all of the MHP terminals in the field).

f) RCA will provide RC1 and RC2 to set top box manufacturers as the new list of root certificates to put in set top boxes.

12.9.3 Test certificates

There shall be a means to make test root certificates (as required by clause 12.12 "Platform minima" on page 367) available while the terminal is being tested. The method for doing so shall be implementation dependent; it may involve either replacing non-test root certificates, or storing test root certificates in addition to non-test root certificates.

Test root certificates shall only be functional when the terminal is being tested. Objects signed with test root certificates shall not be used other than for the purposes of testing.

The present document is intentionally silent on the test root certificates to be used.

12.10 Security on the return channel

General purpose security for the return channel is provided by the TLS (Transport Layer Security) protocol as described in RFC 2246 [63].

12.10.1 MHP functionality

When implementing return channel security the MHP shall:

- Implement the cipher suites identified in clause 12.10.2.

The MHP is not required to implement the following:

- The functionality of being a server for the TLS protocol.
- Compliance with SSL 3.0.

MHP terminals shall support client authentication for TLS where the source of keys is provided to the class `javax.net.ssl.SSLContext` via a `javax.net.ssl.KeyManager`.

12.10.2 TLS cipher suites

The minimum set of cypher tools that implementations of the MHP profile of TLS shall implement are:

- RSA ().
- MD5.
- SHA-1.
- DES.
- AES

More detail of this requirement is given in table 139 (see RFC 2246 [63] for definition of the terms) which identifies which methods are required in an MHP. TLS cipher suites using AES are defined in RFC 3268 [122].

Table 139: Profile of cipher suites that implementations are required to support

CipherSuite	Key Exchange	Cipher	Hash	Value (hex)	MHP status
TLS_NULL_WITH_NULL_NULL (note)	NULL	NULL	NULL	00, 00	Required
TLS_RSA_WITH_NULL_MD5	RSA	NULL	MD5	00, 01	Required
TLS_RSA_WITH_NULL_SHA	RSA	NULL	SHA-1	00, 02	Required
TLS_RSA_EXPORT_WITH_DES40_CBC_SHA	RSA_ EXPORT	DES40_CBC	SHA-1	00, 08	Required
TLS_RSA_WITH_DES_CBC_SHA	RSA	DES_CBC	SHA-1	00, 09	Required
TLS_RSA_WITH_3DES_EDE_CBC_SHA	RSA	3DES_EDE_CBC	SHA-1	00, 0A	Required
TLS_RSA_WITH_AES_128_CBC_SHA	RSA	AES	SHA-1	00, 2F	Required
TLS_RSA_WITH_AES_256_CBC_SHA	RSA	AES	SHA-1	00, 35	Required
NOTE: This cipher suite is only used by a TLS implementation during the negotiation of a connection. It is not required to be enabled as a cipher suite that is available for a negotiated connection.					

NOTE: The ciphers TLS_RSA_WITH_NULL_MD5 and TLS_RSA_WITH_NULL_SHA provide integrity checking but without confidentiality (i.e. data are in clear). Data encryption is very time consuming for a server. They are useful for applications in which data don't need to be encrypted but in which data integrity is very important. For these applications, the server will only have to compute a HMAC for every message exchanged.

12.10.3 Downloading of certificates for TLS

12.10.3.1 Introduction

Before the TLS connection can be established, the MHP has to ensure that the certificate list sent by a server contains at least one trusted certificate. In computer environment, this is simply done by checking the list of certificates against one certificate that is resident in the computer.

In the MHP environment, a downloadable application can establish a TLS session. This can be used for e.g. sensitive transactions. In such a scenario, the application knows which server to connect to, and also knows one certificate against which it can check that a given certificate chain contains the expected certificate that it knows and trusts.

The API that is used by a downloadable application is described in clause 11.8.2 "APIs for return channel security" on page 295. The process of server authentication involves the checking of the certificate chain sent by the TLS server.

This clause specifies how the MHP terminal identifies and manages the TLS certificates that are downloaded along with the application and how verification (or otherwise) is presented to the application).

12.10.3.2 Usage of certificate in TLS

12.10.3.2.1 When certificates are delivered with the application

One or several TLS root certificates can be optionally broadcast along with the application.

When the certificate chain sent by the TLS server is not compatible with any of the TLS root certificates sent with the application an `IOException` will be thrown.

12.10.3.2.1.1 Certificate file naming and location

To facilitate certificate chain checking the name of the certificate file shall be:

```
dvb.tls.organisation_id.application_id.x
```

where:

- "x" is an optional string discriminating certificates where necessary.
- The encoding of `organisation_id` and `application_id` are specified in clause 14.5 "Text encoding of application identifiers" on page 398.

Location of the TLS certificates is application type dependant. See table 140.

Table 140: TLS certificate locator semantics

application_type	description
0x0000	reserved
0x0001	For DVB-J the TLS certificate(s) are placed in the base directory of the application as defined in clause 10.9.2 "DVB-J application location descriptor" on page 244.
0x0002	For DVB-HTML the TLS certificate(s) are placed at the physical root of the application as defined in clause 10.10.2 "DVB-HTML application location descriptor" on page 246.
0x0003 to 0xFFFF	reserved for future use

12.10.3.2.1.2 Certificate authentication

To be considered valid TLS certificates the certificate files shall be authenticated members of the same authenticated sub-tree as the application.

12.10.3.2.1.3 Certificate file format

Each TLS certificate file contains a single certificate. The file format is the same as that used by certificate files for application authentication, see clause 12.4.3 "CertificateFile" on page 324.

12.10.3.2.2 When no certificates are provided

When there are no TLS certificates sent with the application then the implementation will allow connection to be established to any server. The application can then use the JSSE API (see clause 11.8.2) to retrieve the certificate chain and check that it contains what the application requires. In such a case both name and public keys need to be checked by the application if the application wants to be sure of the remote server.

12.10.3.2.3 CRL distribution points

MHP implementations are free to ignore this field during TLS server authentication over the return channel.

12.11 The internet profile of X.509 (informative)

The text that follows summarizes the technical features of RFC 2459 [58] and references the different profile decisions made for the different MHP application areas.

12.11.1 Main part of the certificate

12.11.1.1 Certificate

```
Certificate  ::=  SEQUENCE  {
        tbsCertificate       TBSCertificate,
        signatureAlgorithm   AlgorithmIdentifier,
        signatureValue       BIT STRING }
```

12.11.1.2 signatureAlgorithm

The signatureAlgorithm field contains the identifier for the cryptographic algorithm used by the CA to sign this certificate.

An algorithm identifier is defined by the following ASN.1 structure:

```
AlgorithmIdentifier  ::=  SEQUENCE {
              algorithm                OBJECT IDENTIFIER,
              parameters               ANY DEFINED BY algorithm OPTIONAL }
```

The algorithm identifier is used to identify a cryptographic algorithm. The OBJECT IDENTIFIER component identifies the algorithm. The contents of the optional parameters field will vary according to the algorithm identified.

This field MUST contain the same algorithm identifier as the signature field in the sequence TBSCertificate.

See clause 12.5.1 "signatureAlgorithm" on page 326.

NOTE: RFC 2459 [58] section 7.2 lists the signature algorithms supported by that profile.

For all of the currently specified algorithms possible non-NULL parameters shall be ignored.

12.11.1.3 signatureValue

The signatureValue field contains a digital signature computed upon the ASN.1 DER encoded tbsCertificate. The ASN.1 DER encoded tbsCertificate is used as the input to the signature function. This signature value is then ASN.1 encoded as a BIT STRING and included in the Certificate's signature field.

NOTE: RFC 2459 [58] section 7.2 describes in detail this process for the algorithms supported by that profile.

By generating this signature, a CA certifies the validity of the information in the tbsCertificate field. In particular, the CA certifies the binding between the public key material and the subject of the certificate.

See clause 12.5.2 "signatureValue" on page 326.

12.11.1.4 tbsCertificate

The field contains the names of the subject and issuer, a public key associated with the subject, a validity period, and other associated information. The tbscertificate may also include extensions.

The pair issuer / serialNumber uniquely identifies the certificate.

```
TBSCertificate  ::=  SEQUENCE  {
        version         [0]  EXPLICIT Version DEFAULT v1,
        serialNumber         CertificateSerialNumber,
        signature            AlgorithmIdentifier,
        issuer               Name,
        validity             Validity,
        subject              Name,
        subjectPublicKeyInfo SubjectPublicKeyInfo,
        issuerUniqueID  [1]  IMPLICIT UniqueIdentifier OPTIONAL,
                             -- If present, version shall be v2 or v3
        subjectUniqueID [2]  IMPLICIT UniqueIdentifier OPTIONAL,
                             -- If present, version shall be v2 or v3
        extensions      [3]  EXPLICIT Extensions OPTIONAL
                             -- If present, version shall be v3 }
```

12.11.1.5 version

This field describes the version of the encoded certificate. When extensions are used, as expected in this profile, use X.509 version 3 (value is 2). If no extensions are present, but a UniqueIdentifier is present, use version 2 (value is 1). If only basic fields are present, use version 1 (the value is omitted from the certificate as the default value).

Implementations SHOULD be prepared to accept any version certificate. At a minimum, conforming implementations MUST recognize version 3 certificates.

```
Version  ::=  INTEGER { v1(0), v2(1), v3(2) }
```

Generation of version 2 certificates is not expected by implementations based on this profile.

See clause 12.5.3 "version" on page 326.

12.11.1.6 serialNumber

The serial number is an integer assigned by the CA to each certificate. It MUST be unique for each certificate issued by a given CA (i.e. the issuer name and serial number identify a unique certificate).

```
CertificateSerialNumber  ::=  INTEGER
```

12.11.1.7 signature

This field contains the algorithm identifier for the algorithm used by the CA to sign the certificate.

This field MUST contain the same algorithm identifier as the signatureAlgorithm field in the sequence Certificate. The contents of the optional parameters field will vary according to the algorithm identified.

If the signatureAlgorithm is different from the algorithm identifier in the signature field, the signature shall be rejected as being inconsistent.

See clause 12.5.1 "signatureAlgorithm" on page 326.

NOTE: RFC 2459 [58] section 7.2 lists the supported signature algorithms for that profile.

12.11.1.8 issuer

The issuer field identifies the entity who has signed and issued the certificate. The issuer field MUST contain a non-empty distinguished name (DN). The issuer field is defined as the X.501 type Name. ITU-T Recommendation X.501 [53] Name is defined by the following ASN.1 structures:

```
Name::= CHOICE {
        RDNSequence }

RDNSequence::= SEQUENCE OF RelativeDistinguishedName

RelativeDistinguishedName::=
        SET OF AttributeTypeAndValue

AttributeTypeAndValue::= SEQUENCE {
        type          AttributeType,
        value         AttributeValue }

AttributeType::= OBJECT IDENTIFIER

AttributeValue::= ANY DEFINED BY AttributeType

DirectoryString::= CHOICE {
        teletexString                           TeletexString (SIZE (1..MAX)),
        printableString                         PrintableString (SIZE (1..MAX)),
        universalString                         UniversalString (SIZE (1..MAX)),
        utf8String                              UTF8String (SIZE (1.. MAX)),
        bmpString                               BMPString (SIZE (1..MAX)) }
```

The Name describes a hierarchical name composed of attributes, such as country name, and corresponding values, such as US. The type of the component AttributeValue is determined by the AttributeType; in general it will be a DirectoryString.

See clause 12.5.4 "issuer" on page 326.

12.11.1.9 validity

The certificate validity period is the time interval during which the CA warrants that it will maintain information about the status of the certificate. The field is represented as a SEQUENCE of two dates: the date on which the certificate validity period begins notBefore) and the date on which the certificate validity period ends (notAfter). Both notBefore and notAfter may be encoded as UTCTime or GeneralizedTime.

CAs conforming to this profile MUST always encode certificate validity dates through the year 2049 as UTCTime; certificate validity dates in 2050 or later MUST be encoded as GeneralizedTime.

```
Validity::= SEQUENCE {
        notBefore      Time,
        notAfter       Time }

Time::= CHOICE {
        utcTime        UTCTime,
        generalTime    GeneralizedTime }
```

A subject certificate's validity is limited by the validity period of the issuer's certificate.

12.11.1.9.1 UTCTime

The universal time type, UTCTime, is a standard ASN.1 type intended for representation of dates and time. UTCTime specifies the year through the two low order digits and time is specified to the precision of one minute or one second. UTCTime includes either Z (for Zulu, or Greenwich Mean Time) or a time differential.

For the purposes of this profile, UTCTime values MUST be expressed Greenwich Mean Time (Zulu) and MUST include seconds (i.e. times are YYMMDDHHMMSSZ), even where the number of seconds is zero. Conforming systems MUST interpret the year field (YY) as follows:

- Where YY is greater than or equal to 50, the year shall be interpreted as 19YY; and
- Where YY is less than 50, the year shall be interpreted as 20YY.

12.11.1.9.2 GeneralizedTime

The generalized time type, GeneralizedTime, is a standard ASN.1 type for variable precision representation of time. Optionally, the GeneralizedTime field can include a representation of the time differential between local and Greenwich Mean Time.

For the purposes of this profile, GeneralizedTime values MUST be expressed Greenwich Mean Time (Zulu) and MUST include seconds (i.e. times are YYYYMMDDHHMMSSZ), even where the number of seconds is zero. GeneralizedTime values MUST NOT include fractional seconds.

See clause 12.5.5 "validity" on page 327.

12.11.1.10 subject

The subject field identifies the entity associated with the public key stored in the SubjectPublicKeyInfo field. It thus represents the entity whose public key is certified. It is encoded as a Distinguished Name (see clause 12.11.1.8 "issuer" on page 360). This name must be unique for each subject entity certified by one CA as defined by the issuer field.

12.11.1.10.1 issuerUniqueID

This field is optional and appears in X.509 v2 or v3 only. It enables to reuse the IssuerName over time. It is redundant with the issuer Name, and it is proposed here that this field be not parsed by the client.

12.11.1.10.2 subjectUniqueID

This field is optional and appears in X.509 v2 or v3 only. It enables to reuse the subjectName over time. It is redundant with the subject Name, and it is proposed here not to use this field.

The subject name may be carried in the subject field and/or the subjectAltName extension. If the subject is a CA (e.g. the basic constraints extension, as discussed in RFC 2459 [58] section 4.2.1.10, is present and the value of cA is TRUE,) then the subject field MUST be populated with a non-empty distinguished name matching the contents of the issuer field (see RFC 2459 [58] section 4.1.2.4) in all certificates issued by the subject CA. If subject naming information is present only in the subjectAltName extension (e.g. a key bound only to an email address or URI), then the subject name MUST be an empty sequence and the subjectAltName extension MUST be critical.

Where it is non-empty, the subject field MUST contain an X.500 distinguished name (DN). The DN MUST be unique for each subject entity certified by the one CA as defined by the issuer name field. A CA may issue more than one certificate with the same DN to the same subject entity.

The subject name field is defined as the X.501 type Name. Implementation requirements for this field are those defined for the issuer field (see RFC 2459 [58] section 4.1.2.4). When encoding attribute values of type DirectoryString, the encoding rules for the issuer field MUST be implemented. Implementations of the present document MUST be prepared to receive subject names containing the attribute types required for the issuer field. Implementations of the present document SHOULD be prepared to receive subject names containing the recommended attribute types for the issuer field. The syntax and associated object identifiers (OIDs) for these attribute types are provided in the ASN.1 modules in RFC 2459 [58] Appendices A and B. Implementations of the present document MAY use these comparison rules to process unfamiliar attribute types (i.e. for name chaining). This allows implementations to process certificates with unfamiliar attributes in the subject name.

In addition, legacy implementations exist where an RFC 822 name is embedded in the subject distinguished name as an EmailAddress attribute. The attribute value for EmailAddress is of type IA5String to permit inclusion of the character '@', which is not part of the PrintableString character set. EmailAddress attribute values are not case sensitive (e.g. "fanfeedback@redsox.com" is the same as "FANFEEDBACK@REDSOX.COM").

Conforming implementations generating new certificates with electronic mail addresses MUST use the rfc822Name in the subject alternative name field (see RFC 2459 [58] section 4.2.1.7) to describe such identities. Simultaneous inclusion of the EmailAddress attribute in the subject distinguished name to support legacy implementations is deprecated but permitted.

12.11.1.11 SubjectPublic Key Info

This field is used to carry the public key which is certified and identifies the algorithm with which the key is used. The algorithm is identified using the AlgorithmIdentifier structure (see clause 12.11.1.2 "signatureAlgorithm" on page 359) and the public key is represented as a bitstring.

```
SubjectPublicKeyInfo  ::=  SEQUENCE  {
        algorithm            AlgorithmIdentifier,
        subjectPublicKey     BIT STRING  }
```

See clause 12.5.7 "SubjectPublic Key Info" on page 328.

NOTE: RFC 2459 [58] section 7.3 lists the supported algorithms for that profile.

12.11.1.12 Unique Identifiers

These fields may only appear if the version is 2 or 3. The subject and issuer unique identifiers are present in the certificate to handle the possibility of reuse of subject and/or issuer names over time. This profile recommends that names not be reused for different entities and that Internet certificates not make use of unique identifiers. CAs conforming to this profile SHOULD NOT generate certificates with unique identifiers. Applications conforming to this profile SHOULD be capable of parsing unique identifiers and making comparisons.

```
UniqueIdentifier  ::=  BIT STRING
```

See clause 12.5.8 "Unique Identifiers" on page 328.

12.11.1.13 Extensions

This field may only appear if the version is 3 and is optional. If present, this field is a SEQUENCE of one or more certificate extensions.

```
Extensions  ::=  SEQUENCE SIZE (1..MAX) OF Extension

Extension  ::=  SEQUENCE  {
        extnID      OBJECT IDENTIFIER,
        critical    BOOLEAN DEFAULT FALSE,
        extnValue   OCTET STRING  }
```

The extensions are defined in ITU-T Recommendation X.509 [54].

See clause 12.5.9 "Extensions" on page 328.

12.11.2 Standard certificate extensions

See table 131 "Profile for standard certificate extensions" on page 328.

12.11.2.1 Authority key identifier

This extension is used where an issuer has multiple signing keys. It provides a means of finding the public key that can be used to check the signature of the certificate.

The identification can be based on either the keyIdentifier or the on the pair (authorityCertIssuer, AuthorityCertSerialNumber). It is recommended to use the pair (authorityCertIssuer, AuthorityCertSerialNumber) instead of the keyIdentifier because there is no common agreement on the way to compute a unique KeyIdentifier.

```
AuthorityKeyIdentifier ::= SEQUENCE {
  keyIdentifier             [0] KeyIdentifier           OPTIONAL,
  authorityCertIssuer       [1] GeneralNames            OPTIONAL,
  authorityCertSerialNumber [2] CertificateSerialNumber OPTIONAL }
```

12.11.2.2 Subject key identifier

This extension provides of identifying certificates that contain a particular public key.

```
SubjectKeyIdentifier ::= KeyIdentifier
```

12.11.2.3 Key usage

The key usage extension defines the purpose of the key contained in the certificate.

```
keyUsage ::= BIT STRING {
  digitalSignature      (0),
  nonRepudiation        (1),
  keyEncipherment       (2),
  dataEncipherment      (3),
  keyAgreement          (4),
  keyCertSign           (5),
  cRLSign               (6),
  encipherOnly          (7),
  decipherOnly          (8)
}
```

12.11.2.4 Private key usage period

This field is used to defined a period of validity for the private key which is different from the period of validity of the certificate. This is only meaningful for digital signature keys.

```
privateKeyUsagePeriod EXTENSION ::= {
  SYNTAX        PrivateKeyUsagePeriod
  IDENTIFIED BY id-ce-privateKeyUsagePeriod }

PrivateKeyUsagePeriod ::= SEQUENCE {
  notBefore        [0]  GeneralizedTime OPTIONAL,
  notAfter         [1]  GeneralizedTime OPTIONAL }
  ( WITH COMPONENTS {..., notBefore PRESENT} |
    WITH COMPONENTS   {..., notAfter PRESENT} )
```

12.11.2.5 Certificate policies

This field is used to define a policy defining the purpose for which the certificate may be used.

Applications may have a list of specific policies they will accept, the certificate validation software must be able to compare the policy OIDs found in the certificate to that list.

```
certificatePolicies EXTENSION ::= {
  SYNTAX      CertificatePoliciesSyntax
  IDENTIFIED BY id-ce-certificatePolicies }

CertificatePoliciesSyntax ::= SEQUENCE SIZE (1..MAX) OF PolicyInformation

PolicyInformation ::= SEQUENCE {
  policyIdentifier   CertPolicyId,
  policyQualifiers   SEQUENCE SIZE (1..MAX) OF
                     PolicyQualifierInfo OPTIONAL }

CertPolicyId ::= OBJECT IDENTIFIER

PolicyQualifierInfo ::= SEQUENCE {
  policyQualifierId          CERT-POLICY-QUALIFIER.&id
                             ({SupportedPolicyQualifiers}),
  qualifier                  CERT-POLICY-QUALIFIER.&Qualifier
          ({SupportedPolicyQualifiers}{@policyQualifierId})
          OPTIONAL }

SupportedPolicyQualifiers CERT-POLICY-QUALIFIER ::= { ... }
```

12.11.2.6 Policy mappings

This field is used to define equivalence between policies from different CA's policy Domain.

```
policyMappings EXTENSION ::= {
  SYNTAX      PolicyMappingsSyntax
  IDENTIFIED BY id-ce-policyMappings }
```

```
PolicyMappingsSyntax ::= SEQUENCE SIZE (1..MAX) OF SEQUENCE {
  issuerDomainPolicy    CertPolicyId,
  subjectDomainPolicy   CertPolicyId }
```

12.11.2.7 Subject Alternative Name

This field is used to define additional identities for the subject name of the certificate (such as an internet email address).

```
subjectAltName EXTENSION ::= {
  SYNTAX    GeneralNames
  IDENTIFIED BY id-ce-subjectAltName }

GeneralNames ::= SEQUENCE SIZE (1..MAX) OF GeneralName

GeneralName ::= CHOICE {
  otherName                 [0]  INSTANCE OF OTHER-NAME,
  rfc822Name                [1]  IA5String,
  dNSName                   [2]  IA5String,
  x400Address               [3]  ORAddress,
  directoryName             [4]  Name,
  ediPartyName              [5]  EDIPartyName,
  uniformResourceIdentifier [6]  IA5String,
  iPAddress                 [7]  OCTET STRING,
  registeredID              [8]  OBJECT IDENTIFIER }
```

12.11.2.8 Issuer Alternative Name

This field is similar to the previous one for the issuer identity.

```
issuerAltName EXTENSION ::= {
  SYNTAX      GeneralNames
  IDENTIFIED BY id-ce-issuerAltName }
```

12.11.2.9 Subject Directory attributes

This field is used to carry optional directory attributes associated with the subject.

```
subjectDirectoryAttributes EXTENSION ::= {
  SYNTAX      AttributesSyntax
  IDENTIFIED BY id-ce-subjectDirectoryAttributes }

AttributesSyntax ::= SEQUENCE SIZE (1..MAX) OF Attribute
```

12.11.2.10 Basic Constraints

This field indicates if the subject of the certificate is a certification authority and how deep a certification path may exist through that path.

This extension shall appear in every CA Certificates. It will be used to prevent unauthorized entities to act as a CA.

```
basicConstraints EXTENSION ::= {
  SYNTAX      BasicConstraintsSyntax
  IDENTIFIED BY id-ce-basicConstraints }

BasicConstraintsSyntax ::= SEQUENCE {
  cA                    BOOLEAN DEFAULT FALSE,
  pathLenConstraint     INTEGER (0..MAX) OPTIONAL }
```

12.11.2.11 Name Constraints

This field indicates a namespace within which all subject names in subsequent certificates in a certification path shall be located.

```
nameConstraints EXTENSION ::= {
  SYNTAX      NameConstraintsSyntax
  IDENTIFIED BY id-ce-nameConstraints }

NameConstraintsSyntax ::= SEQUENCE {
  permittedSubtrees          [0]  GeneralSubtrees OPTIONAL,
  excludedSubtrees           [1]  GeneralSubtrees OPTIONAL }
```

```
GeneralSubtrees ::= SEQUENCE SIZE (1..MAX) OF GeneralSubtree

GeneralSubtree ::= SEQUENCE {
  base                GeneralName,
  minimum        [0]  BaseDistance DEFAULT 0,
  maximum        [1]  BaseDistance OPTIONAL }

BaseDistance ::= INTEGER (0..MAX)
```

12.11.2.12 Policy Constraints

This field is only used in CA's certificate (i.e. not in end entity certificate). It is used to prohibit policy mapping or to require that each certificate in a path contain an acceptable policy identifier.

```
policyConstraints EXTENSION ::= {
  SYNTAX      PolicyConstraintsSyntax
  IDENTIFIED BY id-ce-policyConstraints }

PolicyConstraintsSyntax ::= SEQUENCE {
  requireExplicitPolicy   [0] SkipCerts OPTIONAL,
  inhibitPolicyMapping    [1] SkipCerts OPTIONAL }

SkipCerts ::= INTEGER (0..MAX)
```

12.11.2.13 Extended key usage field

This field is an extensions of the previous field keyUsage. It is used to define more purposes for which the certified public key may be used.

```
extKeyUsage EXTENSION ::= {
  SYNTAX      SEQUENCE SIZE (1..MAX) OF KeyPurposeId
  IDENTIFIED BY id-ce-extKeyUsage }

KeyPurposeId ::= OBJECT IDENTIFIER
```

12.11.2.14 CRL Distribution points

This field defines how CRL (Certificate revocation list) information can be obtained.

```
cRLDistributionPoints EXTENSION ::= {
  SYNTAX         CRLDistPointsSyntax
  IDENTIFIED BY  id-ce-cRLDistributionPoints }

CRLDistPointsSyntax ::= SEQUENCE SIZE (1..MAX) OF DistributionPoint

DistributionPoint ::= SEQUENCE {
  distributionPoint  [0]  DistributionPointName OPTIONAL,
  reasons            [1]  ReasonFlags OPTIONAL,
  cRLIssuer          [2]  GeneralNames OPTIONAL }

DistributionPointName ::= CHOICE {
  fullName                  [0]  GeneralNames,
  nameRelativeToCRLIssuer   [1]  RelativeDistinguishedName }

ReasonFlags ::= BIT STRING {
  unused                (0),
  keyCompromise         (1),
  cACompromise          (2),
  affiliationChanged    (3),
  superseded            (4),
  cessationOfOperation  (5),
  certificateHold       (6) }
```

12.12 Platform minima

MHP platform hardware is required to support the following minimum sizes to support the MHP security model:

- A value of 2 for N in clause 12.9.2.2 "Security of RCMM" on page 354.
- A minimum depth of 5 levels in the certificate chain.
- A minimum of 8 CRLs.
- A minimum of 10 entries per CRL.
- A minimum of 3 root certificates (regardless of the number of underlying root certificate authorities).
- A minimum of 3 root certificates for testing (see clause 12.9.3 "Test certificates" on page 356).

12.13 Plug-ins

The security aspects for the plug-in are the same as for any other DVB-J application. The security aspects of the delegated application cannot exceed the permissions available to the plug-in.

So, the plug-in will normally request the set of permissions required to support a delegated application. For a delegated application that follows the security model defined in the present document (e.g. a DVB-HTML application), the plug-in shall implement a security system to grant a sub-set of these permissions to the delegated application (see annex AF "(normative): Plug-in APIs" on page 1033). For a delegated application whose security model does not follow the present document, the plug-in can optionally implement a private security system to manage a sub-set of these permissions to the delegated application.

12.14 Applications loaded from an interaction channel

Same as for applications delivered over the broadcast channel except where specified otherwise below.

12.14.1 Permission for application loading from the return channel

The following policy covers loading of applications over the interaction channel. It includes both initial loading to start and application and dynamic loading during the lifetime of an application. It covers both the code of an application and supporting data however loaded.

- The user enters a locator specifying the location of the AIT file into the navigator:

  In this case the user implicitly gives permission for the connection to retrieve the AIT when they supply the locator.

  Applications launched by this mechanism inherit limited rights to use the return channel. Where the protocol ID is "3" the application gets rights to access the files specified by the transport protocol descriptor.

  Additional permissions can be granted by the normal permissions mechanism.

- A service has a broadcast AIT and the transport protocol for the application is type "3" so ALL files are provided by the interaction channel.

  If the application launch is initiated by another application using the listing and launching API and it is necessary to open the interaction channel before the permissions of the launched application are evident then the permissions of the launching application are considered.

  If the application launch is initiated from service selection (autostart application on a service) then the behaviour depends on policy in the MHP terminal.

NOTE: This behaviour may, for example, be controlled by a terminal user preference.

- A service has a broadcast AIT but a proportion of the files forming the application are provided via the interaction channel.

  If the permission request file and the authentication infrastructure are available without opening the interaction channel then these can be used to determine if opening the interaction channel is suitably authorized.

- An application selects a service using a locator pointing to an AIT file delivered over the return channel to perform service selection

  In this case the service selection succeeds only if the application has permission to do a service selection and the appropriate return channel access permission, as described in clause 12.6.2.12.2 "Signed applications" on page 342.

If the permission request file is not available then, as above, the behaviour depends on policy in the MHP terminal.

12.15 Stored and cached applications

At time of execution of an application, all files in stored applications must have been fully authenticated as defined by clause 12.4.4 "Integration" on page 325. The extent to which this authentication is performed at time of storage and time of execution differs as described below. In all cases, the certificates used must be valid at the time of execution - (e.g. they have not been expired or revoked, and the root certificates they use have not been removed).

The normal constraints on authentication, including clause 11.2.3 "Class Loading" on page 262, shall be respected when executing an application. (This applies even if some class files are stored but others are not.) This may lead to some stored class files failing authentication even if all certificates are still valid.

Files that fail authentication shall be treated in the same manner as files that fail authentication from a carousel. If a stored file fails authentication the implementation shall not fall back to loading that file from carousel.

12.15.1 Stand-alone stored applications

At time of application storage the stored files must be authenticated as if they were being loaded by the application. At this stage the terminal shall not treat class files specially.

In the case that a certificate that was validated during the store process has been revoked or has expired, any additional certificate chains that were not validated at storage time shall now be fully validated using the same rules as would apply to such a file from broadcast - i.e. clause 12.4.3.6 "Authentication rules" on page 325.

If stand-alone stored applications access broadcast files (e.g. using the org.dvb.dsmcc API), the full requirements of clause 12.4.4 "Integration" on page 325 shall apply to those files.

At time of execution, it shall be checked that any certificates used to authenticate credentials have neither expired nor been revoked.

12.15.2 Cached applications

It is implementation dependent how much authentication is performed at the time of storage.

NOTE: As an optimisation, implementations may calculate hash values of files at the time they are stored.

NOTE: Cached applications which will run without access to an object carousel for the stored files (e.g. not_launchable_from_broadcast set to '1') may be authenticated as described for stand-alone stored applications. The time at which the various steps of the authentication process are performed is not visible to applications.

12.16 Inner applications and content embedded within other applications

Inner applications shall inherit the set of permissions granted to the application in which they are embedded.

13 Graphics reference model

13.1 Introduction

The MHP provides tools to control the positioning of: video on an output device, interface components such as buttons and lists, as well as raw graphical primitives.

Each screen connected to an MHP has three planes which are, from back to front, a background plane, a video plane and a graphics plane.

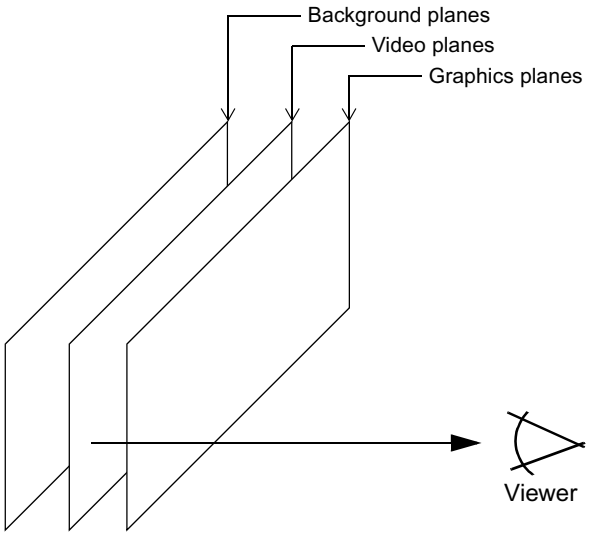


Figure 21: Illustration of the different types of display planes

The behaviour of the subtitle plane varies between implementations. API facilities are provided to allow applications to make the behaviour predictable. See clause 13.5 "Subtitles" on page 389.

An application is provided with a contiguous rectangular region of the graphics plane in which it can draw (see clause 13.3.3 "HAVi devices and AWT components" on page 380). An application can place video, interface elements and graphics inside its rectangle on the graphic plane.

An application can also control video outside of the AWT hierarchy on the video plane, and place still images, video drips or solid colour in the background plane.

The MHP specification enables terminals to support multiple applications at any one time, each of which can have a sub area of the screen to which it can draw. The specification enables the areas to overlap. However, the minimum required support for these features is profile specific. See annex G "(normative): Minimum Platform Capabilities" on page 541.

NOTE: The mapping between planes in this reference model and planes in the hardware used in an MHP terminal is implementation dependent. In particular, it is certainly allowed to use planes which the terminal hardware considers to be "video" as what MHP considers to be "background" for the purposes of displaying MPEG stills and video drips in what MHP considers to be the background.

13.1.1 Interapplication interaction

If the presentations of different applications overlap, the areas obscured by other applications are clipped. Therefore where an application is translucent it will be blended with the video or background image behind it rather than being blended with another application.

13.2 General Issues

13.2.1 Coordinate Spaces

The MHP includes a number of coordinate systems for different purposes and includes the means to transform between these as needed:

- Input video space.

  This considers post upsampling MPEG pixels.

- Device space.

  Logical pixels in the various display devices. There may be different device spaces for the various device types (e.g. video and graphics).

- Normalized screen space

  Normalized coordinates relative to the output (`HScreen`).

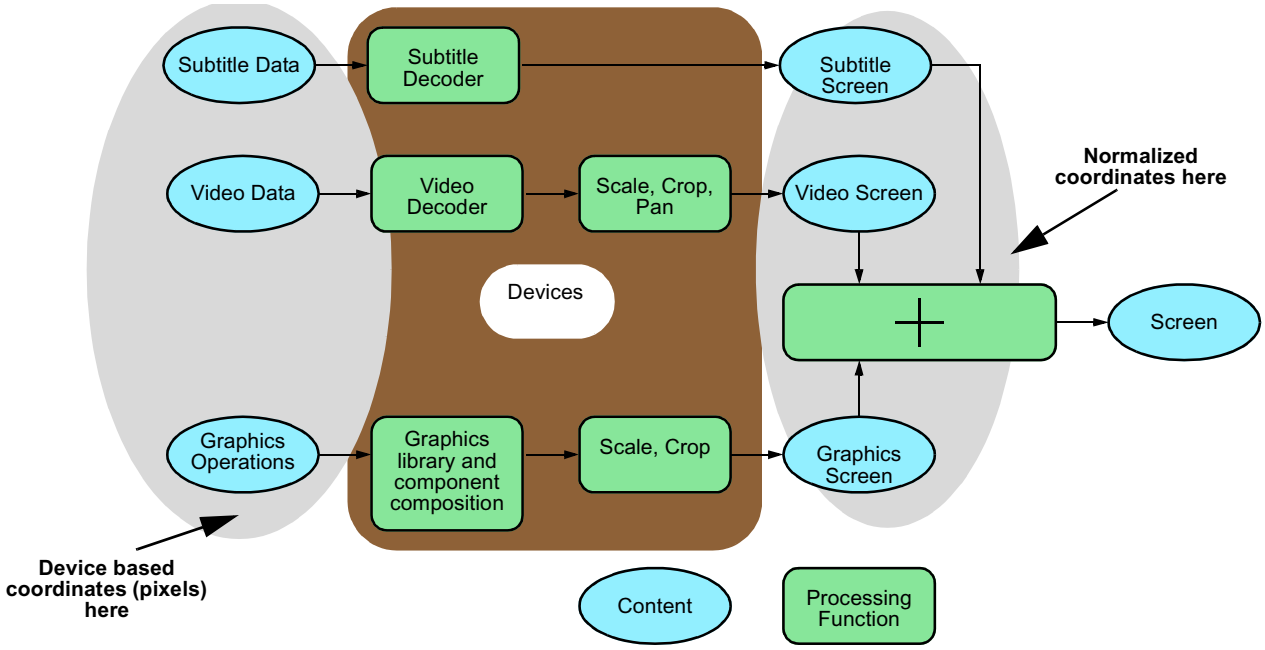


Figure 22

Various different interfaces provide access to different parts of the graphics and video systems using these coordinate spaces.

13.2.1.1 Normalized screen space

A normalized screen coordinate system supports references to positions and sizes in the video output from an MHP device without reference to any form of pixels.

This coordinate system describes the top left corner of the screen as {0, 0} and the bottom right corner of the screen as {1, 1}. This coordinate system is used in the positioning of graphics and video on the screen through the a number of classes in the `org.havi.ui` package and the JMF control `org.dvb.media.VideoPresentationControl`.

The normalized coordinate system is given through the `HScreen`.

13.2.1.2 User space

The coordinate space for graphics used in java.awt is defined by applications through the creation of an `HGraphicsDevice`. The root container, an instance of the class `org.havi.ui.HScene` can be placed within the normalized coordinate system. The `HSceneTemplate` class allows applications to express requirements for their top level container. Instances of this class are used by `HSceneFactory` to return instances of an `HScene`.

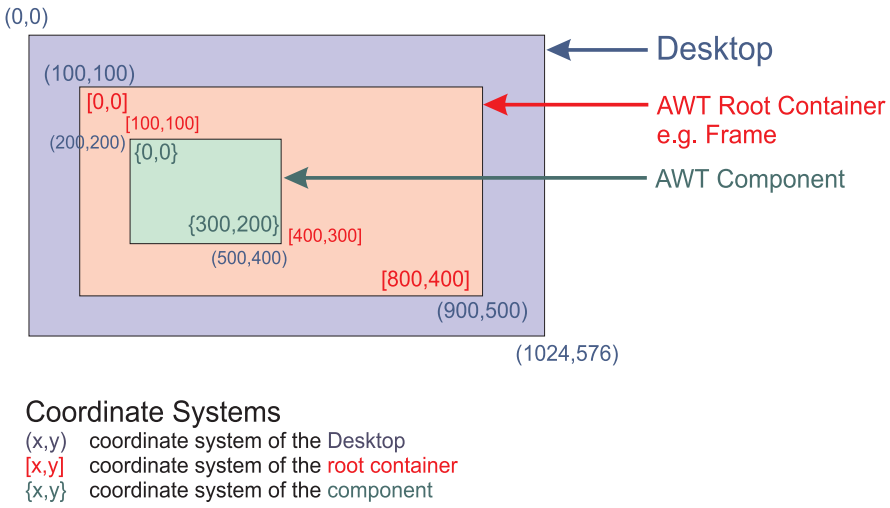


Figure 23: AWT Coordinate system in a computer environment

Figure 23 shows the AWT coordinate system in a normal computer environment. In an MHP device the `HGraphicsDevice` can be thought of being the desktop and the `HScene` as being the AWT RootContainer. Thus an `HScene` is placed within the coordinate system of the `HGraphicsDevice`. An `HScene` itself defines a new coordinate system which pixels are aligned to those of the `HGraphicsDevice` but the origin is translated (see figure 23).

The mapping between the user space and the normalized coordinate system is done given the size and location of the `HGraphicsDevice` in the normalized coordinate system and the resolution of the `HGraphicsDevice` in pixel.

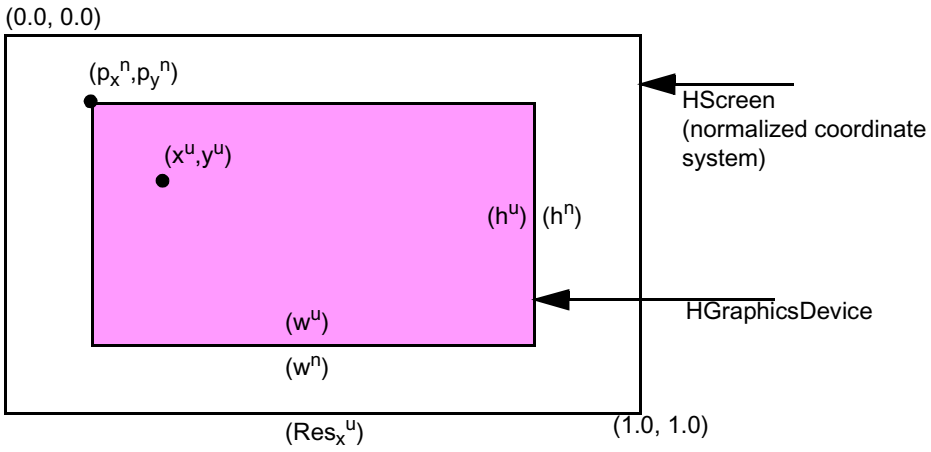


Figure 24: Conversion between normalized and user coordinate systems

(x^n, y^n) = normalized coordinate system of `HScreen`

(x^u, y^u) = coordinate system of the `HGraphicsDevice` in pixels

x^{vu} = "virtual" user coordinate system in pixels relative to the `HScreen`

Assume the HGraphicsDevice has the origin of (p_x^n, p_y^n) with a dimension of (w^n, h^n) and has a pixel resolution of w^u x h^u than the point (x^u, y^u) in normalized coordinates is given by

$$x^n = \frac{x^{vu}}{Res_x{}^{vu}} \qquad y^n = \frac{y^{vu}}{Res_y{}^{vu}}$$

where

$$Res_x{}^{vu} = \frac{w^u}{w^n} \qquad Res_y{}^{vu} = \frac{h^u}{h^n}$$

is the virtual resolution of the HScreen in (sub)pixel and

$$x^{vu} = p_x{}^{vu} + x^u \qquad y^{vu} = p_y{}^{vu} + y^u$$

is the point (x, y) in the virtual coordinate space with

$$p_x{}^{vu} = p_x{}^n \cdot Res_x{}^{vu} \qquad p_y{}^{vu} = p_y{}^n \cdot Res_y{}^{vu}$$

being the location of the HGraphicsDevice in the virtual coordinate system.

Given the Point (x^n, y^n) the point (x^u, y^u) is given by

$$x^u = floor[(x^n - p_x{}^n) \cdot Res_x{}^{vu} + 0.5]$$

and

$$y^u = floor[(y^n - p_y{}^n) \cdot Res_y{}^{vu} + 0.5]$$

Given a HGraphicsDevice which is full screen this simplifies to

$Res_x{}^{vu}=w^u$ and $Res_y{}^{vu}=h^u$, $x^{vu} = x^u$ and $y^{vu}=y^u$ thus

$$x^n = \frac{x^u}{w^u} \qquad y^n = \frac{y^u}{h^u}$$

and

$$x^u = x^n \cdot w^u \qquad y^n = y^n \cdot h^u$$

Within the above calculations precision equivalent to a float shall be used. Conversion to integer shall only be used when the result is a point in a pixel oriented co-ordinate space (e.g. user space).

The resolution of an HGraphicsDevice is specified using the constant HScreenConfigTemplate.PIXEL_RESOLUTION with a Dimension on the setPreference(int,Object,int) method.

The constants HSceneTemplate.SCENE_PIXEL_LOCATION and HSceneTemplate.SCENE_PIXEL_DIMENSION allows applications to define the position and size of an HScene in the coordinate system of the HGraphicsDevice (in pixels). The constants HSceneTemplate.SCENE_SCREEN_LOCATION and HSceneTemplate.SCENE_SCREEN_DIMENSION allows applications to define the position and size which the HScene should occupy on the screen in normalized coordinates.

The combination of these defines the transformation between graphics pixels and the video output from the MHP device concerned. Only a limited set of transformations are required to be supported.

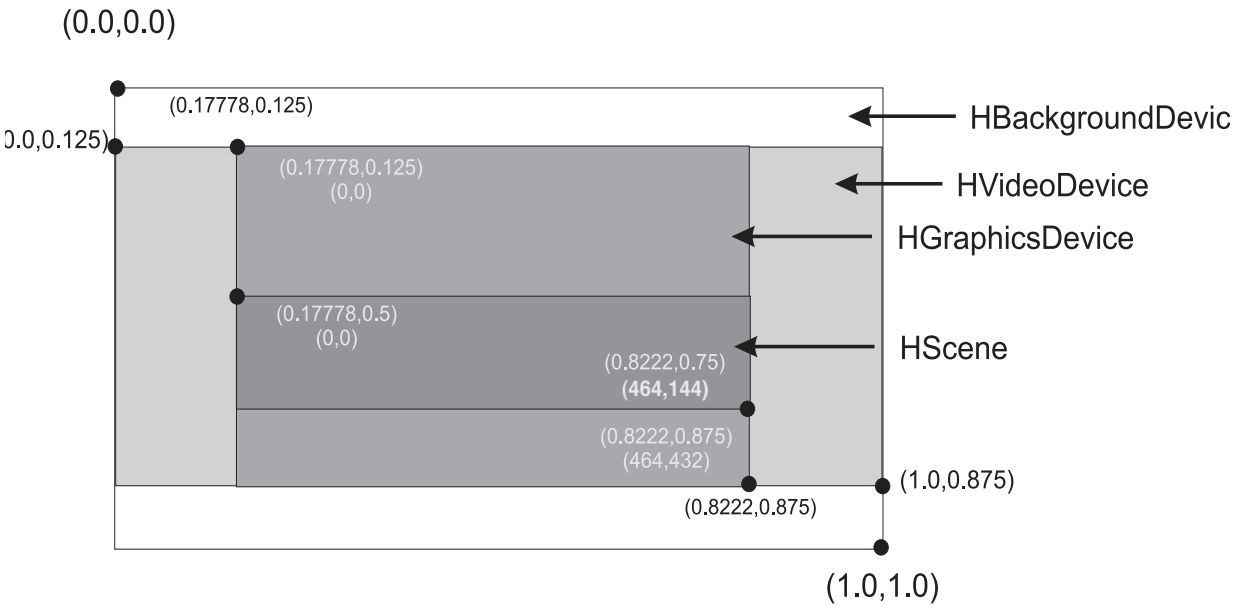


Figure 25: Possible configuration of HAVi Devices

Figure 25 shows a possible configuration of HAVi Devices. The `HBackgroundDevice` is configured to be full screen, the `HVideoDevice` to cover the area of (0.0, 0.125) to (1.0, 0.875).

When positioning video implementations may snap the video position to an adjacent line vertically (for example, to accommodate video and display field order) or an adjacent pixel horizontally (for example, to accommodate display chroma structure). The direction of "snapping" shall always be to minimize the error relative to the requested coordinate.

In figure 25 the `HGraphicsDevice` is configured to cover the area ($0.1\overline{7}$, 0.125) to ($0.8\overline{2}$, 0.875) with a pixel resolution of 464 x 432.

The `HScene` can be configured by setting the location of its origin and by defining its dimensions. The location of the `HScenes` origin can be specified by setting the preference `HSceneTemplate.SCENE_PIXEL_LOCATION` with a `Point` of (0,216) or setting the preference `HSceneTemplate.SCENE_SCREEN_LOCATION` with a `HScreenPoint` of ($0.1\overline{7}$, 0.5). The dimensions can be configured by setting the preference `HSceneTemplate.SCENE_PIXEL_DIMENSION` with a `Dimension` of (464, 144) or setting the preference `HSceneTemplate.SCENE_SCREEN_DIMENSION` with a `HScreenDimension` of ($0.6\overline{4}$, 0.25).

In some implementations and/or configurations pixels in the `HGraphicsDevice` may not correspond to discrete physical pixels in the actual display device. For example, this may be the case when the `HGraphicsDevice` is emulated.

13.2.1.3 Pixel Aspect Ratio

A pixel orientated coordinate system does not say anything about the pixel aspect ratio. The pixel aspect ratio (AR_x^{pixel} / AR_y^{pixel}) is defined by the aspect ratio of the display ($AR_x^{display}$ / $AR_y^{display}$, 4:3 or 16:9), the area that is covered by the `HGraphicsDevice` (w^n, h^n) and the pixel resolution of the `HGraphicsDevice` (w^u, h^u). See figure 26

$$AR^{pixel} = \frac{AR_x^{pixel}}{AR_y^{pixel}} = \frac{AR_x^{display} \bullet w^n}{AR_y^{display} \bullet h^n} \bullet \frac{h^u}{w^u}$$

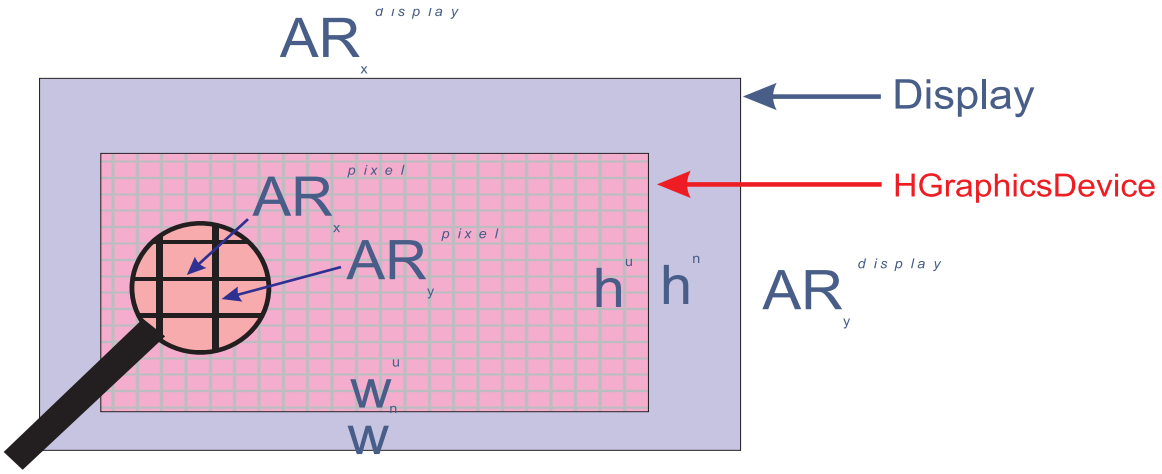


Figure 26: Calculating the Pixel Aspect Ratio

Table 141 shows typical resolutions of a full screen `HGraphicsDevice` and the corresponding pixel aspect ratios for different display aspect ratios. The supported resolutions are defined in annex G "(normative): Minimum Platform Capabilities" on page 541.

Table 141: Typical Resolutions and their pixel aspect ratio (informative)

	4:3 Display	16:9 Display
Resolution for full screen HGraphicsDevice	**Pixel Aspect Ratio**	**Pixel Aspect Ratio**
640 x 480	1:1	4:3
720 x 480	8:9	32:27
720 x 576	48/45	64/45
768 x 576	1:1	48:36
854 x 480	3:4	1:1
1 024 x 576	36:48	1:1

13.2.1.4 Video space

The coordinate space for video is that defined by the input video signal after any scaling required by the platform (e.g. that required by ETR154). Scaling and clipping of video can be achieved using the JMF control `org.dvb.media.VideoPresentationControl`. The JMF control `VideoFormatControl` allows applications to query the various transformations being performed on video as part of its decoding and presentation.

13.2.2 Dependencies between HAVi screen device configurations (informative)

13.2.2.1 Principles

Under some circumstances there are dependencies between configurations of the various HAVi screen devices that are composed together to be output as a single screen. Two example reasons for this are the following;

- The video output signal for a screen must have a single aspect ratio – either 4:3 or 16:9 for standard definition MHP terminals. As a consequence, all HAVi screen devices in that screen must be configured to the same aspect ratio.
- Hardware limitations on memory bandwidth may limit the possibilities of combining HAVi screen device configurations. For example, some devices may be able to support the (optional) graphics resolution of 1 920 x 1 080 only under limited (device specific) conditions, e.g. not simultaneously with the decoding of MPEG-4/AVC video.
- Limitations on scalers may limit the possibilities of combining HAVi screen device configurations. For example, software based scaling solutions may not be able to simultaneously support full screen graphics resolutions of 960 x 540 and 720 x 576 in a single hardware graphics plane.

The concept of sets of HAVi screen device configurations which can be simultaneously selected is supported through the method HScreen.getCoherentScreenConfigurations.

13.2.2.2 Usage examples for standard definition, 625-line markets

If the aspect ratio of the video output signal is 4:3 then the configuration of each HAVi HScreenDevice that contributes to that signal must have a configuration shown in table G.1 "Sets of coherent configurations for standard definition - 625-line markets" on page 541 as having a screen aspect ratio of 4:3. Similarly if the aspect ratio of the video output signal is 16:9 then the configuration of each HAVi HScreenDevice that contributes to that signal must have a configuration shown in table G.1 "Sets of coherent configurations for standard definition - 625-line markets" on page 541 as having a screen aspect ratio of 16:9. DVB-J applications can obtain instances of such coherent configurations by creating HScreenConfigTemplate instances with PIXEL_ASPECT_RATIO set to either 16/15 (for 4:3) or 64/45 (for 16:9) depending on what is required.

13.2.2.3 High definition usage examples

The minimum requirements for support of HD are defined in clause G.1.1.3 "High definition" on page 543 of the present document. These requirements result in 5 coherent sets of HAVi screen device configurations. These are shown below for 625-line / 50Hz markets. For 525-line / 60Hz markets, 720 x 576, 64/45 and 56/45 should be replaced by the values in table G.2 "Sets of coherent configurations for standard definition - 525-line markets" on page 542.

Set 1 (HD in front of SD, SD is 16:9)

HGraphicsConfiguration[0] includes PIXEL_RESOLUTION = 1 280 x 720

HGraphicsConfiguration[1] includes PIXEL_RESOLUTION = 720 x 576 and PIXEL_ASPECT_RATIO 64/45

Set 2 (HD in front of SD, SD is 14:9)

HGraphicsConfiguration[0] includes PIXEL_RESOLUTION = 1 280 x 720

HGraphicsConfiguration[1] includes PIXEL_RESOLUTION = 720 x 576 and PIXEL_ASPECT_RATIO 56/45

Set 3 (SD in front of HD, SD is 16:9)

HGraphicsConfiguration[0] includes PIXEL_RESOLUTION = 720 x 576 and PIXEL_ASPECT_RATIO 64/45

HGraphicsConfiguration[1] includes PIXEL_RESOLUTION = 1 280 x 720

Set 4 (SD in front of HD, SD is 14:9)

HGraphicsConfiguration[0] includes PIXEL_RESOLUTION = 720 x 576 and PIXEL_ASPECT_RATIO 56/45

HGraphicsConfiguration[1] includes PIXEL_RESOLUTION = 1 280 x 720

Set 5 (960 x 540)

HGraphicsConfiguration[0] includes PIXEL_RESOLUTION = 960 x 540

HGraphicsConfiguration[1] is not defined in the present document.

The following partial code fragment illustrates how the HAVi APIs can be used by DVB-J applications to ask for set #3 above and then configure the graphics system in that way.

```
HScreen s ;
HGraphicsConfigTemplate front = new HGraphicsConfigTemplate();
HGraphicsConfigTemplate rear = new HGraphicsConfigTemplate();
front.setPreference(
      HScreenConfigTemplate.PIXEL_RESOLUTION, new Dimension(720,576),
      HScreenConfigTemplate.REQUIRED);
front.setPreference(
      HScreenConfigTemplate.PIXEL_ASPECT_RATIO, new Dimension(64,45),
      HScreenConfigTemplate.REQUIRED);
rear.setPreference(
      HScreenConfigTemplate.PIXEL_RESOLUTION, new Dimension(1280,720),
      HScreenConfigTemplate.REQUIRED);
HGraphicsConfigTemplate input[] = { front, rear };
HScreenConfiguration c[] = s.getCoherentScreenConfigurations( input );
s.setCoherentScreenConfigurations(c);
```

For the case of set #5 above, HGraphicsConfiguration[1] is not defined. Some implementations may set the rear graphics plane to the DISABLED HGraphicsConfiguration. Other implementations may support 960 x 540 simultaneously with other graphics resolutions. Applications wishing to select set #5 should not constrain the rear graphics plane to DISABLED otherwise the call to getCoherentScreenConfigurations may fail on more capable MHP terminals.

13.2.2.4 Scalability and extensibility

MHP terminals may support additional HAVi screen devices and configurations beyond the minimum requirements defined in clause G.1.1 "Device capabilities" on page 541 of the present document. No particular issues arise where the minimum required HAVi screen devices support additional configurations. MHP applications may discover those configurations and, if they are able to reserve the device concerned, attempt to set the configuration. The conditions under which setting such an additional configuration succeeds is not defined by the present document and may be very specific to a particular MHP terminal.

Where extra HAVi screen devices are supported in addition to the minimum requirements, these extra devices shall only appear behind the minimum required HAVi screen devices of the same type. MHP terminal implementations may support extra graphics or video devices in front of the minimum required HAVi screen devices which are not visible to the MHP environment, e.g. for transient UIs relating to device setup, configuration or operation.

13.3 Graphics

13.3.1 Modelling of the MHP display stack composition

The following clauses describes the theoretical model of the MHP display stack. Unfortunately, certain real world constraints may apply see clause 13.6 "Approximations" on page 390. The "Graphics, Video and Subtitle pipeline" is illustrated in figure 27.

Figure 27 shows the conceptual model of the "graphical content" pipelines from an applications point of view. There are four sources of graphical content: subtitles, background, video and application graphics, and these four sources are mapped in a controllable way onto single screen. The figure shows the conceptual processing functions, the content stages, and application control points inside the content pipelines.

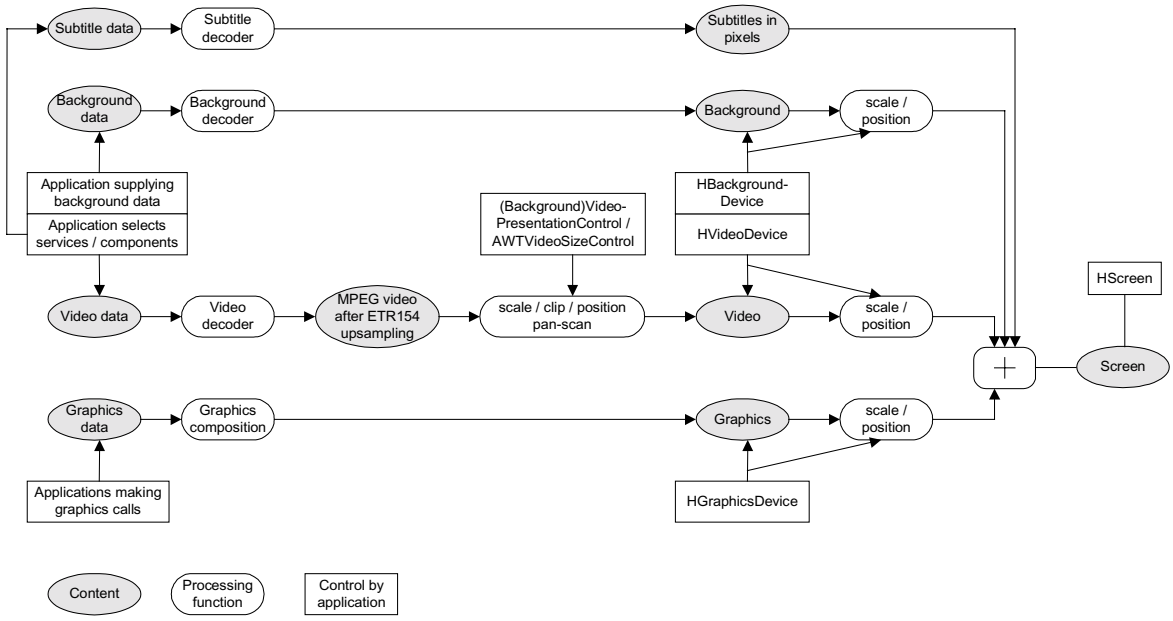


Figure 27: Graphics, Video and Subtitle pipeline

The figure shows that applications have full control over the source of the content that enters the different pipelines. Furthermore the application may control clipping, scaling and positioning of the content at different stages in the different pipelines. Of course an application can only apply operations that are supported by the underlying system.

The clipping and positioning of subtitles follows the video. Behaviour of subtitles when video is scaled is platform dependent.

From the application author's point of view the behaviour of the graphics composition process has 3 elements:

- The graphics elements are composed following the traditional graphics model using Porter-Duff rules (see Porter-Duff).The default rule used is the SRC_OVER rule.
- The background and video planes are composed using the Porter-Duff rule SRC_OVER.

NOTE: Only alpha of 0 and 1 is used in the Video planes.

- The results are composed together using the SRC_OVER rule (with the graphics results as the source and the results of the background / video composition as the destination).

This is illustrated in figure 28.

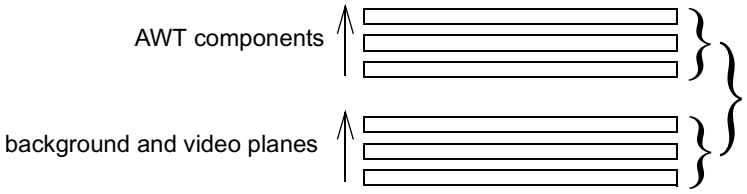


Figure 28: Overview of AWT / HAVi plane composition

The HAVi stack has a single full screen `HBackgroundDevice` at the back. In front of this are an ordered set of zero or more `HVideoDevices`. Each of the video devices can occupy the full screen area or part of it. Any area that is not occupied behaves as transparent. The occupied areas (video pixels) are considered to be opaque and will be obscured by any video devices in front of them. Non active video devices are invisible.

Systems that support only a single video device that can display full screen (and possibly other partial screen video devices) should report the full screen capable device as the first (back most) of the video devices.

The composition rules in each group follow the traditional "painter's" algorithm i.e. composing the layers from back to front.

The Xlet AWT Root Component is transparent (as shown in figure 29) so by default the result of the HAVi video and background device composition is the background to any application graphics.

Video already running in the HVideoDevice will keep on playing when an application starts.

The stack is illustrated in figure 29.

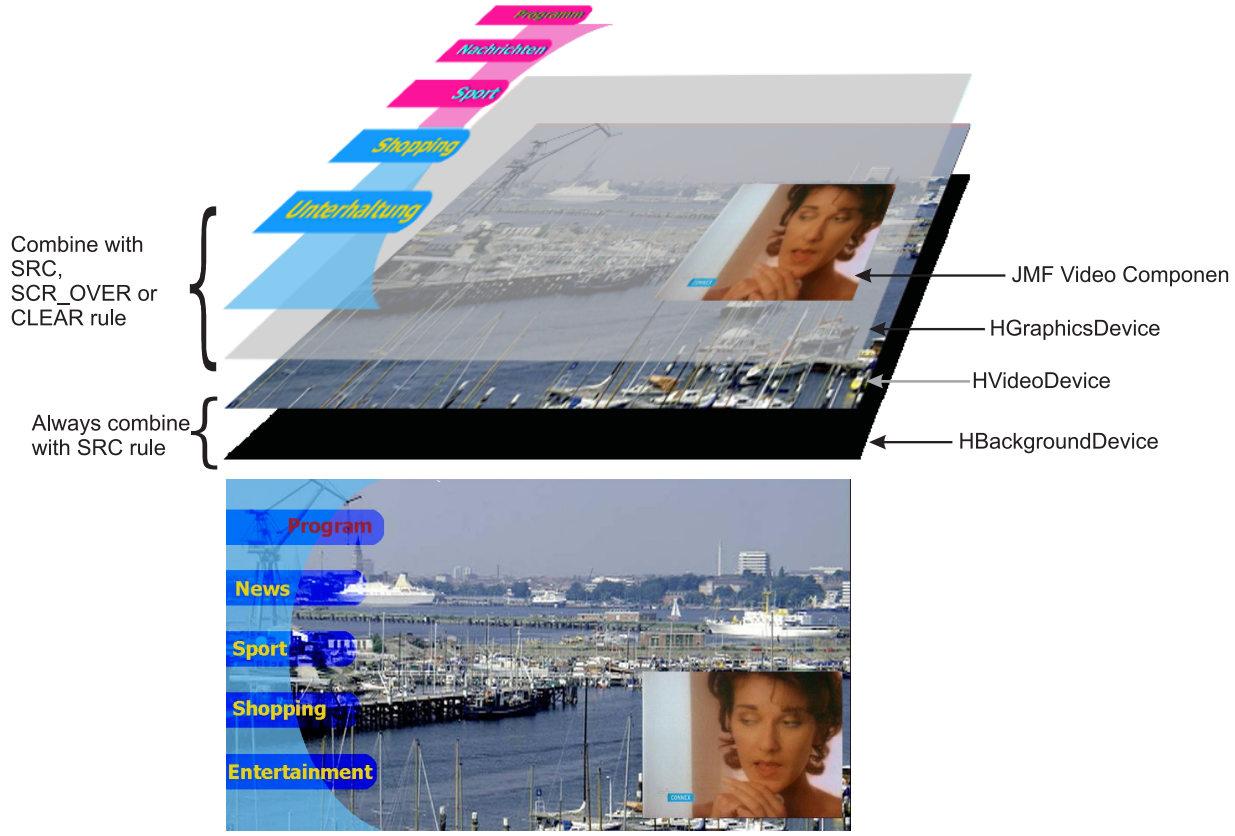


Figure 29: The MHP display stack illustrated

13.3.2 AWT Reference Model in the MHP

In the AWT all graphics rendering of the lightweight components is done via the `java.awt.Graphics` class. When a component needs to be redrawn it issues a repaint command which gets passed from component to component from top to bottom until a heavyweight component is reached. Although the enhanced and interactive profiles of MHP do not require any heavyweight components to be present, the `HScene` can be thought of being similar to a heavyweight component. Thus in MHP devices the repaint command gets passed until it reaches the root container - the `HScene`. The repaint method of the `HScene` causes a call to this component's `update` method as soon as possible. Before calling the paint method of a child the origin gets translated to the coordinate system of the child and the graphics object passed is clipped to the size of the child (see figure 30).

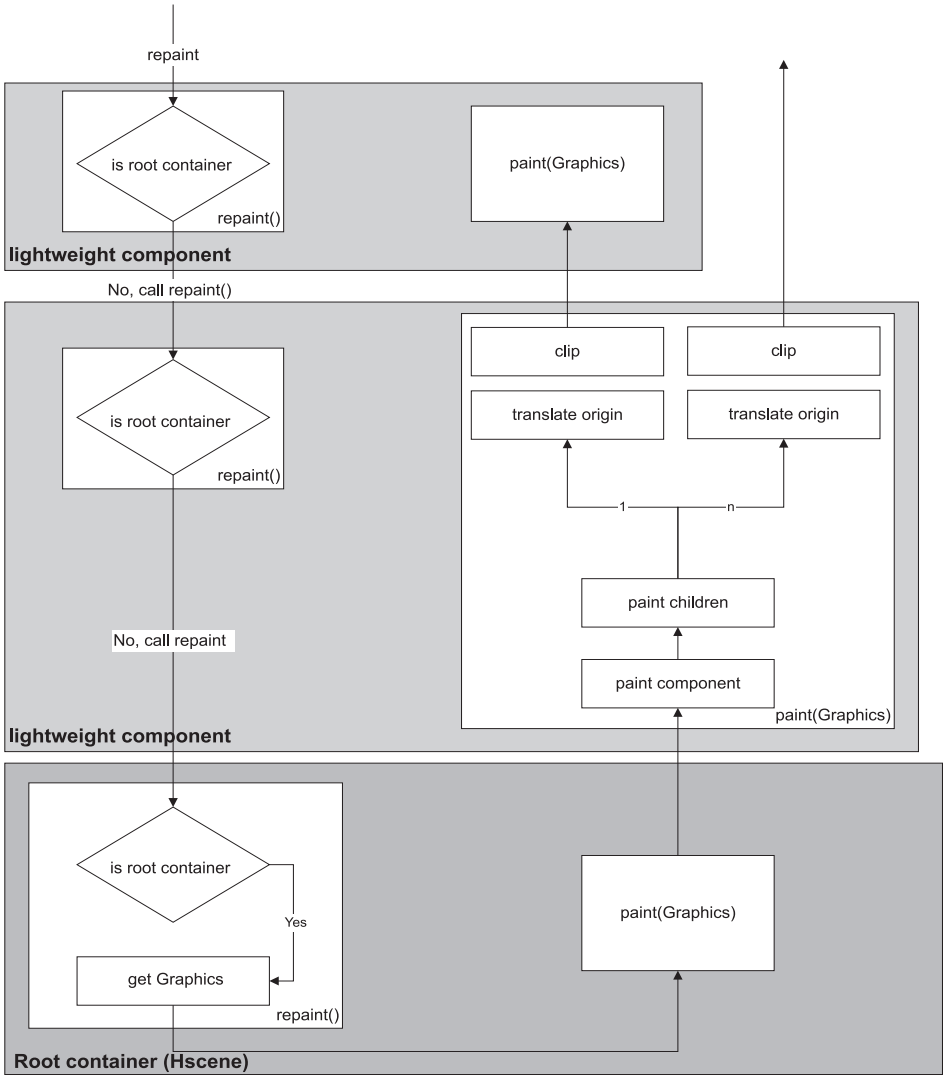


Figure 30: Repaint model in the MHP

13.3.3 HAVi devices and AWT components

The top level user interface container for DVB-J applications is represented by the `org.havi.ui.HScene` class. DVB-J applications may obtain an instance of this class from an instance of `org.havi.ui.HSceneFactory`. The `HSceneFactory` class provides a number of methods which may be used to obtain an `HScene` depending on the specific requirements of the DVB-J application. `HScene` is conceptually equivalent to `java.awt.Window` or `java.awt.Frame` however it models the differing graphical environment found in many digital TV receivers. In this environment, there are typically significant constraints on what sizes and positions of top level containers may be possible.

One means for obtaining an HScene from an HSceneFactory is to populate an HSceneTemplate with a set of constraints and then request an HScene from the getBestScene() method which meets these constraints. Applications wishing to obtain a full screen sized HScene may use the getFullScreenScene() method specifying a particular graphics device on which the full screen scene should be presented.

MHP terminals are allowed to support only non overlapping HScenes. In implementations not supporting overlapping HScenes the following behaviour shall be implemented:

- Overlapping at creation or size change through HSceneFactory:

  Returns a null reference if "REQUIRED" is used. Returns best effort if "PREFERRED" is used.

- Overlapping later when sizes change by awt:

  Size does not change. Fails silently.

The MHP specification provides a general model for video output devices using the model found in the HAVi specification. A final output video signal is expressed through the org.havi.ui.HScreen class and is the result of adding a number of different video components.

- The output of one or more graphics decoders.
- The output of one or more video decoders.
- The output of any special decoders, e.g. a background.

An abstraction of each of these decoders is represented by an instance of a class inheriting from HScreenDevice - HGraphicsDevice, HVideoDevice and HBackgroundDevice respectively. Each of these can potentially exist in a range of configurations which are exposed by instances of classes inheriting from HScreenConfiguration - HGraphicsConfiguration, HVideoConfiguration and HBackgroundConfiguration respectively. Where devices support multiple configurations, applications may construct and populate templates to define criteria to select between configurations. These templates are classes inheriting from HScreenConfigTemplate.

As well as the general features, some of these sub-classes provide support for specific features of the devices concerned. HGraphicsConfiguration supports loading of images and listing of fonts specific to that configuration. It also support conversion between various coordinate systems. HVideoDevice provides access to the source of the video currently being decoded (a Locator) and provides access to the decoder object for the video currently being decoded (a javax.media.Player). The HBackgroundClass provides a means to support MPEG I-frames through the HStillImageBackgroundConfiguration class.

The method HScreen.getCoherentScreenConfigurations (HScreenConfigTemplate[] configs) allows applications to express a common set of constraints for video, graphics and backgrounds and get back a coherent answer. In HGraphicsConfigTemplate, the constant VIDEO_MIXING allows applications to request configurations where graphics is super-imposed above video but without any requirement for pixels to be aligned. In HScreenConfigTemplate, there are constants to allow applications to ask for configurations as follows: -

- VIDEO_GRAPHICS_PIXEL_ALIGNED - video and graphics pixels are the same size and aligned.
- ZERO_VIDEO_IMPACT - a graphics configuration must not change the existing video configuration.
- ZERO_GRAPHICS_IMPACT - a video configuration must not change the existing graphics configuration.

13.3.3.1 Video and graphics pixel aligned

The VIDEO_GRAPHICS_PIXEL_ALIGNED relationship between the pixels in the HGraphicsDevice and the pixels in the HVideoDevice is shown in figure 31.

NOTE: The relationship applies to the pixels in `HVideoDevice` after "Decoder Format Conversion" processing, and the pixels in `HGraphicsDevice`. As a result of this relationship the following constraint holds for the configurations of `HGraphicsDevice` and `HVideoDevice` that have aligned video and graphics pixels:

- The pixel aspect ratio of the pixels in both devices is equal.

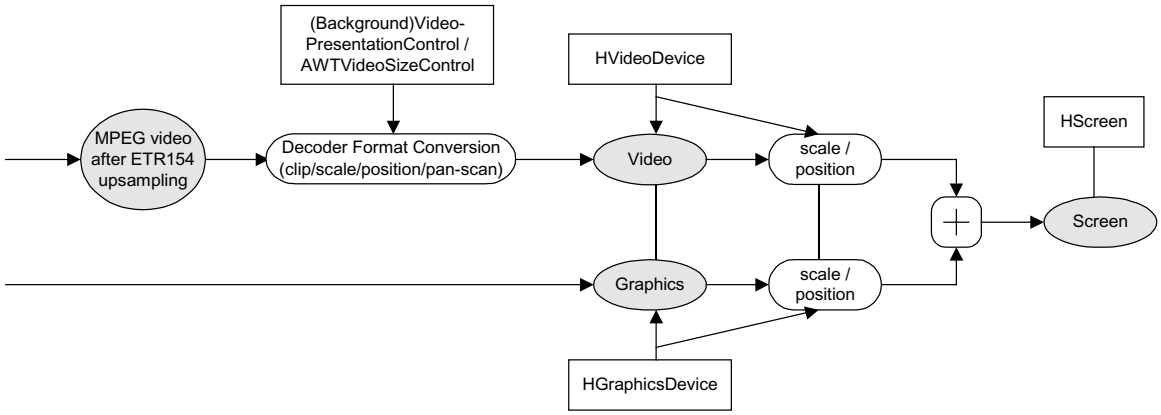


Figure 31: Video and graphics pixel impact

13.3.3.2 Zero graphics impact

Constants `ZERO_GRAPHICS_IMPACT` and `ZERO_VIDEO_IMPACT` can be used by applications to prevent changes to the `HGraphicsDevice` or the `HVideoDevice` respectively, in the case that changes are not intended. In general a change of the configuration of the `HGraphicsDevice` may lead to an automatic change of the configuration of, for example, the `HVideoDevice` (if the application is authorized to make this change), because restricted systems may not be able to deal with the two different configurations simultaneously. Therefore an application must specify `ZERO_GRAPHICS_IMPACT` or `ZERO_VIDEO_IMPACT` in the configuration template if it does not want to change the configuration of another device.

13.3.4 Composition

13.3.4.1 AWT paint rule

The normal AWT paint rules shall be followed. That is the root container (the `HScene`) is painted and then its components are painted recursively.

The observed *behaviour* shall be such that of each component drawing directly into the root component. Any use of temporary storage or double buffering shall not affect the final result of the AWT composition or its subsequent composition with the result of the video composition.

The process is shown in figure 32. The numbers in the arrows indicate the chronological order of the painting

NOTE: The root container is painted first.

If a container has multiple components they get painted in the order N, N-1,…,0 where N indicates the order components are added to the parent container. (See Documentation on `java.awt.Container` in PBP 1.1 [116]).

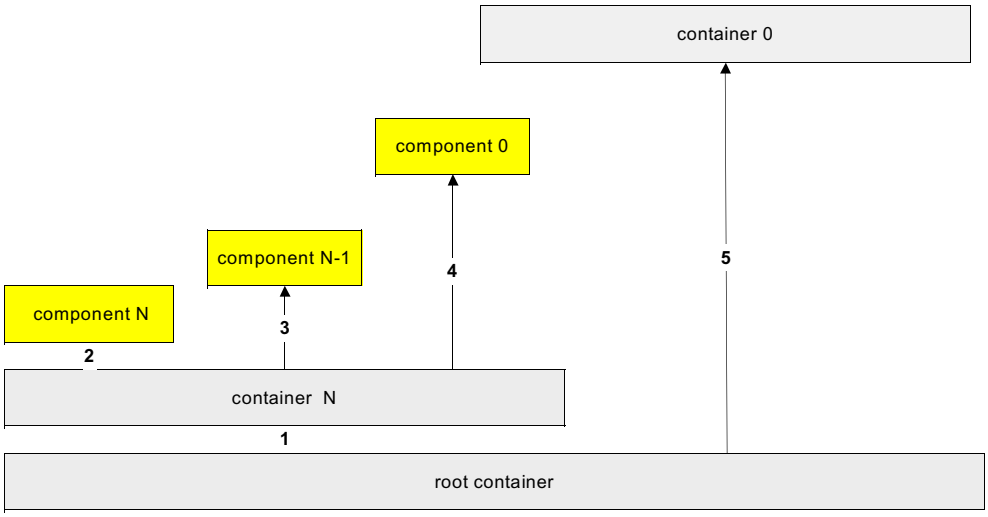


Figure 32: Chronological order of painting

13.3.5 Composition Rules

13.3.5.1 Components generally

By setting an appropriate `DVBAlphaComposite` rule on a `DVBGraphics` and using translucent colours blending may be achieved. By repeated placement of components complex scenes can be described. In figure 33 the background picture (of the harbour) is representative of the video plane. The translucent grey rectangle is drawn into a transparent off-screen buffer using the SRC rule. The red circle is then drawn into this off-screen buffer using one of the 8 most common Porter-Duff operations. When the AWT rendering in the off-screen buffer is complete it is composited with the video using the SRC_OVER rule.

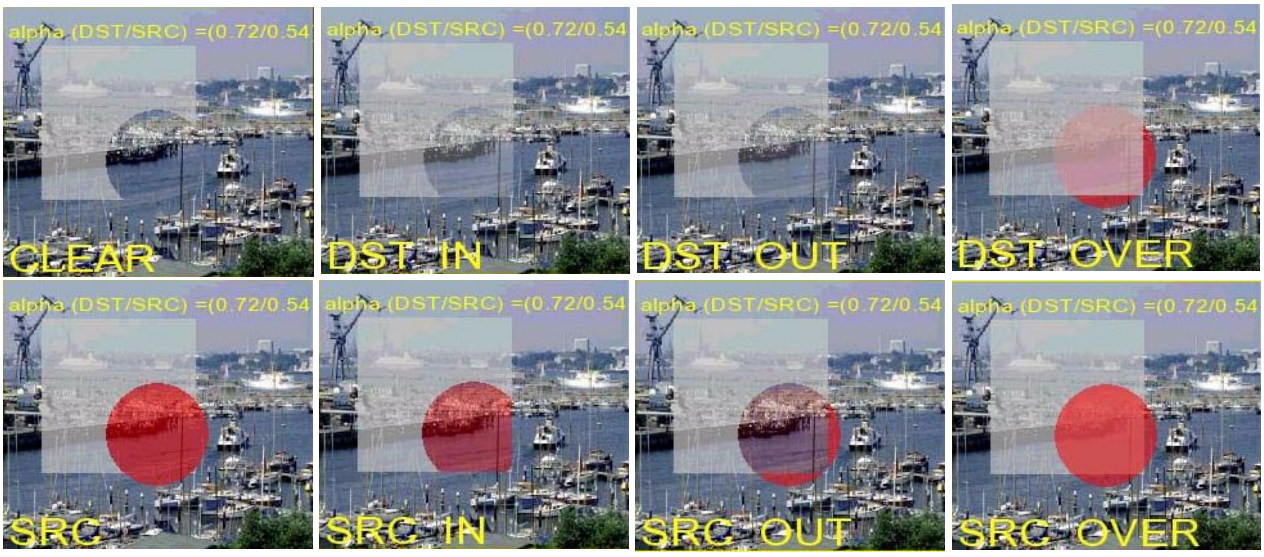


Figure 33: Summary of the Porter-Duff rules

13.3.6 Extensions to the AWT graphics capabilities

For graphics the MHP specification mainly uses AWT facilities defined in PBP 1.1 [116]. However, certain extensions are made.

In order to allow compositing in the MHP the graphics capabilities of PBP 1.1 [116] have been extended by providing the `org.dvb.ui` package.

The package consist of the classes DVBGraphics, DVBAlphaComposite, DVBBufferedImage, DVBColor and one Exception. See annex U "(normative): Extended graphics APIs" on page 892.

13.3.6.1 Graphics Objects in the MHP

The class org.dvb.ui.DVBGraphics extends the normal java.awt.Graphics class by adding support for alpha compositing.

In the MHP each platform-created graphics object shall be an instance of org.dvb.ui.DVBGraphics.

DVBGraphics and DVBAlphaComposite has a principle support of 8 different Porter-Duff compositing rules but not all rules have to be supported for all DVBGraphics Objects.

Different DVBGraphics Object could support different compositing rules. E.g. a DVBGraphics Object created using a DVBBufferedImage with an image type of DVBBufferedImage.TYPE_ADVANCED supports all 8 specified Porter-Duff rules, TYPE_BASIC supports only SRC, CLEAR, SRC_OVER. Application can query the available compositing rules using DVBGraphics.getAvailableCompositingRules(). When setting an unsupported compositing rule a org.dvb.ui.UnsupportedDrawingOperationException will be thrown. All images whose getGraphics method returns a non-null object shall support alpha.

The supported compositing rules are defined in annex G "(normative): Minimum Platform Capabilities" on page 541.

The default compositing rule used by all graphics objects is SRC_OVER.

13.3.6.2 Buffered Image

The class DVBBufferedImage in the package org.dvb.ui adds the support for an accessible, transparent Image which can be used e.g. for off screen buffers. Two different platform dependent sample models are supported by DVBBufferedImage. When doing compositing in the TYPE_BASE sample model approximations may be applied (using SRC instead of SRC_OVER, see figure 41 or by approximating the alpha, see annex G "(normative): Minimum Platform Capabilities" on page 541) while in the
TYPE_ADVANCED sample model the compositing rules set by the program will be used.

TYPE_ADVANCED is always a direct colour model while TYPE_BASE can be a CLUT based colour model.

13.3.6.3 DVBColor

NOTE: The general philosophy of this class has been to imitate the features of JDK 1.2 dealing with colour.

Unless explicitly specified otherwise, the internal implementation of the platform (e.g. java.awt) shall use the org.dvb.ui.DVBColor class instead of the java.awt.Color where technically possible (e.g. not the constructor for java.awt.Color). The class signatures shall not change. For example, where a method is specified to return java.awt.Color it shall return an instance of org.dvb.ui.DVBColor.

13.3.6.3.1 Modified packed colour representation

The most significant byte of the integer representation of an RGB colour is defined to hold an alpha value as is illustrated in figure 34. This data type is used in various of the constructors and methods described in the API documentation. It is referred to in the API documentation as TYPE_INT_ARGB.

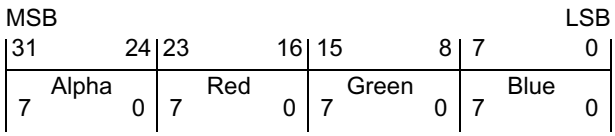


Figure 34: MHP colour format (TYPE_INT_ARGB)

13.3.7 14:9 Aspect Ratio Support

As well as the real display aspect ratios of 4:3 and 16:9, MHP defines a 14:9 aspect ratio. When this is in effect, all text will be subject to moderate aspect ratio distortion. However, broadcasters will be able to predict text flow without having to author specifically for each display type.

All `HGraphicsDevices` must be `HEmulatedGraphicsDevices` capable of emulating a14:9 aspect ratio on their actual aspect ratio at the time.

NOTE 1: Applications can still set the configuration of an `HEmulatedGraphicsDevice` to an `HGraphicsConfiguration` and have this be supported without emulation.

Where the current configuration of an `HEmulatedGraphicsDevice` has a 14:9 aspect ratio and the device is not reserved by any MHP application, the MHP terminal shall automatically maintain this 14:9 aspect ratio if the real underlying aspect ratio changes between 4:3 and 16:9 or vice-versa.

NOTE 2: The `HGraphicsConfiguration` observed by an application when it starts running may be unpredictable since there may be an already running MHP application which has reserved the `HGraphicsDevice` and set the `HGraphicsConfiguration`.

Setting the configuration of an `HGraphicsDevice` to an `HEmulatedGraphicsConfiguration` supporting a 14:9 display shall only impact the transformation of outline fonts into display pixels. Display pixels shall remain mapped 1:1 onto the actual pixels of the `HGraphicsDevice`.

13.3.8 Interaction between graphics from MHP and resident applications

If application graphics are wholly or partly obscured by graphics from resident applications (e.g. the MHP navigator), then either:

a) the resident application shall restrict itself to the use of opaque colours; or

b) the composition between the graphics of the resident application and those of MHP applications shall be done such that it does not result in video pixels that are obscured by opaque graphics pixels from an MHP application becoming visible.

Implementations that cannot meet one of these requirements shall remove the MHP application graphics from the screen when the graphics of resident applications are visible as described in clause 9.10.

13.4 Video

13.4.1 Component-based players and background players

Video is received by the MHP as an MPEG sequence of compressed frames, each of which contains a large number of picture elements (pels) arranged in rows and columns. The MHP decodes the MPEG stream to a presented stream which may be placed either in the video plane, or in a component in the graphics plane.

These two different ways of presenting video result in having two different kinds of JMF players, a background JMF player and a component-based JMF player.

A component-based JMF player plays video inside an AWT component, and the video inside that component is positioned and scaled by positioning and resizing the component. The video is always scaled to the full size of the component (or, if the terminal is not capable of scaling and positioning video this accurately, the video may extend outside the bounds of the component by up to one pixel in each direction [above, below, left and right]). This approximation shall not affect the position and size of the AWT component itself and hence shall not be visible to applications via the usual AWT methods).

Support for background players is mandatory for broadcast streaming formats (see clause 7.2 "Broadcast streaming formats" on page 71).

Background JMF players play video in the video plane, outside and independent of any AWT component hierarchy.

When a component-based player is stopped, the last displayed frame shall continue to be displayed until the underlying video decoder resource is re-used. The behaviour when the underlying video decoder resource is re-used is implementation dependent.

When a background player is in the realized state, the video plane concerned shall become transparent to expose what is behind it such as background plane(s). See figure 21 "Illustration of the different types of display planes" on page 370.

In MHP terminals exposing through the MHP-defined API the simultaneous decoding of more than one broadcast video stream, only a single background player shall be supported at one time. Realising a second JMF player while an existing background player is in use shall result in the second player replacing the first as the background player. Applications wishing the older player to remain visible must convert it to a component-based player and make that visible.

13.4.2 Modelling MPEG decoding and presentation pipeline

Figure 35 illustrates the underlying format conversion control process in aTS 101 154 [9] compliant SD digital receiver. In this model the video decoder produces "full-screen" video from the MPEG data (i.e. the decoder resolves any sub-sampling in the MPEG broadcast). Subsequent "Decoder Format Conversion" adapts this for the display device taking account of:

- Broadcast meta data (aspect ratio, pan/scan and active format description).
- Display knowledge (4:3 or 16:9, and resolution).
- User preferences (e.g. display wide screen in a letterbox).

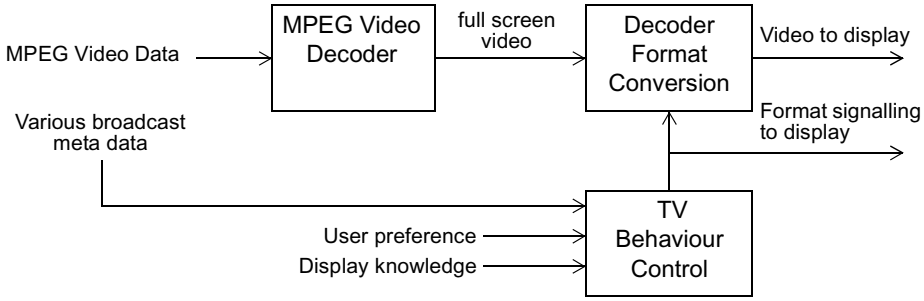


Figure 35: Format control in TV mode

If appropriate, the video that is sent to the display is accompanied by the proper WSS or SCART signalling to indicate the format of the video that is being sent.

NOTE: That the display device may do its own Decoder Format Conversion on top of the Decoder Format Conversion that the MHP device does. This is beyond the control of the MHP device.

In this version of the MHP specification, the video decoding process complies with clause 5.1.4 "Luminance resolution" ofTS 101 154 [9] and applies up sampling for a defined set of luminance resolutions so that the decoded pictures are displayed at full-screen size. The input video source to JMF shall be the output of this up sampling process as illustrated in figure 36. In addition, there are two alternative sources of control for the "Decoder Format Conversion" process:

- Conventional TV format control behaviour (as in figure 35).
- Application format control behaviour.

The selection between these behaviours is under the control of the application. Before and after the existence of an application the behaviour is that for a conventional TV. During application execution the default behaviour of the JMF player's decoder format conversion shall be the conventional TV behaviour.

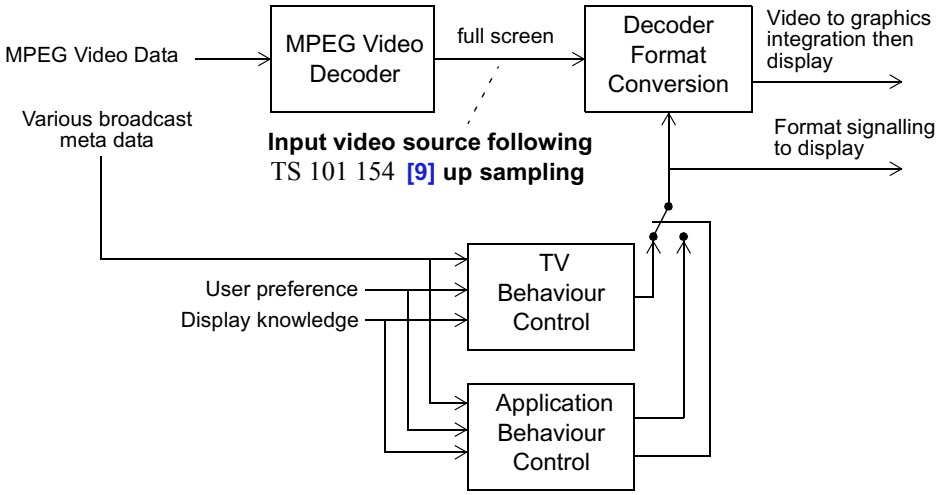


Figure 36: Format control in the presence of a JMF player

The Decoder Format Conversion consists of three steps that are performed on the full screen input video, which may have been up-sampled by the MPEG video decoder to become full screen. As illustrated in figure 37, these steps are clipping, scaling and positioning.

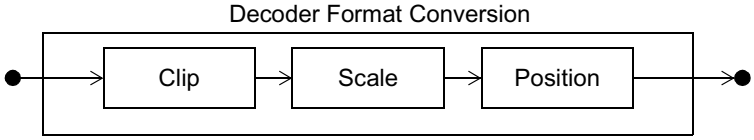


Figure 37: Reference model for Decoder Format Conversion

An application can query the implemented capabilities of each step of the Decoder Format Conversion using the org.dvb.media.VideoPresentationControl ("VideoPresentationControl" on page 588). For instance, it can query the supported scaling factors.

An application can also set up the Decoder Format Conversion steps atomically by using an org.dvb.media.VideoTransformation object ("VideoTransformation" on page 593) that encapsulates the clipping, scaling, and positioning parameters. An application can get a number of pre-defined video transformations that correspond with standard Decoder Format Conversions like 16:9 letterboxing in a 4:3 display. It can either use these video transformations directly to set the Decoder Format Conversion, or it can change one or more parameters of the transformation before setting it. The API also offers support for querying the current video transformation.

13.4.3 Coordinate Spaces

The input to the Decoder Format Conversion block is always full screen video. If necessary, the MPEG video decoder block performs up-sampling as required byTS 101 154 [9] to get full screen video.

An application expresses the video clipping in terms of the pixel-based coordinate space of the full screen video. For 50 Hz SD video this is always a 720 x 576 raster, and for 60Hz SD video, 720x480 raster.

Positioning of the video is expressed in the normalized coordinate space for background JMF players. For component-based JMF players, the position of the video component is expressed in the pixel-based device coordinate space (i.e. a video component is positioned like any other AWT component).

13.4.4 Video components

A scaled portion of a video can be presented as a component within the AWT hierarchy. The controls that influence this presentation are parts of AWT and JMF.

Video components are treated just like any other component. However, it shall be noted that pixels within the video have opaque colours. The mapping to the source video is provided by the video presentation control (see annex N "(normative): Streamed Media API Extensions" on page 688) which allows an arbitrary portion of the video to be placed within the AWT hierarchy.

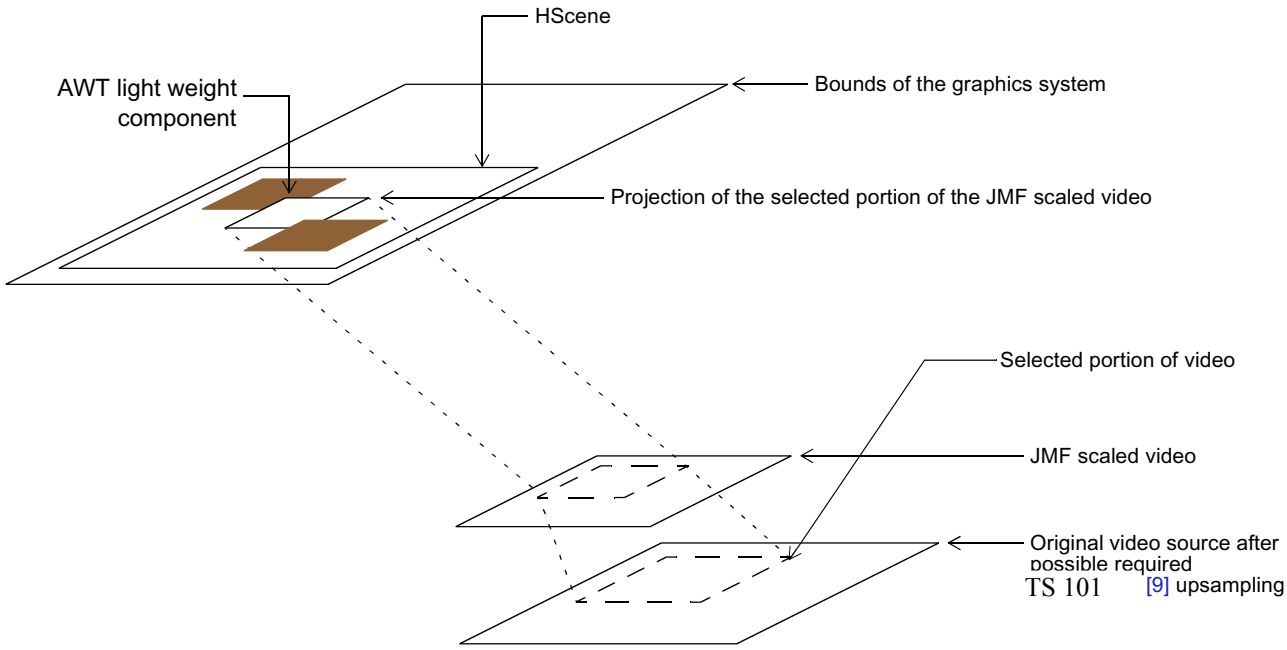


Figure 38: Introducing video into the AWT component stack

Graphics drawn over a component-based JMF Player using the SRC or CLEAR rules shall be alpha-blended with the scaled video from the component-based Player, not the background video plane.

Where two or more video components overlap, the z-order of the video shall be determined by the z-order of the video components within the AWT graphics system.

13.5 Subtitles

13.5.1 Language and presentation setting

The following reference model shows the how the presentation of subtitles is controlled. The selection of the subtitles language depends by default on the user's preferences, the audio language and can be overridden by the application. The end user can set the subtitles on or off where the default depends on the preferences. The application can override all this and switch the subtitles off even if the user has set them on.

The figure below illustrates the decision procedure:

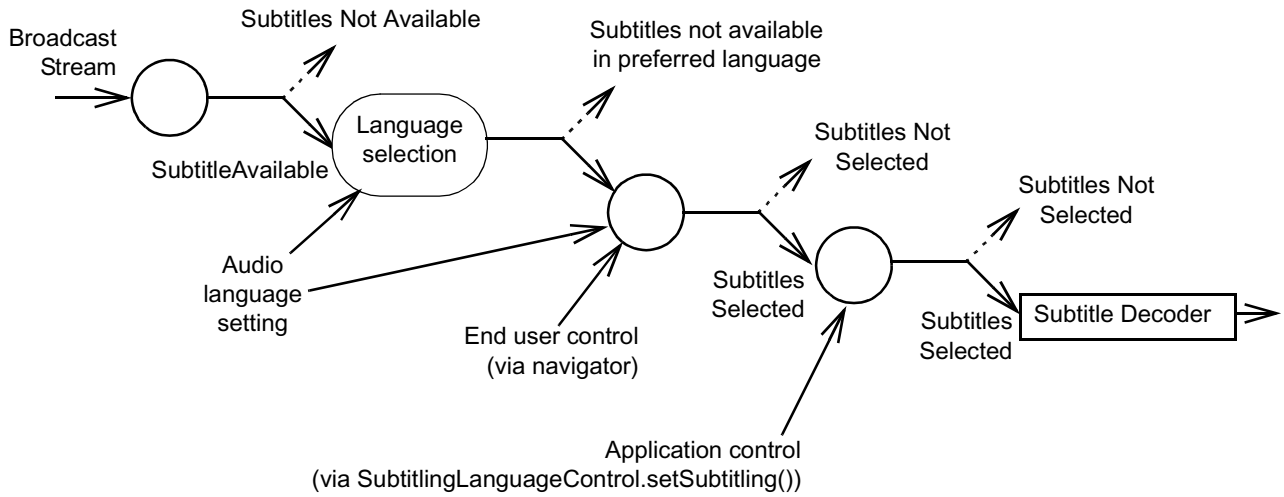


Figure 39: Determining subtitling language and presentation setting

The DVB-J API includes a control (see "SubtitlingEventControl" on page 579) that the application can use to get notified of the state changes in the availability and presentation status of the subtitles. This corresponds to the status of the left hand side input and the right hand side output in the diagram. The language selection and the resulting preferred language are determined using an implementation dependent algorithm. e.g. the platform may support separate language preferences for audio and for subtitles.

The org.davic.media.SubtitlingLanguageControl allows the application to query the currently set subtitling language, override the default language setting and switch the subtitles off or let them be end user controlled. This corresponds to the language selection phase and the application controlled switch in the diagram

13.5.2 Relation to graphics

Ideally, subtitles should be presented on top of the video plane but below the graphics plane(s). However, MHP terminals conforming to this specification are only required to support subtitles in areas where they are not overlapped by application graphics (i.e. by an HScene for a DVB-J application). If any MHP application has an HScene occupying the full area of the screen or has the AWT focus, MHP application graphics should be given preference over subtitles when they overlap otherwise subtitles should be given preference.

See also the description of television viewing mode in clause 11.4.1.4.

The subtitling plane is full screen and allows the subtitles to be positioned anywhere on screen. The positioning of the subtitling texts is part of the subtitling stream content and is fully controlled by the broadcaster.

13.5.3 Coordinate Spaces

Subtitles are decoded into a plane with the same coordinate system and position as the `HVideoDevice`.

13.6 Approximations

13.6.1 Approximations in composition

The MHP specification references the Porter-Duff rules for composition (see Porter-Duff).The minimum set of operations required is defined in (clause G.1.3.1 "Composition rules" on page 545), in addition the implementation of the compositions may be approximated as detailed below.

13.6.1.1 Implementation of modes

Typical implementations have a hardware blending process that blends the graphics plane over the video using SRC_OVER (see figure 40). This places certain practical limitations on the purity of the display model.

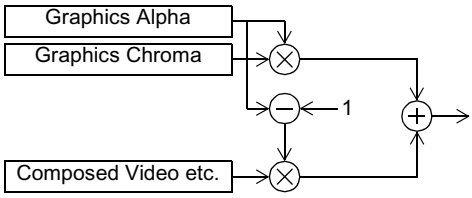


Figure 40: Typical current technology implementation

The SRC rule simply requires that the colour and alpha characteristics of the new pixels replace those previously present.

Components obtained from a JMF Player via the `Player.getVisualComponent()` method are treated as having an alpha of 1 so whether SRC or SRC_OVER is used when placing the video component the effect is that the video completely replaces anything previously drawn.

For the purposes of this discussion, MPEG I-frames and video drips shall be considered as video and not as graphics even if particular implementations may implement them using part of the graphics system of their hardware.

13.6.1.1.1 Graphics directly over video

When drawing graphics directly over video:

- The effect of SRC_OVER mode is as expected as the alpha value of the drawn graphics is used to control blending of the graphics with the video.

13.6.1.1.2 Graphics over other graphics

13.6.1.1.2.1 SRC

If graphics are painted over other graphics using SRC mode the result is as expected.

13.6.1.1.2.2 SRC_OVER

If graphics are painted over other graphics using SRC_OVER mode the result will be implementation dependant when $0 < \text{alpha} < 1$. Drawing with colour where alpha = 0 (i.e. fully transparent) shall not cause any effect to the existing pixels. Figure 41 illustrates a variety of implementations of SRC_OVER graphics to graphics blending. One allowed behaviour where the sample model is of `TYPE_BASE` is that defined in PBP 1.1 [116] for those signatures of the `drawImage` methods in `java.awt.Graphics` which do not have a `"bgcolor"` parameter. Specifically, only pixels which are fully opaque are drawn at all. Pixels which are transparent to any extent do not affect whatever pixels are already there.

[a] Shows the logically correct result where the green and red areas mix to produce intermediate colours.

This implies a graphics to graphics blending process, it also implies a large gamut in both the chroma and alpha channels. This may not be practical in many early implementations.

The following cases illustrate simplifications of the blending scheme. These should not be considered equally good approximations:

[b] Here the graphics alpha is preserved only when it is drawn directly over a video component. When drawn over another graphic the alpha facets of the colours are considered to be 1.

[c] Here the source graphics alpha is preserved when it is drawn over a video component even if there is an intermediate semi-transparent graphic. Where the source is over opaque graphics then a graphic to graphic blend is implemented.

[d] Here the source graphics alpha becomes the hardware mixing alpha regardless of what has been drawn previously over the MPEG image. This approximation is not permitted for mixing of graphics from the same MHP application. This approximation is permitted for mixing of graphics between MHP applications on MHP terminals that support overlapping HScenes.

[e] Here the source graphics alpha becomes the hardware mixing alpha in areas where the alpha is already less than 1. Where the alpha is currently 1 (i.e. over opaque graphics) the alpha remains 1.

a) Perfect.

b) All graphics-graphics overlays are solid. Transparency is only preserved over video.

c) Transparency punches through transparent layers and blends with opaque layers.

d) Transparency is always to video and so punches through other graphics.

e) Transparency punches through transparent layers and graphics over solid graphics are not blended.

Figure 41: Implementations of blending

13.6.1.1.2.3 CLEAR

If graphics are painted over other graphics using the CLEAR mode the result is as expected. This operation is the same as using a source with alpha=0 and the SRC rule.

13.6.1.2 Approximation of alpha

The precision of implementation of alpha depends on the `DVBGraphics` object concerned. The minimum requirements are specified in annex G "(normative): Minimum Platform Capabilities" on page 541. The actual colour used for a given colour can be queried using `org.dvb.ui.DVBGraphics.getBestColorMatch()`.

13.6.1.3 Approximation of colour

Logically the colour model is a "true colour" one. However, colour approximation is allowed as described in clause G.1.5 "Colour capabilities" on page 545.

14 System integration aspects

14.1 Namespace mapping (DVB Locator)

An extended format of the DAVIC DVB URL (DAVIC 1.4.1p9 [3]) shall be used for addressing DVB-SI entities as well as files within object carousels. This extension of the DAVIC locator is backwards compatible with both the original DAVIC locator as well as the UK DTG extension (UK MHEG Profile [55]). The main extensions are support for multiple component tags for specifying a subset of the components of a service, and a specified way of referencing files in an object carousel within a service.

Using the same informal notation as used above, the following locator formats shall be used:

dvb://<original_network_id>.[<transport_stream_id>][.<service_id>[.<component_tag>{&<component_tag>}][;<event_id>]]{/<path_segments>}

or

dvb://'<textual_service_identifier>'[.<component_tag>{&<component_tag>}][;<event_id>]]{/<path_segments>}

A more formal specification of the DVB URL expressed in BNF (as used in RFC 2396 [41]) is presented below:

Table 142: DVB URL syntax

```
dvb_url                     = dvb_scheme ":" dvb_hier_part
dvb_scheme                  = "dvb"
dvb_hier_part               = dvb_net_path | dvb_abs_path
dvb_net_path                = "//" dvb_entity [ dvb_abs_path ]
dvb_entity                  = dvb_transport_stream | dvb_service | dvb_service_component
dvb_transport_stream        = original_network_id "." transport_stream_id
dvb_service                 = dvb_service_without_event [ dvb_event_constraint ]
dvb_service_component       = dvb_service_without_event "." component_tag_set [ dvb_event_
constraint ]
dvb_service_without_event   = original_network_id "." [ transport_stream_id ] "." service_id |
                              "'" textual_service_identifier "'"
component_tag_set           = component_tag *( "&" component_tag )
dvb_event_constraint        = ";" event_id
original_network_id         = hex_string
transport_stream_id         = hex_string
service_id                  = hex_string
component_tag               = hex_string
event_id                    = hex_string
hex_string                  = 1*hex
hex                         = digit | "A" | "B" | "C" | "D" | "E" | "F" | "a" | "b" | "c" |
                              "d" | "e" | "f"
digit                       = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
dvb_abs_path                = "/" path_segments

(path_segments as defined in RFC 2396 [41])
textual_service_identifier = 1*(unreserved | escaped)
```

NOTE: This syntax is fully compliant with the generic syntax of URIs as specified in RFC 2396 [41] and uses the registry-based naming authority version of that. Furthermore, all generic definitions specified in RFC 2396 [41] shall be valid for the DVB URL as well (e.g. escaping of special characters within file names, etc.).

RFC 2396 [41] defines methods for path segments to include parameters (introduce with a semicolon character ";"). The present document currently makes no use of such parameters. Implementations conforming to the present document shall ignore any such parameters to ensure compatibility with future specifications.

14.1.1 dvb_entity = dvb_service

When a path is present in a URL where the dvb_entity part identifies a DVB service, the path references an object in an object carousel within the service. If the dvb_service_component element is not present there shall only be one Object Carousel in the DVB service.

The numeric identifiers original_network_id, transport_stream_id (if present) and service_id shall be matched against the corresponding fields in the SDT.

If present, the network_id shall be matched against the corresponding field in the NIT.

14.1.2 dvb_entity = dvb_service_component

When a path is present in a URL where the dvb_entity part identifies one component of a DVB service and that component carries an object carousel stream, the path references an object in an object carousel whose "root" (i.e. DSI message) is sent within that component. In this case the component tag set shall only contain one element.

The semantics when the path is present in URL where the dvb_entity part identifies something else than the two cases described above are not specified in the present document.

If present, the network_id shall be matched against the corresponding field in the NIT.

The numeric identifiers original_network_id, transport_stream_id (if present) and service_id shall be matched against the corresponding fields in the SDT.

14.1.3 dvb_hier_part = dvb_abs_path

When the dvb_net_path part is missing and only the dvb_abs_path is present, the URL refers to a file in a default object carousel within the current service. The "current" service is dependent on the usage context.

14.1.4 dvb_abs_path

The following restrictions apply to the dvb_abs_path part of a name:

- The total length of pathnames, separators and filename shall be less than or equal to 254 bytes long.
- The following characters are not allowed in filenames and pathnames: character null (0xC080), byte zero.
- The encoding of the filename is in UTF-8 (see clause 7.1.5).
- The directory separator character shall be a slash character (0x2F).
- An absolute filename starts with a slash character (as indicated in the BNF above).

14.1.5 dvb_entity = dvb_transport_stream

The numeric identifiers original_network_id and transport_stream_id shall be matched against the corresponding fields in the NIT.

If present, the network_id shall be matched against the corresponding field in the NIT.

14.1.6 textual_service_identifier

The textual_service_identifier in a DVB Locator is encoded in UTF-8. See clause 14.9.1 for the syntax of this field, and clause 14.9.2 for usage.

14.1.7 Application locator

A locator for an application in the current service can be identified by the following specific forms Only applications that are visible in the application database using the current service filter can be found by this locator.

Selecting this locator will launch the application, with the associated parameters.

Table 143

Locator	Meaning
`dvb://current.ait/Orgid.Appid?param=val&`	An application in the service currently selected by the application.

Where Orgid and Appid are both zero, this shall define a special locator meaning no applications. If this is the only application locator among a set of locators then no applications shall be launched.

14.2 Reserved names

File names starting with the characters "dvb." are reserved for use as "well known" files defined in this or future specifications.

Authors shall not use file names with this form to avoid possible collision with standards defined files.

14.3 XML notation

These rules shall apply to the processing and encoding of all the files where XML is used as an encoding format in the MHP.

Rules for encoding of the XML formatted files:

- The file shall be a well-formed XML document (but not necessarily valid against the DTD specified in this version of the present document). Here 'well-formed' and 'valid' are used as defined in the XML 1.0 (see XML 1.0 [65]) specification.

NOTE 1: The remark on validity is included, because it is possible to be valid only relative to one DTD. Valid documents relative to a DTD specified in a later version of the present document would not be valid relative to the DTD specified in the present document - however, the rules defined here intend to provide this future-proofness and allow terminal implementations compliant with the present document to be able to process files that may be encoded according to a later version of the present document.

- The XML files may contain the XMLDecl item ("<?xml … ?>" tag) in the prologue in the beginning of the file.
- All the XML files shall be formatted using the UTF-8 character encoding which is the default used in XML.
- The possible XMLDecl item in the beginning of the file shall not contain an 'encoding' attribute specifying another encoding than UTF-8.
- If the XMLDecl item is included in files conforming to the present document, it shall indicate XML version 1.0.
- The XML file shall contain a document type declaration ("<!DOCTYPE …>" tag) where the Name is the same as the name of the root element.
- The document type declaration shall contain an `ExternalID` item with the "PUBLIC" identifier and both a `PublicLiteral` and a `SystemLiteral`. The present document specifies the `PublicLiteral` that shall be used to identify the document types defined in the present document. The present document specifies a `SystemLiteral` that can be used for identifying a location where the DTD can be retrieved. The `SystemLiteral` included in the document type declaration shall point to a location where the DTD can be obtained via the Internet using the HTTP protocol as specified in the present document.
- The `PublicLiteral` is used for identifying the type of the file. For document types specified in the present document, the `PublicLiteral` shall have the following syntax:

  `"-//DVB//DTD " <document type> " " <version_number> "//EN"`

  where:

  `<document type>` has the following syntax:

```
<document_type> = letter letters
letters = "" | letter letters
letter = uppercase_letter | lowercase_letter | space
uppercase_letter =   "A" | "B" | "C" | "D" | "E" | "F" | "G" | "H"
                       | "I" | "J" | "K" | "L" | "M" | "N" | "O"
                       | "P" | "Q" | "R" | "S" | "T" | "U" | "V"
                       | "W" | "X" | "Y" | "Z"
lowercase_letter = "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h"
                       | "i" | "j" | "k" | "l" | "m" | "n" | "o"
                       | "p" | "q" | "r" | "s" | "t" | "u" | "v"
                       | "w" | "x" | "y" | "z"
space = " "
```

<version_number> has the following syntax:

```
<version_number> = major_version "." minor_version
major_version = digit digits
minor_version = digit digits
digit = "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" | "8" | "9"
digits = "" | digit digits
```

The <document_type> part of the PublicLiteral is used as an identifier of the document type. When future versions of the present document specify newer, backwards compatible versions of the document type, the <document_type> part shall not be changed and the <version_number> part shall be changed to a new version number unused in a previous version of the present document for that document type.

- The XML file shall be valid relative to the DTD identified in the ExternalId document type declaration. Here 'valid' is used as defined in the XML 1.0 specification.
- The document type declaration shall not contain a declaration part in square brackets ('[' and ']').
- Where the XML type PCDATA is used in XML elements and it is specified that this contains a string (for example a file name), these strings shall not contain '<', '&' or '>' characters that might be mistaken as XML tags or references of the markup.

NOTE 2: Strings where these characters must be allowed should be specified to be encoded as CDATA, leading to a more complex notation but allowing those symbols to be used.

- The file shall include only tags and attributes that are defined in the present document or a later version of the present document.
- The file shall not include XML entity declarations ("<!ENTITY ….>" tags).
- The file shall not include XML character or entity references (references starting with '&' character).
- The file shall not include XML processing instructions, except optionally the "<?xml …?>" XMLDecl item.
- The file may include XML comments ("<!-- … -->" strings), but not within elements that are specified as PCDATA containing strings to be encoded as defined in the present document.

Rules for processing of the XML formatted files in the MHP terminal:

- The parser shall use the `PublicLiteral` in the document type declaration in the XML file ("<!DOCTYPE …>" tag) for identifying the type of the file.
- The `PublicLiteral` in the document type declaration identifies the version of the DTD that is used for this file. There is no requirement for the parser to try to fetch that DTD file using the URL defined by the `SystemLiteral`. It is an implementation option for the parser to retrieve the DTD from that URL. If the DTD is unavailable from that URL, then the behaviour shall be platform dependent.
- The parser shall accept files that have a different version number in the `PublicLiteral` than the one specified in the present document for the given file type. These are probably files encoded according to a different version of the present document. From those files, the parser shall parse, recognize and handle all those elements and attributes that are part of the DTD included in the present document.
- The parser shall ignore all XML elements (start tag, end tag, and possible string between them) that are not specified in the DTD included in the present document.

NOTE 3: This allows extending the DTDs in the future in a future proof manner where existing terminals ignore all the elements introduced in later versions of the present document

- The parser shall ignore such attributes of XML tags that are not specified in the DTD included in the present document.
- The parser shall ignore XML comments encoded as defined in the XML 1.0 specification.
- The parser must accept empty XML elements specified in the present document both in their start-tag and end-tag form as well as in the empty element tag form (e.g. '<tuning value="true"></tuning>' may be used as well as '<tuning value="true"/>').
- Rules for evolving the specification must ensure that the encoding of the file will always be maintained backwards compatible when these rules are followed (i.e. later versions of the present document may add new XML tags and new attributes to existing XML tags, but may not change the semantics of the existing elements).
- If the encoding of the file violates the rules defined for the encoding above, the behaviour of the parser can be platform dependent, including the possibility that the parser may completely discard such files and the system may behave as if the file is not present at all.

14.4 Network signalling

The behaviour of MHP terminals when receiving incorrectly formatted data, however transmitted or otherwise acquired, is implementation dependent except where a specific error behaviour is required by the present document or referenced specifications. MHP terminals may implement whatever strategy they like for this situation. It is an allowed implementation choice to pass values from the network straight through to applications without checking them for correctness. Hence API calls which are specified as returning a specific piece of information may not return a valid piece of information if the original information in the network is wrong.

MHP terminals should observe the behaviour defined in section 4.1 ofTS 101 154 [9].

NOTE: It is highly recommended that the MHP terminal should be designed to allow for future compatible extensions to the DVB SI, DSMCC or other formatted data interpreted by the MHP terminal. All of the fields "reserved" (for ISO), "reserved_future_use" (for ETSI), and "user defined" in the EN 300 468 [4] should be ignored by MHP terminals not designed to make use of them. The "reserved" and "reserved_future_use" fields may be specified in the future by the respective bodies, whereas the "user defined" fields will not be standardized. Where an MHP API provides access to this data, the data should be returned to the MHP application without validation or correction.

14.5 Text encoding of application identifiers

Where an organisation_id or application_id is encoded in textual form it shall be encoded as follows:

- A hexadecimal representation of the value.
- Lower case letters.
- No extra leading zeros (as would be produced by Integer.toHexString).

Where both an organisation_id and application_id are combined into an application identifier, they will be represented as a single hexadecimal number using the previously described encoding with the organisation_id as the most significant bits and the application_id as the least significant bits.

14.6 Filename requirements

14.6.1 Persistent storage

Receivers shall support path and file names as specified by `persistentpath` and `persistentfilename` in the following BNF:

```
lowalpha =  "a" | "b" | "c" | "d" | "e" | "f" | "g" | "h" | "i" |
            "j" | "k" | "l" | "m" | "n" | "o" | "p" | "q" | "r" |
            "s" | "t" | "u" | "v" | "w" | "x" | "y" | "z"

upalpha =   "A" | "B" | "C" | "D" | "E" | "F" | "G" | "H" | "I" |
            "J" | "K" | "L" | "M" | "N" | "O" | "P" | "Q" | "R" |
            "S" | "T" | "U" | "V" | "W" | "X" | "Y" | "Z"

alpha    =  lowalpha | upalpha

digit    =  "0" | "1" | "2" | "3" | "4" | "5" | "6" | "7" |
            "8" | "9"

punct    =  "_"

persistentfilechar := alpha | digit | punct

persistentfilesubstring := persistentfilechar | persistentfilesubstring persistentfilechar

persistentfilename = persistentfilesubstring
                   | persistentfilesubstring "."
                   | persistentfilesubstring "." persistentfilesuffix
persistentpath = persistentfilesubstring | persistentpath "/" persistentfilesubstring

persistentfilesuffix = persistentfilechar | persistentfilesuffix persistentfilechar
```

Receivers are required to support:

- `persistentfilesubstrings` of length less than or equal to 8 characters.
- `persistentfilesuffixes` of length less than or equal to 3 characters.

Receivers are not required to reject filenames which exceed these requirements but applications using such filenames are not compliant. These restrictions do not apply to stored applications.

Receivers shall have filesystems for persistent storage which are either case sensitive or "case preserving". Applications shall be written to work on both of these. "case preserving" filesystems are case insensitive when opening an existing file but preserve the case which was used when the file was initially created.

14.6.2 DSMCC object carousel

Receivers shall support object carousels at least matching these requirements;

- File paths (i.e. the concatenation of directory names, directory separators and a filename) must be ≤ 1 024 bytes long.
- Within the file path requirement, file and directory names must be ≤ 255 bytes.
- The OC file system shall be case sensitive.

Other object carousel limitations are found in clause B.2.6 "Mapping of objects to data carousel modules" on page 504.

NOTE 1: There is no limit on the maximum number of directory nesting levels as long as the limit on file paths is not exceeded.

NOTE 2: Authors should avoid relying on OC being case sensitive since some authoring platforms will get it wrong.

NOTE 3: To ease development of applications on computer platforms using traditional file systems the author is recommended to restrict file names to the character codes 0x21 to 0x7E excluding 0x22, 0x27, 0x3A, 0x3B, 0x5C (double quote, single quote, colon, semicolon, backslash).

14.6.3 Stored applications

Receivers shall support file and path names in stored applications as defined for the object carousel in clause 14.6.2 "DSMCC object carousel" on page 399 except as follows:

- File systems for stored applications shall be either case sensitive or "case preserving". Applications to be stored shall be written to work on both of these. "Case preserving" is defined in clause 14.6.1 "Persistent storage" on page 398 above.
- The characters 0x22 (double quote), 0x27 (single quote), 0x3A (colon), 0x3B (semicolon), 0x5C (backslash), 0x2F (slash), 0x3F (question-mark), 0x3C (less-than), 0x3E (greater-than), 0x2A (star) or 0x7C (pipe) shall not be used.

14.7 Files and file names

The MHP specification defines how applications can use the names of files in order to access content held in files. It is intentionally silent about the file systems and file system namespaces of MHP terminals except as defined below.

- When an MHP application starts, the filesystem where that application is carried will be mounted into the file system namespace of the MHP terminal concerned. For a DVB-J application clause 11.5.1 "Broadcast Transport Protocol Access API" on page 279 defines that creating a new instance of `java.io.File(".")` will result in a reference to the base directory of the application. This specification does not define the use of "file:" URLs relative to this base directory, only absolute URLs are defined. This base directory may be a sub-directory within this filesystem.
- MHP applications which have requested the right to access persistent storage, and had this right granted, are allowed to access the persistent file namespace. For DVB-J applications, the top level directory of this namespace is obtainable from the system property, `"dvb.persistent.root"`.
- MHP applications may have the ability to mount additional filesystems into the file system namespace of the MHP terminal concerned. DVB-J applications are allowed to use the `attach()` method on the `org.dvb.dsmcc.ServiceDomain` class in order to attach an object carousel as an additional file system. In all other methods, using a DVB locator including the `dvb_abs_path` part of the name part of the syntax shall not mount the specified object carousel file system.
- Conformant MHP applications shall not attempt to access files or file systems outside what is allowed by the present document. The consequences should they attempt to do this are undefined and implementation dependent. Platforms are allowed to choose to limit the access rights of DVB-J applications through use of platform security mechanisms, e.g. `java.io.FilePermission`.

- References to content carried in files shall either be done using names of files encoded in text or using "file:" URLs as defined in RFC 1738 [67]. File names encoded in "dvb:" locators shall be transformed to "file:" URLs before use. For DVB-J applications, file names shall be encoded in Java String objects and "file:" URLs shall be encoded in instances of `java.net.URL`. See `ServiceDomain.getURL(Locator)`. When applications construct a `java.net.URL` for the "file:" protocol, the host part shall be empty and the path part shall be as specified for the constructors of `java.io.File` with the platform file separator replaced by "/" and omitting the first separator character.

- Stand-alone interaction channel applications shall see a file system where the current directory is derived from the contents of the AIT file (see clause 10.4.9). Unless the MHP terminal is certain of the complete contents of a directory in this file system, all attempts to list such contents shall fail as if an I/O error had occurred in the underlying system.

14.8 Locators and content referencing

The table below lists the types of entity which the present document requires locators to be able to address. It defines the text representation for each entity. Where no text representation is standardized, an implementation dependent representation shall be used. The present document does not require support for addressing any other type of entity in an MHP system by locator or URL.

Table 144: Addressable entities, locators and their text representation

Entity	Text Representation
Transport stream	DVB locator including "dvb_transport_stream" element.
Network	No standardized text representation
Bouquet	No standardized text representation
DVB Service	• DVB locator including "dvb_service" element (note 3). • No standardised text representation for services referenced via `org.dvb.locator.FrequencyLocator`.
Service other than DVB service, e.g. stored application service and sub-classes of InternetClientService	No standardized text representation
DVB Event	DVB locator including "dvb_service" element and "dvb_event_constraint" element
MPEG Elementary Stream	If the elementary stream is signalled with a component tag then this shall be a DVB locator including the "dvb_service_component" element otherwise there is no standardized text representation.
File	"file:" URL as defined in RFC 1738 [67] (note 1) DVB locator including "dvb_abs_path" element (note 2) "http:" URL as defined in RFC 2616 [40]. "https:" URL as defined in RFC 2818 [112].
Directory	"file:" URL as defined in RFC 1738 [67] (note 1) DVB locator including "dvb_abs_path" element (note 2) "http:" URL as defined in RFC 2616 [40]. "https:" URL as defined in RFC 2818 [112].
Drip feed decoder	"dripfeed://"
MHP application	See clause 14.1.7 "Application locator" on page 394.

NOTE 1: The hostname part of a "file:" URL shall always be the empty string. These URLs are always in the namespace of the receiver. Transmitting them across a network as part of an application is meaningless.

NOTE 2: DVB locators including the "dvb_abs_path" element may be returned by MHP APIs as a mechanism to provide references to files in carousels which may not currently be mounted. These locators can only be used to mount new carousels or be translated into a "file:" URL once a new carousel has been mounted.

NOTE 3: It is not recommended to include the transport_stream_id in references to DVB services because the pair (original_network_id, service_id) already uniquely identifies the service.

The DVB specifications define two places where multiple logical service components can be carried in a single MPEG elementary stream - DVB subtitles and MPEG-2 multichannel audio. The present document does not provide locators to distinguish between multiple languages of subtitles or audio carried in a single MPEG elementary stream in this way. Hence methods returning locators for service components / elementary streams shall return the same locator regardless of any selection between such logical service components. Methods accepting locators for service components / elementary streams shall select between any such logical service components based on the rules for elementary stream selection in clause 11.4.2.2 "Clarifications" on page 272.

Where there is no standardized text representation, the implementation specific representation can be used to construct Locators which address the original addressable entity but only within that single application instance.

NOTE: This means there is no requirement to be able to re-use implementation specific representations after reading them in from persistent storage or over the inter-application communication API.

14.9 Service identification

In the MHP, there are two mechanisms for uniquely identifying a service:

- The triplet of numeric SI identifiers:

  `original_network_id`, `transport_stream_id` and `service_id` (corresponding to identifiers with the same name defined by EN 300 468 [4] carried in the SI of the broadcast)

NOTE: It is not recommended to use the `transport_stream_id` because the tuple `original_network_id`, `service_id` already uniquely identifies a service.

- A textual service identifier:

  textual_service_identifier_bytes carried in the optional Service identifier descriptor in the SDT (see clause 10.12.1).

Both enable global, unique identification of a service.

The textual identifier has additional properties:

- They can identify two (or more) service instances as being the same service even if they for technical reasons have different numeric identifiers.

  It is up to the service provider to decide whether different service instances are identified as being the same service.

- They can give alternative identifications for a single service.

14.9.1 Syntax of the textual service identifier

The syntax of the textual service identifier is:

```
<service_name> "." <service_provider_domain_name>
```

where:

<service_name>: is a unique name for the service within the service provider's domain

<service_provider_domain_name>: is an Internet DNS domain name that the service provider has rights to control. The organization's administrating the Internet DNS domain names are used as a globally unique registration mechanism that allows these textual service identifiers to be globally unique names.

The <service_name> field shall follow the rules defined for Internet DNS names so that the whole textual service identifier is a valid host name to be used in the Internet DNS as defined in RFC 1035 [75].

An example of a textual service identifier is:

```
movie-channel-1.broadcaster-b.com
```

where "broadcaster_b.com" is an Internet DNS domain owned by the broadcaster and "movie_channel_1" is a unique name for the service assigned by the service provider

NOTE: The textual service identifier has the same syntax as an Internet host name and it must be assigned in a domain that the service provider has the rights to control. However, the textual service name for a service is not required to resolve to any IP address using the Internet DNS service and if it does, this version of the present document does not specify any specific services that this host should provide if contacted using the IP protocols.

14.9.2 Handling of the textual service identifiers within the MHP terminal

The MHP terminal discovers the textual service identifiers for a given service from the SDT table similarly as it discovers the existence of the service in the first place. The MHP terminal shall know the textual service identifiers for the available services in the same way that it knows the numeric identifiers: original_network_id, transport_stream_id and service_id.

When the application uses a URI referring to a DVB service, the resolution of this URI to the necessary information needed to locate the service happens in the same way regardless of if this URI contains a textual identifier or the numeric identifiers.

The URI string provided by the application shall be considered to match the one included in the SDT when the strings are the same.

14.10 CA system

In this clause the term "CA system" applies to the CA system however implemented and thus embraces both embedded CA systems and those implemented via the DVB common Interface.

If a functioning CA system is exposed to MHP applications at all then it shall be equally exposed through all CA related API features, e.g.

- The CA API.
- CA related reason codes of org.dvb.media.PresentationChangedEvent.
- javax.tv.service.selection.PresentationChangedEvent and sub-classes.

14.10.1 Service selection

Where the CA system causes changes in the currently decoded service the effect is equivalent to a service selection.

In the specific case of the DVB Common Interface this will occur when a Host Control tune request is made by a module. A javax.tv.service.selection.AlternateContentEvent shall be sent in this case.

14.10.2 Media component selection

Requests from the CA system to change in composition of the media components (Audio, Video or subtitles) shall be automatically performed (this effect is equivalent effect to using javax.tv.media.MediaSelectControl) and shall be reported to the application by the org.davic.net.ca.PIDChangeEvent and org.dvb.media.PresentationChangedEvent with reason code either CA_FAILURE or CA_RETURNED as specified for that event. It shall also be reported by sending MediaSelectEvents to all currently registered MediaSelectListeners whose current selection would be changed by this.

In the specific case of the DVB Common Interface this will occur when a Host Control replace / clear_replace request is made by a module. Events javax.tv.service.selection.AlternativeContentEvent and NormalContentEvent shall be sent respectively.

14.10.3 Non-media component selection

Requests from the CA system to change in composition of the non-media components (e.g. DSM-CC Object Carousel and private data) shall not be automatically performed but shall be reported to the application by the org.davic.net.ca.PIDChangeEvent.

In the specific case of the DVB Common Interface this will occur when a Host Control replace / clear_replace request is made by a module.

15 Detailed platform profile definitions

This clause defines the capabilities of platforms as presented to applications. Products that claim to conform to a profile shall provide at least the minimum capabilities identified for the profile. In some cases this implies that specific hardware resources are present in the platform.

Table 145: Detailed platform profile definitions

Area	Specification	Enhanced Broadcast Profile 2	Interactive Broadcast Profile 2	Internet Access Profile 2
Broadcast channel protocols				
	6.2.2, "MPEG-2 Sections"	M	M	M
	6.2.5, "DSM-CC User-to-User Object Carousel"	M	M	M
	IP Multicast stack based on: 6.2.6, "DVB Multiprotocol Encapsulation", 6.2.7, "Internet Protocol (IP)" 6.2.8, "User Datagram Protocol (UDP)" 6.2.10, "IP signalling"	O	Ro	M
Interaction channel protocols				
TCP/IP	6.3.3, "Transmission Control Protocol (TCP)" 6.3.2, "Internet Protocol (IP)"	-	M	M
UDP/IP	6.3.2, "Internet Protocol (IP)" 6.3.9, "User Datagram Protocol (UDP)"	-	M	M
DSM-CC U-U RPC	6.3.4, "UNO-RPC" 6.3.5, "UNO-CDR" 6.3.6, "DCM-CC User to User"	-	O	O
HTTP	6.3.7.1, "HTTP 1.1"	-	O	O
HTTP	6.3.7.2, "MHP profile of HTTP 1.0"	-	M	M
DNS	6.3.10, "DNS"	-	M	M
HTTPS	6.3.7.3, "HTTPS"	-	M	M
Interaction Channel File System	6.4.1, "File system implemented only via the interaction channel"	-	M	M
DSMCC / HTTP hybrid	6.4.2, "Hybrid between broadcast stream and interaction channel"	-	M	M
Static formats				
Bitmap pictures	7.1.1.3, "PNG" + 15.1, "PNG - restrictions"	M	M	M
	7.1.1.3, "PNG" without restrictions	n/r	n/r	n/r (note 2)
	7.1.1.4, "GIF"	n/r	n/r	n/r (note 2)
	7.1.2, "MPEG-2 I-Frames"	M	M	M
	7.1.1.2, "JPEG" + 15.3, "JPEG - restrictions"	M	M	M
	7.1.1.2, "JPEG"	-	M	M
Audio clips	7.1.4, "Monomedia format for audio clips"	M	M	M
Video drips	7.1.3, "MPEG-2 Video "drips""	M	M	M
Text encoding	7.1.5, "Monomedia format for text"	M	M	M
Broadcast streaming formats				
Video	7.2.2, "Video"	M	M	M
Audio	7.2.1, "Audio"	M	M	M
Subtitles	7.2.3, "Subtitles"	M	M	M

Area	Specification	Enhanced Broadcast Profile 2	Interactive Broadcast Profile 2	Internet Access Profile 2
Fonts				
Built in	Character set see annex E, "(normative): Character set", Metrics see annex D, "(normative): Text presentation" Face: UK RNIB "Tiresias"	M	M	M
Downloadable	7.4.1, "PFR"	M	M	M
	7.4.2, "OpenType"	O	O	O
DVB-HTML				
DVB-HTML	8, "DVB-HTML"	n/r	O (note 1)	O (note 1)
Application model				
Application model	All parts of clause 9, "Application model" except those clauses (and their subclauses) identified below.	M	M	M
	9.3, "DVB-HTML Model"	-	O (note 1)	O (note 1)
	9.5, "Life cycle of Xlets embedded in DVB-HTML"	-	O (note 1)	O (note 1)
	9.6.1, "Applications loaded from the interaction channel"	-	M	M
	9.7, "Lifecycle of internet access applications"	-	-	M
Application signalling				
Application signalling	All parts of clause 10, "Application Signalling" except those clauses (and their subclauses) identified below.	M	M	M
	10.6.2.2, "DVB-HTML"	-	O (note 1)	O (note 1)
	10.8.1.3, "Transport via interaction channel"	-	M	M
	10.10, "DVB-HTML Specific descriptors"	-	O (note 1)	O (note 1)
DVB-J				
Core	11.3, "Fundamental DVB-J APIs"	M	M	M
Presentation	11.4.1, "Graphical User Interface API"	M	M	M
	11.4.2, "Streamed Media API"	M	M	M
Data Access	11.5.1, "Broadcast Transport Protocol Access API"	M	M	M
	11.5.2, "Support for Multicast IP over the Broadcast Channel"	O	Ro	M
	11.5.3, "Support for IP over the Return Channel"	-	M	M
	11.5.4, "MPEG-2 Section Filter API"	M	M	M
	11.5.5, "Mid-Level Communications API"	M	M	M
	11.5.6, "Persistent Storage API"	M	M	M
	11.5.7, "File storage device access"	M	M	M
Service Information and Selection	11.6.1, "DVB Service Information API"	M	M	M
	11.6.2, "Service Selection API"	M	M	M
	11.6.3, "Tuning API"	M	M	M
	11.6.4, "Conditional Access API"	M	M	M
	11.6.5, "Protocol Independent SI API"	M	M	M

Area	Specification	Enhanced Broadcast Profile 2	Interactive Broadcast Profile 2	Internet Access Profile 2
Common Infrastructure	11.7.1, "APIs to support DVB-J application lifecycle"	M	M	M
	11.7.2, "Application discovery and launching APIs"	M	M	M
	11.7.3, "Inter-Application and Inter-Xlet communication API"	M	M	M
	11.7.4, "Basic MPEG Concepts"	M	M	M
	11.7.5, "Resource Notification"	M	M	M
	11.7.6, "Content Referencing"	M	M	M
	11.7.7, "Common Error Reporting"	M	M	M
	11.7.8, "Plug-in APIs"	M	M	M
	11.7.9.1, "API framework"	M	M	M
	11.7.9.2, "SelectionProvider"	O	O	O
Security	11.8.1, "Basic Security"	M	M	M
	11.8.2, "APIs for return channel security"	-	M	M
	11.8.3, "Additional permissions classes"	M	M	M
	11.8.5, "Cryptographic API"	M	M	M
	11.8.6, "DVB Extensions for Cryptography"	-	M	M
Others	11.9.1, "Timer Support"	M	M	M
	11.9.2, "User Settings and Preferences API"	M	M	M
	11.9.3, "Profile and version properties"	M	M	M
	11.9.4, "Non-CA smart card API"	M	M	M
	11.9.5, "XML parsing API"	M	M	M
Stand-alone applications	11.12.2, "Stored services"	M	M	M
Support for DVB-HTML	11.13, "Support for DVB-HTML"	O (note 1)	O (note 1)	O (note 1)
Internet access	11.14, "Internet access"	-	-	M
	17, "Internet access clients"	-	-	M

NOTE 1: DVB-HTML is a single option which shall only be considered included if all parts of it are included.
NOTE 2: Recommended to be implemented as part of WWW browser but outside the scope of the MHP conformance regime

Where an MHP product claims to support a feature defined as optional, recommended optional or not required in the above table, it shall be supported according to the present document, shall be subject to the MHP conformance regime and shall report that the feature is supported using the mechanisms defined in table 126, "System properties for optional feature interrogation".

Key	
-	Not applicable
n/r	Not required
O	Optional feature in the receiver
Ro	Recommended optional feature in the receiver
M	Mandatory feature in the receiver

15.1 PNG - restrictions

MHP terminals are required to support ALL of the PNG colour types defines in PNG Specification Version 1.0 (see table 146). MHP terminals are responsible for mapping these colours to those used by the terminal's OSD.

Any combination of PNGs with different colour types may be active at any one time. Similarly, terminals are responsible for mapping RGB16 direct colour specifications to colours that the OSD can support.

Table 146: PNG formats

Colour Type	Allowed Bit Depths	Interpretation
0	1, 2, 4, 8, 16	Each pixel is a grayscale sample.
2	8, 16 per component	Each pixel is an R,G,B triple.
3	1, 2, 4, 8	Each pixel is a palette index; PLTE chunk must appear.
4	8, 16	Each pixel is a grayscale sample, followed by an alpha sample.
6	8, 16	Each pixel is an R,G,B triple, followed by an alpha sample.

Receivers should ignore gAMA (gamma) and cHRM (chromaticity) chunks in PNG files.

15.2 Minimum media formats supported by DVB-J APIs

The following table specifies the minimum set of media types that implementations of the "Enhanced Broadcast Profile 1" and "Interactive Broadcast Profile 1" shall support. It also identifies the APIs that shall provide this support:

Table 147: Media type support required in Enhanced and Interactive Broadcast profile 1

Media type	Reference	API(s)
Downloadable fonts	7.4	`org.dvb.ui.FontFactory`
Audio from file	7.1.4	`org.havi.ui.HSound` JMF only with references to files
MPEG I frame images	7.1.1	`org.havi.ui.HBackgroundImage`
PNG images	7.1.1.3	`java.awt.Image`
JPEG images	7.1.1.2	`java.awt.Image`
DVB service	EN 300 468 [4]	JMF only with references to DVB services for playback direct from the network
Video "drips"	7.1.3	`org.dvb.media.DripFeedDataSource`
Text files	7.1.5	All Java APIs supporting reading or writing text files.
Subtitles	7.2.3	JMF only as part of a DVB service

15.3 JPEG - restrictions

The restricted JPEG specification is as specified in clause 7.1.1.2 except that the "progressive DCT-based" mode is excluded.

15.4 Locale support

Support of resources for the following locales is required:

- One guaranteed one (EN.UK).
- Zero (or more) implementation dependant ones.

Further it is guaranteed that the default Locale shall have resources. The default Locale is implementation dependant.

15.5 Video raster format dependencies

This clause addresses the aspects of the present document that vary as a consequence of the video raster format. The formats names follow those used inTS 101 154 [9].

15.5.1 25 Hz standard definition

15.5.1.1 Logical pixel resolution

The logical pixel resolution shall be 72 dots per inch.

16 Registry of Constants

16.1 System constants

Table 148: Registry of constants

Entity	Value	Description
PTimerMinRepeatInterval	40 ms	This (or optionally a smaller) value shall be returned by javax.tv.util.TVTimer.getMinRepeatInterval(). See clause 11.9.1 "Timer Support" on page 297.
PTimerGranularity	10ms	This (or optionally a smaller) value shall be returned by javax.tv.util.TVTimer.getGranularity(). See clause 11.9.1 "Timer Support" on page 297.

Table 149: Profile encoding

application profile	version			Definition
	major	minor	micro	
1	1	1	3	Enhanced Broadcast Profile 2 as defined in the present document
2	1	1	3	Interactive Broadcast Profile 2 as defined in the present document
3	1	1	3	Internet Access Profile 2 as defined in the present document

16.2 DVB-J constants

This clause to be populated with the values of public final static symbols from the various Java APIs.

16.2.1 Public and Protected final static primitive fields from DVB packages

The following is a list of the values assigned for public and protected final static primitive fields defined in the DVB defined DVB-J packages:

```
public final static int org.dvb.application.AppAttributes.DVB_J_application = 1;
public final static int org.dvb.application.AppAttributes.DVB_HTML_application = 2;
public final static int org.dvb.application.AppProxy.STARTED = 0;
public final static int org.dvb.application.AppProxy.DESTROYED = 1;
public final static int org.dvb.application.AppProxy.NOT_LOADED = 2;
public final static int org.dvb.application.AppProxy.PAUSED = 3;
public final static int org.dvb.application.AppsDatabaseEvent.NEW_DATABASE = 0;
public final static int org.dvb.application.AppsDatabaseEvent.APP_CHANGED = 1;
public final static int org.dvb.application.AppsDatabaseEvent.APP_ADDED = 2;
public final static int org.dvb.application.AppsDatabaseEvent.APP_DELETED = 3;
public final static int org.dvb.application.DVBJProxy.LOADED = 5;

public static final int org.dvb.application.DVBHTMLProxy.LOADING=6;
public static final int org.dvb.application.DVBHTMLProxy.KILLED=7;

public final static int org.dvb.dsmcc.DSMCCObject.FROM_CACHE = 1;
public final static int org.dvb.dsmcc.DSMCCObject.FROM_CACHE_OR_STREAM = 2;
public final static int org.dvb.dsmcc.DSMCCObject.FROM_STREAM_ONLY = 3;
public final static int org.dvb.dsmcc.DSMCCObject.FORCED_STATIC_CACHING=4;

public final static int org.dvb.event.UserEvent.UEF_KEY_EVENT = 1;
public final static int org.dvb.io.ixcIxcRegistry.SERVICE=1;
public final static int org.dvb.io.ixcIxcRegistry.PAGE=2;
public final static int org.dvb.io.ixcIxcRegistry.GLOBAL=3;
```

```
public final static int org.dvb.io.persistent.FileAttributes.PRIORITY_LOW = 1;
public final static int org.dvb.io.persistent.FileAttributes.PRIORITY_MEDIUM = 2;
public final static int org.dvb.io.persistent.FileAttributes.PRIORITY_HIGH = 3;

public final static int org.dvb.media.PresentationChangedEvent.STREAM_UNAVAILABLE = 0;
public final static int org.dvb.media.PresentationChangedEvent.CA_FAILURE = 1;
public final static int org.dvb.media.PresentationChangedEvent.CA_RETURNED = 2;
public final static int org.dvb.media.VideoFormatControl.ASPECT_RATIO_UNKNOWN = -1;
public final static int org.dvb.media.VideoFormatControl.AFD_NOT_PRESENT = -1;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_UNKNOWN = -1;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_NONE = 0;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_FULL = 1;
public final static int org.dvb.media.VideoFormatControl.DAR_4_3 = 1;
public final static int org.dvb.media.VideoFormatControl.ASPECT_RATIO_4_3 = 2;
public final static int org.dvb.media.VideoFormatControl.AFD_16_9_TOP = 2;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_LB_16_9 = 2;
public final static int org.dvb.media.VideoFormatControl.DAR_16_9 = 2;
public final static int org.dvb.media.VideoFormatControl.ASPECT_RATIO_16_9 = 3;
public final static int org.dvb.media.VideoFormatControl.AFD_14_9_TOP = 3;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_LB_14_9 = 3;
public final static int org.dvb.media.VideoFormatControl.ASPECT_RATIO_2_21_1 = 4;
public final static int org.dvb.media.VideoFormatControl.AFD_GT_16_9 = 4;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_CCO = 4;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_PAN_SCAN = 5;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_LB_2_21_1_ON_4_3 = 6;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_LB_2_21_1_ON_16_9 = 7;
public final static int org.dvb.media.VideoFormatControl.AFD_SAME = 8;
public final static int org.dvb.media.VideoFormatControl.DFC_PLATFORM = 8;
public final static int org.dvb.media.VideoFormatControl.AFD_4_3 = 9;
public final static int org.dvb.media.VideoFormatControl.AFD_16_9 = 10;
public final static int org.dvb.media.VideoFormatControl.AFD_14_9 = 11;
public final static int org.dvb.media.VideoFormatControl.AFD_4_3_SP_14_9 = 13;
public final static int org.dvb.media.VideoFormatControl.AFD_16_9_SP_14_9 = 14;
public final static int org.dvb.media.VideoFormatControl.AFD_16_9_SP_4_3 = 15;
public final static int org.dvb.media.VideoFormatControl.DFC_PROCESSING_16_9_ZOOM = 9;
public final static byte org.dvb.media.VideoPresentationControl.POS_CAP_OTHER = -1;
public final static byte org.dvb.media.VideoPresentationControl.POS_CAP_FULL = 0;
public final static byte org.dvb.media.VideoPresentationControl.POS_CAP_FULL_IF_ENTIRE_VIDEO_ON_
SCREEN = 1;
public final static byte org.dvb.media.VideoPresentationControl.POS_CAP_FULL_EVEN_LINES = 3;
public final static byte org.dvb.media.VideoPresentationControl.POS_CAP_FULL_EVEN_LINES_IF_ENTIRE_
VIDEO_ON_SCREEN = 4;

public final static int org.dvb.net.rc.RCInterface.TYPE_PSTN = 1;
public final static int org.dvb.net.rc.RCInterface.TYPE_ISDN = 2;
public final static int org.dvb.net.rc.RCInterface.TYPE_DECT = 3;
public final static int org.dvb.net.rc.RCInterface.TYPE_CATV = 4;
public final static int org.dvb.net.rc.RCInterface.TYPE_LMDS = 5;
public final static int org.dvb.net.rc.RCInterface.TYPE_MATV = 6;
public final static int org.dvb.net.rc.RCInterface.TYPE_RCS = 7;
public final static int org.dvb.net.rc.RCInterface.TYPE_UNKNOWN = 8;
public final static int org.dvb.net.rc.RCInterface.TYPE_OTHER = 9;

public final static short org.dvb.si.DescriptorTag.NETWORK_NAME = 64;
public final static short org.dvb.si.DescriptorTag.SERVICE_LIST = 65;
public final static short org.dvb.si.DescriptorTag.STUFFING = 66;
public final static short org.dvb.si.DescriptorTag.SATELLITE_DELIVERY_SYSTEM = 67;
public final static short org.dvb.si.DescriptorTag.CABLE_DELIVERY_SYSTEM = 68;
public final static short org.dvb.si.DescriptorTag.BOUQUET_NAME = 71;
public final static short org.dvb.si.DescriptorTag.SERVICE = 72;
public final static short org.dvb.si.DescriptorTag.COUNTRY_AVAILABILITY = 73;
public final static short org.dvb.si.DescriptorTag.LINKAGE = 74;
public final static short org.dvb.si.DescriptorTag.NVOD_REFERENCE = 75;
public final static short org.dvb.si.DescriptorTag.TIME_SHIFTED_SERVICE = 76;
public final static short org.dvb.si.DescriptorTag.SHORT_EVENT = 77;
public final static short org.dvb.si.DescriptorTag.EXTENDED_EVENT = 78;
public final static short org.dvb.si.DescriptorTag.TIME_SHIFTED_EVENT = 79;
public final static short org.dvb.si.DescriptorTag.COMPONENT = 80;
public final static short org.dvb.si.DescriptorTag.MOSAIC = 81;
public final static short org.dvb.si.DescriptorTag.STREAM_IDENTIFIER = 82;
public final static short org.dvb.si.DescriptorTag.CA_IDENTIFIER = 83;
```

```
public final static short org.dvb.si.DescriptorTag.CONTENT = 84;
public final static short org.dvb.si.DescriptorTag.PARENTAL_RATING = 85;
public final static short org.dvb.si.DescriptorTag.TELETEXT = 86;
public final static short org.dvb.si.DescriptorTag.TELEPHONE = 87;
public final static short org.dvb.si.DescriptorTag.LOCAL_TIME_OFFSET = 88;
public final static short org.dvb.si.DescriptorTag.SUBTITLING = 89;
public final static short org.dvb.si.DescriptorTag.TERRESTRIAL_DELIVERY_SYSTEM = 90;
public final static short org.dvb.si.DescriptorTag.MULTILINGUAL_NETWORK_NAME = 91;
public final static short org.dvb.si.DescriptorTag.MULTILINGUAL_BOUQUET_NAME = 92;
public final static short org.dvb.si.DescriptorTag.MULTILINGUAL_SERVICE_NAME = 93;
public final static short org.dvb.si.DescriptorTag.MULTILINGUAL_COMPONENT = 94;
public final static short org.dvb.si.DescriptorTag.PRIVATE_DATA_SPECIFIER = 95;
public final static short org.dvb.si.DescriptorTag.SERVICE_MOVE = 96;
public final static short org.dvb.si.DescriptorTag.SHORT_SMOOTHING_BUFFER = 97;
public final static short org.dvb.si.DescriptorTag.FREQUENCY_LIST = 98;
public final static short org.dvb.si.DescriptorTag.PARTIAL_TRANSPORT_STREAM = 99;
public final static short org.dvb.si.DescriptorTag.DATA_BROADCAST = 100;
public final static byte org.dvb.si.PMTStreamType.MPEG1_VIDEO = 1;
public final static byte org.dvb.si.PMTStreamType.MPEG2_VIDEO = 2;
public final static byte org.dvb.si.PMTStreamType.MPEG1_AUDIO = 3;
public final static byte org.dvb.si.PMTStreamType.MPEG2_AUDIO = 4;
public final static short org.dvb.si.SIInformation.FROM_CACHE_ONLY = 0;
public final static short org.dvb.si.SIInformation.FROM_CACHE_OR_STREAM = 1;
public final static short org.dvb.si.SIInformation.FROM_STREAM_ONLY = 2;
public final static byte org.dvb.si.SIMonitoringType.NETWORK = 1;
public final static byte org.dvb.si.SIMonitoringType.BOUQUET = 2;
public final static byte org.dvb.si.SIMonitoringType.SERVICE = 3;
public final static byte org.dvb.si.SIMonitoringType.PMT_SERVICE = 4;
public final static byte org.dvb.si.SIMonitoringType.PRESENT_FOLLOWING_EVENT = 5;
public final static byte org.dvb.si.SIMonitoringType.SCHEDULED_EVENT = 6;
public final static byte org.dvb.si.SIRunningStatus.UNDEFINED = 0;
public final static byte org.dvb.si.SIRunningStatus.NOT_RUNNING = 1;
public final static byte org.dvb.si.SIRunningStatus.STARTS_IN_A_FEW_SECONDS = 2;
public final static byte org.dvb.si.SIRunningStatus.PAUSING = 3;
public final static byte org.dvb.si.SIRunningStatus.RUNNING = 4;
public final static short org.dvb.si.SIServiceType.UNKNOWN = -1;
public final static short org.dvb.si.SIServiceType.DIGITAL_TELEVISION = 1;
public final static short org.dvb.si.SIServiceType.DIGITAL_RADIO_SOUND = 2;
public final static short org.dvb.si.SIServiceType.TELETEXT = 3;
public final static short org.dvb.si.SIServiceType.NVOD_REFERENCE = 4;
public final static short org.dvb.si.SIServiceType.NVOD_TIME_SHIFTED = 5;
public final static short org.dvb.si.SIServiceType.MOSAIC = 6;
public final static short org.dvb.si.SIServiceType.PAL = 7;
public final static short org.dvb.si.SIServiceType.SECAM = 8;
public final static short org.dvb.si.SIServiceType.D_D2_MAC = 9;
public final static short org.dvb.si.SIServiceType.FM_RADIO = 10;
public final static short org.dvb.si.SIServiceType.NTSC = 11;
public final static short org.dvb.si.SIServiceType.DATA_BROADCAST = 12;
public final static short org.dvb.si.SIServiceType.MHP_APPLICATION = 16;

public final static int org.dvb.test.DVBTest.UNTESTED = -5;
public final static int org.dvb.test.DVBTest.UNRESOLVED = -4;
public final static int org.dvb.test.DVBTest.HUMAN_INTERVENTION = -3;
public final static int org.dvb.test.DVBTest.OPTION_UNSUPPORTED = -2;
public final static int org.dvb.test.DVBTest.FAIL = -1;
public final static int org.dvb.test.DVBTest.PASS = 0;

public final static int org.dvb.ui.DVBAlphaComposite.CLEAR = 1;
public final static int org.dvb.ui.DVBAlphaComposite.SRC = 2;
public final static int org.dvb.ui.DVBAlphaComposite.SRC_OVER = 3;
public final static int org.dvb.ui.DVBAlphaComposite.DST_OVER = 4;
public final static int org.dvb.ui.DVBAlphaComposite.SRC_IN = 5;
public final static int org.dvb.ui.DVBAlphaComposite.DST_IN = 6;
public final static int org.dvb.ui.DVBAlphaComposite.SRC_OUT = 7;
public final static int org.dvb.ui.DVBAlphaComposite.DST_OUT = 8;
public final static int org.dvb.ui.DVBBufferedImage.TYPE_ADVANCED = 20;
public final static int org.dvb.ui.DVBBufferedImage.TYPE_BASE = 21;
public final static int org.dvb.ui.DVBTextLayoutManager.HORIZONTAL_START_ALIGN = 1;
public final static int org.dvb.ui.DVBTextLayoutManager.HORIZONTAL_END_ALIGN = 2;
public final static int org.dvb.ui.DVBTextLayoutManager.HORIZONTAL_CENTER = 3;
public final static int org.dvb.ui.DVBTextLayoutManager.VERTICAL_START_ALIGN = 4;
```

```
public final static int org.dvb.ui.DVBTextLayoutManager.VERTICAL_END_ALIGN = 5;
public final static int org.dvb.ui.DVBTextLayoutManager.VERTICAL_CENTER = 6;
public final static int org.dvb.ui.DVBTextLayoutManager.LINE_ORIENTATION_HORIZONTAL = 10;
public final static int org.dvb.ui.DVBTextLayoutManager.LINE_ORIENTATION_VERTICAL = 11;
public final static int org.dvb.ui.DVBTextLayoutManager.START_CORNER_UPPER_LEFT = 20;
public final static int org.dvb.ui.DVBTextLayoutManager.START_CORNER_UPPER_RIGHT = 21;
public final static int org.dvb.ui.DVBTextLayoutManager.START_CORNER_LOWER_LEFT = 22;
public final static int org.dvb.ui.DVBTextLayoutManager.START_CORNER_LOWER_RIGHT = 23;

public static final int org.dvb.internet.InternetServiceFilter.EMAIL_CLIENT = 1;
public static final int org.dvb.internet.InternetServiceFilter.WWW_CLIENT = 2;
public static final int org.dvb.internet.InternetServiceFilter.NEWS_CLIENT = 3;
public static final int org.dvb.application.AppProxy.INVALID = 8;

public static final int org.dvb.smartcard.SmartCardReaderEvent.SMART_CARD_ERROR = 3;
public static final int org.dvb.smartcard.SmartCardReaderEvent.SMART_CARD_IN = 0;
public static final int org.dvb.smartcard.SmartCardReaderEvent.SMART_CARD_MUTED = 2;
public static final int org.dvb.smartcard.SmartCardReaderEvent.SMART_CARD_OUT = 1;
```

17 Internet access clients

17.1 Referencing DVB services and content within WWW content

MHP internet access clients shall support the following mechanisms of referencing DVB services and content from within WWW content.

- Use of a reference to a DVB service in an HTML "href" shall launch that DVB service in the same way as is done by MHP applications using the MHP service selection API or the end user of the MHP terminal using the navigator to select DVB services. MHP internet access clients are not covered by the MHP security model and shall be able to perform service selection and tuning without any consideration of permissions. The normal MHP resource management mechanisms shall be applied if tuning is required and the tuner concerned is reserved.

NOTE: Only MHP applications with `SelectPermission` can start an internet access client. Such applications can in any case use the service selection API to also select broadcast services. Hence this does not weaken the MHP security model.

MHP internet access clients which support a particular element.attribute from tables 13 "Use of ContentType attribute on elements" on page 90 and 15 "Use of MIME media type by element" on page 91 to a specific MIME type listed in the table shall support the DVB-HTML behaviour defined for that type of reference. This applies to the following MIME types only:

- audio/mpeg, video/mpeg.
- multipart/dvb.service.

NOTE: MHP applications shall only be started in response to selection of a reference to a DVB service. All MHP applications run in the scope of a DVB service and cannot run on their own outside of a service of some type.

17.2 Minimum requirements for internet clients

The following table defines some minimum network protocols which shall be supported by those internet client applications which form part of the MHP internet access profile.

Table 150

Internet Client Application	Minimum required protocols
WWW browser	HTTP (see clause 6.3.7.2 "MHP profile of HTTP 1.0" on page 63) HTTPS (see clause 6.3.7.3 "HTTPS" on page 64)
Email client	SMTP for sending email (see RFC 821 [107]) or HTTP to a WebMail server. Protocols for receiving email are implementation dependent.
Usenet news	NNTP (RFC 977 [108]) or HTTP to a WebNews server.

WWW browser internet clients shall support use of the "mailto" URL as defined in RFC 2818 [112], RFC 2368 [114].

Email internet clients shall support use of the "http" and "https" URLs as defined in section 3.2.2 of RFC 2616 [40].

If a Usenet news internet client is present, then the WWW browser and E-mail internet clients shall also support the use of the "news" URL as defined by RFC 1738 [67]. Usenet news internet clients, if present, shall support the use of the "http", "https", and "mailto" URLs.

17.3 Internet streamed media

There is no requirement for MHP terminals to support internet streaming media content however where these are both supported and visible to DVB-J applications, it shall be done using the Java Media Framework (Java TV [51]).

17.4 Internet connection management

Internet client applications shall always use the default ISP configured into the MHP. For example, in a MHP terminal with only one `RCInterface` that is a `ConnectionRCInterface`, this is the same default as defined by `ConnectionRCInterface.setTargetToDefault`. If this default ISP is reached via a `ConnectionRCInterface` that is currently connected to another target, the normal MHP resource management mechanism shall apply with the internet client application having the resource priority of the MHP application that launched it. If the internet client application fails to reserve such a `ConnectionRCInterface`, the service selection shall fail with a `SelectionFailedEvent` with reason code `INSUFFICIENT_RESOURCES`.

Annex A (normative): External references; errata, clarifications and exemptions

This clause lists known errata in normative external references, as well as clarifications to those references and/or exemptions from requirements in those specifications.

A.1 Void

A.2 Void

A.3 Void

A.4 Void

A.5 Java TV

With reference to Java TV [51].

A.5.1 javax.tv.service.selection

A.5.1.1 Void

A.5.1.2 ServiceContext.select(Locator [])

a) void

b) void

c) void

d) void

e) The following text shall be added at the end of the method description;

If the service containing the specified parts is the same as the service currently selected in this service context then the following shall apply;

the specified media components shall be selected.

if locators to Xlets are listed then the specified Xlets shall be started and other running Xlets in that service context shall be stopped

if no locators to Xlets are listed and the ServiceContext on which the method is called is the one returned by passing the calling Xlet's XletContext to ServiceContextFactory.getServiceContext(XletContext) then the Xlets selected shall be the same as would be selected by calling select(Service) on the service of which the specified components are members. (I.e., if the components belong to a different service than is being presented, the auto-start Xlets of the service will be selected; if the components belong to the same service as is being presented, then no change is made to the currently selected Xlets.)

if no locators to Xlets are listed and the ServiceContext on which the method is called is not the one returned by passing the calling Xlet's XletContext to ServiceContextFactory.getServiceContext(XletContext) then all running Xlets in that ServiceContext shall be stopped.

f) The following additional text shall be considered to form part of the description of this method.

In the specific circumstances when both of the following apply;

the ServiceContext on which the method is called is the one returned by passing the calling Xlet's XletContext to ServiceContextFactory.getServiceContext(XletContext)

the components array does not include any Locators for Xlets

Then the Xlets selected shall be the same as would be selected by calling select(Service) on the service of which the specified components are members.

A.5.1.3 Void

A.5.1.4 Void

A.5.1.5 ServiceContext.select(Service)

The following additional text shall be considered to be added to the end of the method description;

If the service that is currently selected in the service context is re-selected, its auto-start components are ignored and no change is made to the content being presented. A NormalContentEvent is generated immediately.

A.5.1.6 Void

A.5.1.7 PresentationChangedEvent

PresentationChangedEvent (and subtypes) are not generated as a result of changes in or to running applications.

A.5.2 Void

A.5.3 Void

A.5.4 Void

A.5.5 Void

A.5.6 Void

A.5.7 Void

A.5.8 Void

A.5.9 Void

A.5.10 Void

A.5.11 Void

A.5.12 Void

A.5.13 Void

A.6 DAVIC 1.4.1p9

With reference to DAVIC 1.4.1p9 [3].

A.6.1 org.davic.mpeg

A.6.1.1 General

The following classes are considered to have a no argument protected constructor:

- `ElementaryStream`
- `Service`
- `TransportStream`

A.6.1.2 NotAuthorizedException

The specification is considered to include `org.davic.mpeg.NotAuthorizedException` as specified below:

[1]org.davic.mpeg
NotAuthorizedException

Syntax

```
public class NotAuthorizedException extends java.lang.Exception implements
    org.davic.mpeg.NotAuthorizedInterface

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.davic.mpeg.NotAuthorizedException
```

All Implemented Interfaces:

`NotAuthorizedInterface`, java.io.Serializable

Description

This class is thrown by MPEG related APIs when access is requested to information which is scrambled and to which access is not permitted by the security system.

Constructors

NotAuthorizedException()

```
public NotAuthorizedException()
```

Constructs a NotAuthorizedException with no detail message

NotAuthorizedException(String)

```
public NotAuthorizedException(java.lang.String s)
```

Constructs a NotAuthorizedException with the specified detail message

Parameters:

`s` - the detail message

Methods

getElementaryStreams()

```
public ElementaryStream[] getElementaryStreams()
```

If getType() returns ELEMENTARY_STREAM, then this method returns the set of ElementaryStreams that could not be descrambled. Otherwise it returns null.

Specified By:

`NotAuthorizedInterface.getElementaryStreams()` in interface `NotAuthorizedInterface`

Returns:

either the set of ElementaryStreams that could not be descrambled or null

getReason(int)

```
public int[] getReason(int index)
```

Returns the reason(s) why descrambling was not possible.

Specified By:

`NotAuthorizedInterface.getReason(int)` in interface `NotAuthorizedInterface`

Parameters:

`index` - If the component to which access failed is a Service, index shall be 0. Otherwise index shall refer to one stream in the set returnedby getElementaryStreams().

Returns:

an array of length 2 where the first element of the array is the major reason and the second element of the array is the minor reason.

Throws:

`IndexOutOfBoundsException` - If the component to which access failed is a Service, this exception will be thrown if index is non zero. If the component(s) to which access failed was a (set of) elementary streams then this exception will be thrown where index is beyond the size of the array returned by getElementaryStreams.

See Also:

`NotAuthorizedInterface.getElementaryStreams()`

getService()

```
public Service getService()
```

If getType() returns SERVICE, then this method returns the Service that could not be descrambled. Otherwise it returns null.

Specified By:

`NotAuthorizedInterface.getService()` in interface `NotAuthorizedInterface`

Returns:

either the Service that could not be descrambled or null

getType()

```
public int getType()
```

Specified By:

`NotAuthorizedInterface.getType()` in interface `NotAuthorizedInterface`

Returns:

SERVICE or ELEMENTARY_STREAM to indicate that either a service (MPEG program) or one or more elementary streams could not be descrambled.

A.6.2 Chapter 9, Application Format

A.6.2.1 Section 9.4.7. "The MPEG-2 Section Filter API"

In the description of this class there are 2 instances of a cross reference to DAVIC part 10, section 115.3. In each case this shall be considered as a reference to DAVIC part 10 [60], section 12.5.3.

A.6.3 org.davic.mpeg.dvb

A.6.3.1 General

The following classes are considered to have a no argument protected constructor:

- `DvbService`
- `DvbElementaryStream`
- `DvbTransportStream`

A.6.4 org.davic.mpeg.sections

A.6.4.1 RingSectionFilter

Is considered to have the following text appended to its description:

> All sections in a ring section filter are initialized to empty when the ring section filter is first created. Clearing them to empty any time after this is the responsibility of the application. Starting a ring section filter shall not clear any of the sections to empty.

A.6.4.2 Section

A.6.4.2.1 clone()

Section is considered to have the method clone() with the following behaviour.

> A cloned Section object is a new and separate object. It is unaffected by changes in the state of the original Section object or restarting of the SectionFilter the source Section object originated from. The clone method must be implemented without declaring exceptions.

A.6.4.2.2 getData()

Remove the following text from the methods of `org.davic.mpeg.sections.Section`:

> (everything after the length field, not including a CRC check)

A.6.4.2.3 getFullStatus()

Is considered to have the following text appended to its description:

> Returns true when the `Section` object contains valid data.

A.6.4.2.4 Class Description

The following text shall be considered to be present at the end of the class description.

> In this class, the term "section data" shall be considered to include the section header, any possible CRC and all bytes in between.

A.6.4.3 SectionFilter

A.6.4.3.1 Cross reference error

In the description of this class there are 12 instances of a cross reference to H7. In each case this shall be considered as a reference to E.8.1.

A.6.4.3.2 startFiltering(all signatures)

In these methods, the description of when the `FilterResourceException` shall be thrown is considered to have the following text appended to its description:

> This shall be applied whether the parent section filter group is connected to a TS or not, or whether this SectionFilter object is already started or not.

A.6.4.3.3 startFiltering(java.lang.Object, int, int, int, byte[], byte[])

Is considered to have the following text appended to its description:

> `IllegalFilterDefinitionException` is thrown if offset is too small.

A.6.4.3.4 startFiltering (appData, pid, tableId) exceptions

Like other `startFiltering` methods `org.davic.mpeg.sections.SectionFilter.startFiltering (appData, pid, tableId)` shall throw an `IllegalFilterDefinitionException` where:

- the Java integer is negative
- the Java integer is larger than what is allowed for PID or table_id according to the relevant MPEG specification

A.6.4.3.5 Started Section Filters

The class description is considered to have the following text added at its end.

> When a SectionFilterGroup is detached, either by the client or through resource withdrawal, started SectionFilters shall remain started. Hence if the SectionFilterGroup is re-attached, those filters shall re-activate.

A.6.4.4 SectionFilterGroup

A.6.4.4.1 attach

A `NotAuthorizedException` is added to the definition of this method.

A.6.4.4.2 Constructors

The constructors are considered to have.

> Throws `IllegalArgumentException` if `numberOfFilters` <1.

A.6.4.4.3 sectionSize

All methods with a `sectionSize` parameter are considered to have the following text appended to their descriptions:

> Throws `IllegalArgumentException` if `sectionSize` <1.

A.6.4.4.4 newRingSectionFilter

Is considered to have the following text appended to its description:

> Throws `IllegalArgumentException` if `ringSize` <1.

A.6.4.4.5 Constructor(int, boolean)

Is considered to have the following text appended to its description:

> The scope of the `resourcePriority` shall be a single application only.

A.6.4.4.6 General

In the methods of this class, all occurrences of "(successful startFiltering)" shall be considered to read "(successful call to the startFiltering method of the newly created instance)".

A.6.4.5 TimeOutEvent

The specification is considered to include `org.davic.mpeg.sections.TimeOutEvent` as specified below:

org.davic.mpeg.sections
TimeOutEvent

Declaration

```
public class TimeOutEvent extends org.davic.mpeg.sections.EndOfFilteringEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.davic.mpeg.sections.org.davic.mpeg.sections.SectionFilterEvent
              |
              +--org.davic.mpeg.sections.org.davic.mpeg.sections.EndOfFilteringEvent
                    |
                    +--org.davic.mpeg.sections.TimeOutEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is generated if section filter operations time out within the period specified by the setTimeOut() method. For a SimpleSectionFilter it will be generated if no sections arrive within the specified period. For a TableSectionFilter, it will be generated if the complete table does not arrive within the specified time. For a RingSectionFilter, it will be generated if the specified time has elapsed since the arrival of the last section being successfully filtered.

Constructors

TimeOutEvent(SectionFilter, Object)

```
public TimeOutEvent(SectionFilter f, java.lang.Object appData)
```

This constructs an TimeOutEvent event for the specified SectionFilter object.

Parameters:

`f` - the SectionFilter object which timed out

`appData` - application data that was passed to the startFiltering method

Methods

getSource()

```
public java.lang.Object getSource()
```

This returns the SectionFilter object which timed out

Overrides:

`EndOfFilteringEvent.getSource()` in class `EndOfFilteringEvent`

A.6.5 Simple Section Filter

The description of the getSection method shall be considered to have the following text added:

> This method shall return null if no section has been successfully filtered for this instance and the owning SectionFilterGroup is not attached.

A.6.6 org.davic.media

A.6.6.1 FreezeControl.resume()

Add the following to the description of the semantics for this method:

If the player is started and if decoding of the media stream is not frozen then calls to this method shall have no effect. If the player is not started then the exception shall be thrown.

A.6.6.2 MediaTimePositionChangedEvent

Add the following constructor:

```
MediaTimePositionChangedEvent (
   Controller from,
   int previous,
   int current,
   int target,
   Time mediaTime)
```

With the following definition of parameters:

> Parameters:
>
> from - the controller whose media position was changed
>
> previous - the state the controller was in before this event
>
> current - the state the controller was in at the time the event was generated
>
> target - the state that the controller is heading to
>
> mediaTime - the media time after the change

A.6.6.3 NotAuthorizedMediaException

The following constructors are considered to be removed from the specification:

```
NotAuthorizedMediaException()
NotAuthorizedMediaException(java.lang.String reason)
```

The following constructors are considered to be a normative part of the specification:

```
NotAuthorizedMediaException( org.davic.mpeg.Service, int reason )
NotAuthorizedMediaException( org.davic.mpeg.ElementaryStream[], int reason[] )
NotAuthorizedMediaException( org.davic.mpeg.ElementaryStream[], int[], int[] )
NotAuthorizedMediaException(Service, int major_reason,int minor_reason)
```

NotAuthorizedMediaException(ElementaryStream[], int[])

```
public NotAuthorizedMediaException(org.davic.mpeg.ElementaryStream[] e, int[] reason)
```

Constructor for exception due to failure accessing one or more MPEG elementary streams The caller of this constructor is responsible for ensuring the two arrays provided as parameters are the same size. The implementation is not expected to check this. The exception has no detail message.

Parameters:

e - the elementary streams which could not be accessed

reason - the reason why the exception was thrown for each elementary stream

Use of the constructor NotAuthorizedMediaException(ElementaryStream[] e, int[] reason) will result in the major reason for each elementary stream being the one specified in the reason parameter to the method and the minor reason being OTHER as defined in NotAuthorizedInterface.

NotAuthorizedMediaException(Service, int)

```
public NotAuthorizedMediaException(org.davic.mpeg.Service s, int reason)
```

Constructor for exception due to failure accessing an MPEG service. The exception has no detail message.

Parameters:

s - the service which could not be accessed

reason - the reason why the service could not be accessed

Use of the constructor NotAuthorizedMediaException(Service, int reason) will result in the major reason for the service being the one specified in the reason parameter to the method and the minor reason being OTHER as defined in NotAuthorizedInterface.

NotAuthorizedMediaException(ElementaryStream[], int[], int[])

```
public NotAuthorizedMediaException(ElementaryStream[] e, int[] major_reason,int[] minor_
            reason)
```

Constructor for exception due to failure accessing one or more MPEG elementary streams The caller of this constructor is responsible for ensuring the three arrays provided as parameters are the same size. The implementation is not expected to check this.

Parameters:

e - the elementary streams which could not be accessed

major_reason - the major reason why the exception was thrown for each elementary stream

minor_reason - the minor reason why the exception was thrown for each elementary stream

NotAuthorizedMediaException(Service, int, int)

```
public NotAuthorizedMediaException(org.davic.mpeg.Service s, int major_reason, int minor_
            reason)
```

Constructor for exception due to failure accessing an MPEG service

Parameters:

s - the service which could not be accessed

major_reason - the major reason why the service could not be accessed

minor_reason - the minor reason why the service could not be accessed

Since:

MHP 1.0.2

A.6.6.4 LanguageControl

A.6.6.4.1 Class description

The following description of semantics is considered to be present:

If more than one stream with the same language exists, the behaviour of `selectLanguage(String)` is to select the first listed in the network signalling.

NOTE: This is equivalent to item b under clause 11.4.2.3 "Default media player behaviour" on page 272.

In the methods `getCurrentLanguage` and `selectDefaultLanguage`, the following additional text shall be considered to be present:

> If no content of the appropriate media type for the control is present, a String of length zero is returned.

In the method `selectDefaultLanguage`, the following shall be considered to be appended to the method description:

> If this information is not available, a String of length zero is returned.

A.6.6.4.2 selectLanguage(String)

The following additional text shall be considered to form part of the description of this method;

> When this method returns normally, the language will have been synchronously selected.

A.6.7 org.davic.net

A.6.7.1 InvalidLocatorException

The following class definition is considered to be a normative part of the specification:

org.davic.net
InvalidLocatorException

Syntax

```
public class InvalidLocatorException extends java.lang.Exception

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.davic.net.InvalidLocatorException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown when one or more parameters to construct a Locator are invalid.

Constructors

InvalidLocatorException()

```
public InvalidLocatorException()
```

Constructor without reason.

InvalidLocatorException(String)

```
public InvalidLocatorException(java.lang.String reason)
```

Constructor for the exception with a specified reason

Parameters:
`reason` - the reason why the exception was raised

A.6.7.2 Locator

A.6.7.2.1 Locator()

The no-argument constructor for `org.davic.net.Locator` is considered to not be present. The absence of any description on the method indicates that this was an editing error in the DAVIC specification.

A.6.7.2.2 toExternalForm()

Is considered to have the following text appended to its description:

> If the instance of `Locator` has been created using `Locator(java.lang.String url)` and the URL is a non-null invalid URL the behaviour is implementation dependent.

A.6.7.3 tuning

A.6.7.3.1 NetworkInterfaceController

A.6.7.3.1.1 reserve()

The semantic of the following throws clause is corrected as follows:

```
Throws:  NoFreeInterfaceException
         raised if the requested network interface can not be reserved
```

The following from the semantic of this method:

> If this NetworkInterfaceController has already reserved another NetworkInterface, then it will either release that NetworkInterface and reserve the specified one, or throw an exception. If the specified NetworkInterface has already been reserved by this NetworkInterfaceController, then this method does nothing.

is replaced with the following:

> If this NetworkInterfaceController has currently reserved another NetworkInterface, then it will either release that NetworkInterface and reserve an appropriate one, or throw an exception. If a NetworkInterface that is able to tune to the specified transport stream is currently reserved by this NetworkInterfaceController, then this method does nothing.

A.6.7.3.1.2 reserveFor()

The following from the semantic of this method:

> If this NetworkInterfaceController has already reserved another NetworkInterface, then it will either release that NetworkInterface and reserve an appropriate one, or throw an exception. If NetworkInterfaceController has already reserved a NetworkInterface that is able to tune to the specified transport stream, then this method does nothing.

is replaced with the following:

> If this NetworkInterfaceController has currently reserved another NetworkInterface, then it will either release that NetworkInterface and reserve an appropriate one, or throw an exception. If a NetworkInterface that is able to tune to the specified transport stream is currently reserved by this NetworkInterfaceController, then this method does nothing.

A.6.7.3.1.3 tune()

Replace "this NetworkInterface" with "the NetworkInterface reserved by this NetworkInterfaceController" in section H.5.4.3 of DAVIC specification.

A.6.7.3.2 NetworkInterface

A.6.7.3.2.1 Protected constructor

This class is considered to have a no argument protected constructor with the following statement attached to it:

> This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

A.6.7.4 ca

A.6.7.4.1 CAMessage

The following class definition is considered to be a normative part of the specification:

```
public class CAMessage
extends java.lang.Object
```

This class represents messages to CA modules.

Constructors

```
public CAMessage(byte [] data)
```

Constructor for the message

Parameters:

data - message data

Method Detail

getData

public byte[] getData()

Returns:

the data of the message

A.6.7.4.2 CAModule

A.6.7.4.2.1 buyEntitlement(org.davic.net.Locator)

This method is considered to have the amendment.

Replace:

> Initiates a purchase dialogue for specified service or future event (specified by a Locator).

With:

> Request to buy a specified service or future event (specified by a Locator) from a conditional access system.

In the comments of `org.davic.net.ca.CAModule.buyEntitlement()` the sentence:

> In case of CA0 this maps onto event_query with event_cmd_id = mmi (Common Interface specification, section B.4.1.1)."

is replaced with

> In case of DVB Common Interface, this maps onto CI messages as follows:
>
> • when the Locator points to a service and the terminal is currently receiving the transport stream that this service is carried in and this transport stream is available to this CA module, then this method is mapped to a ca_pmt message with ca_pmt_cmd_id set to "ok_mmi". The value returned in the ca_pmt_reply is mapped as defined in

the documentation of the constants in the class. If the module is currently descrambling the service and the terminal is aware of this, ENTITLEMENT_AVAILABLE shall be returned immediately without communicating with the module.

• when the Locator points to a service that is not carried in a currently received transport stream, NotTunedException is thrown

• when the Locator points to an event, this maps onto event_query message with event_cmd_id set to "mmi" (Common Interface specification, section B.4.1.1). The value returned in the event_reply message is mapped as defined in the documentation of the constants in this class.

In the CA API, the constants defined in the `org.davic.net.ca.CAModule` class are mapped to the `CA_enable` values of the `ca_pmt_response` message and the `event_status` values of the `event_reply` message in the Common Interface protocol as follows:

ENTITLEMENT_AVAILABLE:

CA_enable value "Descrambling possible" (0x01)

event_status value "entitlement_available" (0x01)

event_status value "mmi_complete_available" (0x05)

ENTITLEMENT_NOT_AVAILABLE:

CA_enable value "Descrambling not possible (because no entitlement)" (0x04)

event_status value "entitlement_not_available" (0x02)

event_status value "mmi_complete_not_available" (0x06)

ENTITLEMENT_UNKNOWN:

CA_enable value "Descrambling not possible (for technical reasons)" (0x05)

all other CA_enable values not having an explicit mapping in this section

event_status value "entitlement_unknown" (0x00)

event_status value "mmi_complete_unknown" (0x04)

all other event_status values not having an explicit mapping in this section

MMI_DIALOGUE_REQUIRED:

CA_enable value "Descrambling possible under conditions (purchase dialogue)" (0x02)

CA_enable value "Descrambling possible under conditions (technical dialogue)" (0x03)

event_status value "mmi_dialogue_required" (0x03)

A.6.7.4.2.2 isDescramblable(ElementaryStream streams[])

Is considered to have the following text appended to its description:

If an empty array is passed in, returns true.

Is considered to have the following text added as a parameters clause:

Parameters:

streams - the set of elementary streams to be tested for the possibility to descramble

A.6.7.4.2.3 openMessageSession(MessageListener)

This method is considered to have the amendment:

Modify:

Throws: ModuleBusyException

raised if the module is busy and is not able to handle a message session at the moment

To say:

> Throws: ModuleBusyException
>
> raised if the module is busy and is not able to handle a message session at the moment. This is CA system dependant.

The description of this method is considered to have the following text added to it.

> In systems based on the DVB common interface, messages sessions opened using this method shall be mapped onto the CA pipeline for the module represented by this CAModule instance as defined in section 6.8. of the common interface extensions specification. Neither the `module_id` or the `resource_id` of the module are visible to the application. It is the responsibility of the platform to perform the relevant mapping.

NOTE: The document referred to as "common interface extensions specification." is TS 101 699 [71].

The following text:

> Throws: ModuleResourceNonExistentException
>
> raised if the specified resource cannot be addressed. This includes situations where the resource is not present in the module as well as addressing what would be a public resource in a DAVIC CA0 / DVB-CI system.

Is considered to be replaced by:

> Throws: ModuleResourceNonExistentException
>
> raised if the specified resource is not present in the module.

NOTE: The `ModuleResourceVersionTooLowException` shall never be thrown in this version of this specification.

A.6.7.4.2.4 queryEntitlement(org.davic.net.Locator)

This method is considered to include the following:

> Throws: org.davic.net.InvalidLocatorException
>
> if the locator does not point to a valid service or event

In the comments of `org.davic.net.ca.CAModule.queryEntitlement()` the sentence:

> In case of CA0 this maps onto event_query with event_cmd_id = query (Common Interface specification, sectionB.4.1.1)."

is replaced with

> In case of DVB Common Interface, this maps onto CI messages as follows:
>
> • when the Locator points to a service and the terminal is currently receiving the transport stream that this service is carried in and this transport stream is available to this CA module, then this method is mapped to a ca_pmt message with ca_pmt_cmd_id set to "query". The value returned in the ca_pmt_reply is mapped as defined in the documentation of the constants in the class. If the module is currently descrambling the service and the terminal is aware of this, ENTITLEMENT_AVAILABLE shall be returned immediately without communicating with the module.
>
> • when the Locator points to a service that is not carried in a currently received transport stream, ENTITLEMENT_UNKNOWN shall be returned.
>
> • when the Locator points to an event, this maps onto event_query with event_cmd_id = query (Common Interface specification, section B.4.1.1). The return values is mapped as defined in the documentation of the constants in this class.

A.6.7.4.2.5 sendToModule

The description of this method is considered to have the following text added to it.

In systems based on the DVB common interface, messages sent using this method shall be mapped onto the CAPipelineRequest as defined in section 6.8.3 of the common interface extensions specification. Responses from the CA system reported through the CAPipelineResponse and CAPipelineNotification messages shall be mapped onto instances of ModuleResponseEvent.

NOTE: The document referred to as "common interface extensions specification." is TS 101 699 [71].

A.6.7.4.2.6 Protected constructor

This class is considered to have a no argument protected constructor with the following statement attached to it:

This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

A.6.7.4.2.7 Additional methods"

The following specification is considered to contain the following additional methods:

getApplicationTitle

```
/**
* Retrieves the Application Title String.

This functionality is provided at low lowel (within MMI and Application Information
sessions defined in EN50221) by the message application_info() message (Application
Information resource, see 8.
4.2.2)

* @exception ModuleUnavailableException raised if the physical CA module
*            has been removed and is not available any more
* @return the application title string
*/
public String getApplicationTitle() throws ModuleUnavailableException;
```

enterApplication

```
/**
* Requests the module to start the application and enter
* the main application menu.

This functionality is provided at low lowel (within MMI and Application Information
sessions defined in EN50221) by the message enter_menu() message (Application Information
resource, see 8.4.2.3)

* @exception ModuleUnavailableException raised if the physical CA module
*            has been removed and is not available any more
*/
public void enterApplication() throws ModuleUnavailableException;
```

closeMMI

```
/**
* Requests the module to leave
* the complete tree of the current high-level MMI dialogs.

This functionality is provided at low lowel (within MMI and Application Information
sessions defined in EN50221) by the message close_mmi() message (MMI resource, see 8.6.2.1)

* @exception ModuleUnavailableException raised if the physical CA module
*            has been removed and is not available any more
*/
public void closeMMI() throws ModuleUnavailableException;
```

A.6.7.4.2.8 listEntitlements

This method is considered to have the following text added:

In case of DVB Common Interface, it is not possible to obtain this information from the CI module. Thus this method shall return an array of length zero.

A.6.7.4.3 CAModuleManager

A.6.7.4.3.1 addMMIListener()

Is considered to have the following text appended to its description:

If an application has registered (and not removed) a listener to handle the MMI dialogues and if an MMI dialogue is required, this causes the platform to ask the MMI listener to handle the MMI dialogues. If there is no application registered to handle the MMI dialogues, these will be handled by the platform.

A.6.7.4.3.2 getModules(Service s)

Is considered to have the following text appended to its description:

If the service passed as a parameter is not scrambled, returns an empty array whose length is 0.

A.6.7.4.4 NoFreeCapacityException

The following class definition is considered to be a normative part of the specification:

org.davic.net.ca
NoFreeCapacityException

Syntax

```
public class NoFreeCapacityException extends org.davic.net.ca.CAException

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.davic.net.ca.CAException
                    |
                    +--org.davic.net.ca.NoFreeCapacityException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown when a method is called and the CA module does not have the required capacity to perform the action

Constructors

NoFreeCapacityException()

```
public NoFreeCapacityException()
```

Default constructor for the exception

NoFreeCapacityException(String)

```
public NoFreeCapacityException(java.lang.String reason)
```

Constructor for the exception with a specified reason

Parameters:
`reason` - the reason why the exception was raised

A.6.7.4.5 MMIObject

The following class definition is considered to be a normative part of the specification:

org.davic.net.ca
MMIObject

Syntax
```
public class MMIObject

java.lang.Object
  |
  +--org.davic.net.ca.MMIObject
```

Direct Known Subclasses:

List, Text

Description
The base class of all MMI classes.

Methods

close()

```
public void close()
```

Closes the MMI object and informs the CA API implementation that the application intends to close or has closed the corresponding MMI screen.

A.6.7.4.6 DescramblerProxy

A.6.7.4.6.1 startDescrambling()

In the comments of `org.davic.net.ca.DescramblerProxy.startDescrambling()` (all signature versions) the sentence:

> This method may start an MMI dialog.

is replaced with:

> This method may result in the CA system requesting an MMI dialog.

The description of this method is considered to be extended by the following text:

> In systems based on the DVB common interface this maps onto ca_pmt with ca_pmt_cmd_id = ok_descrambling (Common Interface specification, section 8.4.3.4). and the NotAuthorizedException shall never be thrown.

A.6.7.4.6.2 startDescrambling(org.davic.mpeg.Service, java.lang.Object)

Is considered to have the following text appended to its description:

> DescramblerProxy applies from the point of view of one application. Methods such as `startDescrambling()` and `stopDescrambling` apply on a per-application basis and do not impact descrambling on behalf of other applications, except subject to platform resource limitations.

A.6.7.4.6.3 startDescrambling(org.davic.mpeg.ElementaryStream[], java.lang.Object)

Is considered to have the following text appended to its description:

> If `org.davic.mpeg.ElementaryStream[]` is a zero length array the method has no effect.

A.6.7.4.6.4 startDescrambling(org.davic.mpeg.ElementaryStream[], CAModule, java.lang.Object)

Is considered to have the following text appended to its description:

> If `org.davic.mpeg.ElementaryStream[]` is a zero length array the method has no effect.

A.6.7.4.6.5 startDescramblingDialog(org.davic.mpeg.ElementaryStream[])

Is considered to have the following text appended to its description:

> If `org.davic.mpeg.ElementaryStream[]` is a zero length array the method has no effect.

A.6.7.4.6.6 stopDescrambling()

Is considered to have the following text appended to its description:

> If no descrambling is being done then this method has no effect

A.6.7.4.6.7 stopDescrambling(org.davic.mpeg.ElementaryStream[] streams)

Is considered to have the following text appended to its description:

> The method `stopDescrambling( ElementaryStream[])` only stops the descrambling of streams which have been started through this `DescramblerProxy` instance, and not started through any other instance.

Is considered to include the following parameter specification:

streams: array of ElementaryStreams whose descrambling is to be stopped.

Is considered to have the following text appended to its description:

> The `stopDescrambling` method only affects members of the array of streams that are being descrambled. There is no effect on any streams listed in the array that are not being descrambled.

A.6.7.4.6.8 startDescramblingDialog

The description of this method is considered to be extended by the following:

> In systems based on the DVB common interface, the `NotAuthorizedException` shall never be thrown.

A.6.7.4.6.9 Class Description

The methods `startDescrambling` and `stopDescrambling` in `DescramblerProxy` are used to add and remove, respectively, elementary streams of one service from the set of elementary streams to be descrambled. The MHP implementation needs to keep track of the set of elementary streams that are requested to be descrambled by the application.

When the application calls `startDescrambling` or `stopDescrambling` and this set of elementary streams changes while the service is being descrambled, an implementation using the Common Interface shall send the CA_PMT message with the ca_pmt_list_management set to "update" and the version number appropriately changed. This CA_PMT message shall include information about only those elementary streams that are to be descrambled. Those elementary streams that are not requested to be descrambled should be omitted from the CA_PMT message completely.

NOTE 1: The ca_pmt_cmd_id can't be used to tag elementary streams that should not be descrambled because there is no suitable value of ca_pmt_cmd_id for this purpose. Therefore these streams need to be left out from the CA_PMT completely.

NOTE 2: Updating the CA_PMT in response to the method calls from the MHP application requires also changing the CA_PMT version_number field. This implies that the MHP implementation needs to have an independent version numbering for the CA_PMTs while descrambling one service and the version_number field of the PMT in the broadcast can't be simply copied into the CA_PMT.

A.6.7.4.7 StartMMIEvent(MMIObject, int, java.lang.Object)

Is considered to include the following parameter specification:

caModule: the CAModule object that is the source of the event, which shall be returned by the getSource() method.

A.6.7.4.8 ModuleResponseEvent

A.6.7.4.8.1 Protected Constructor

This class is considered to have a no argument protected constructor with the following statement attached to it:

> This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

A.6.7.4.9 NewModuleEvent

The class description for this class is considered to have the following text appended to it:

> In the case of a CA module based on the DVB common interface, this event shall only be generated when module initialization has been completed. Hence an application has no means to detect when a module is inserted but has not yet been initialized.

A.6.7.4.10 PIDChangeEvent

The following the text:

> This event is generated as part of the Host Control functionality in the Common Interface / CA0 to signal that an elementary stream should be substituted with an other one. This event is intended for data services only. Television services that are presented using a high level media player API (whose implementation implicitly handles descrambling) will also have this event handled implicitly by that implementation.

Is considered to be replaced with the following:

> In systems based upon the DVB Common Interface this event is generated in response to the Host Control replace / clear_replace requests.

NOTE: This event is for information only. The platform is responsible for implementing the requests from the CA system. See also R206-001 [79].

This class is considered to inherit from `org.davic.net.ca.CAEvent` instead of `org.davic.net.ca.DescramblerEvent`.

The text:

```
public PIDChangeEvent(short oldPid,
                      short newPid,
                      Object descramblerProxy)
```

and:

> descramblerProxy - the DescramblerProxy object representing the descrambling resource which is the source of the event.

is considered to be replaced with:

```
public PIDChangeEvent(short oldPid,
                      short newPid,
                      Object caModule)
```

and:

caModule - the CAModule object representing the CA system which is the source of the event.

The text:

```
public Object getSource()
```
Returns the DescramberProxy that is the source of the event.

Overrides:

getSource in class DescramblerEvent

is considered to be replaced with:

```
public Object getSource()
```
Returns the CAModule that is the source of the event.

Overrides:

getSource in class CAEvent

A.6.7.4.11 TuneRequestEvent

The following text:

> This event is generated as part of the Host Control functionality in the Common Interface / CA0.

Is considered to be replaced with the following:

> In systems based upon the DVB Common Interface this event is generated in response to the Host Control tune request.

NOTE 1: This event is only guaranteed to be delivered to applications that survive the service selection caused by the Host Control tune request (see clause 11.6.4 "Conditional Access API" on page 287).

NOTE 2: This event is for information only. The platform is responsible for implementing the service selection autonomously in response to the request from the CA system.

This class is considered to inherit from `org.davic.net.ca.CAEvent` instead of `org.davic.net.ca.DescramblerEvent`.

The text:

```
public TuneRequestEvent(Locator locator,
                        Object descramblerProxy)
```

and:

descramblerProxy - the DescramblerProxy object representing descrambler resource which is the source of the event

is considered to be replaced with:

```
public TuneRequestEvent(Locator locator,
                      Object caModule)
```

and:

caModule - the CAModule object representing the CA system which is the source of the event.

The text:

`public Object getSource()`
Returns the DescramberProxy that is the source of the event.

Overrides:

getSource in class DescramblerEvent

is considered to be replaced with:

`public Object getSource()`
Returns the CAModule that is the source of the event.

Overrides:

getSource in class CAEvent

A.6.7.4.12 DescramblingStartedEvent

In the case of DVB common interface, this event is sent when the MHP terminal has requested the module to start the descrambling.

A.6.7.4.13 DescramblingStoppedEvent

In the case of DVB common interface, this event is sent when the MHP terminal has requested the module to stop the descrambling.

A.6.7.5 dvb.DvbLocator(int onid, int tsid, int serviceid, int eventid, int componenttags[], String filePath).

The following parameter specification:

the: file path string including the slash character in the beginning

is considered to read:

filePath: string including the slash character in the beginning

A.6.7.6 dvb.DvbLocator

A.6.7.6.1 DvbLocator(int, int, int, int, int[])

In the constructor `DvbLocator(int, int, int, int, int[])`, the name of the last parameter in the method signature shall be considered to be "`componenttags`".

A.6.7.6.2 Additional method

The following method is considered to be present:

```
/** Returns the textual service identifier, if one was provided to the constructor.
 * @return the textual service identifier, null if not present
 * @since MHP1.0.1
 */
public String getTextualServiceIdentifier() ;
```

A.6.7.6.3 getOriginalNetworkId

The returns clause of the `getOriginalNetworkId()` method is considered to include "-1 if not present" similarly as the other methods returning the numeric identifiers.

A.6.8 org.davic.net.tuning

A.6.8.1 Figure H-1

In Figure H-1: " Tuning API object model: Base classes. " in the class `NetworkInterface`, the method `getURL()` shall be considered to be "`getLocator()`"

A.6.8.2 Figure H-2

In:

> Figure H-2: " Tuning API object model: Exceptions."

the exception `IncorrectURLException` shall be considered to be absent.

A.6.8.3 Network Interface

The following additional methods are considered to be present:

```
/**
 * Tests for equality where two NetworkInterface objects are equal if and only if
 * they control the same physical tuner.
 * @param other the reference object with which to compare.
 * @return true if and only if other is an instance of NetworkInterface and calls to other
 * control the same physical tuner as this.
 */
public boolean equals(Object other)

/**
 * Returns a hash code value for the object. which obeys the contract of Object.hashCode().
 * @return a hash code value for the object.
 */
public int hashCode()
```

A.6.9 Extensibility and Over-Riding

The DAVIC specification DAVIC 1.4.1p9 [3] is considered to include the following;

> The addition of public or protected constructors, methods or fields to the `org.davic` packages is allowed except where this would cause a compliant MHP application to fail. Examples of the latter include the adding of abstract methods to classes or adding of methods to interfaces which application classes will implement.
>
> Within the `org.davic` package and its sub packages, overriding inherited public and protected methods not specified as being overridden is an allowable implementation option.
>
> NOTE: This language does not apply to constructors or to fields, because inherited fields and constructors cannot be overridden in the Java language.

A.7 HAVi

With reference to HAVi [50].

A.7.1 Drafting conventions

This specification does not follow the ETSI drafting rules as specified in SR 001 262 [i.6]. In particular, the term "should" shall be interpreted in terms of the ETSI drafting rules as being closer to "shall" than "should".

A.7.2 General

A.7.2.1 Thread-safety

As with the `java.awt package`, the `org.havi.ui` package is not required to be thread safe.

A.7.2.2 javadoc errors

The javadoc for the HAVi specification appears to be compiled against a version of the "java.*" packages more recent than that required for the MHP specification. All methods, fields and inner classes shown as inherited from classes outside the "org.havi" package namespace which are not present in the MHP specification for that class shall be considered to be absent from the HAVi specification.

A.7.3 Event mechanism

This section presents a clarification for the HAVi event mechanism.

A.7.3.1 Introduction

One of the reasons for the HAVi event mechanism is to provide a mechanism for widgets to request a type of input that may not be available on the input device supported by a platform. A HAVi widget can indicate its input preference by implementing one or more `HxxxInputPreferred` interfaces. This is important to enable application provided widgets to have access to the same capabilities as have always been available to platform provided ones.

An `HxxxInputPreferred` interface indicates the widget that implements the interface expects a certain type of input events. E.g. on systems with limited input devices the platform can supply a virtual keyboard to generate the interface-specific events.

The `Hxxxable` and `HxxxValue` interfaces group methods common to various `HVisible` subclasses; they do not imply additional support from the platform.

The `HxxxInputPreferred` interfaces all imply possible support by a (virtual) keyboard. The platform shall provide a way for the user to generate the input expected by the focused component. This could mean automatically presenting some kind of virtual keyboard when a focused component requires input that could not be generated in another way. The platform can determine which virtual keys a widget requires by looking at the `HxxxInputPreferred` interfaces it implements.

For `keyCode` input, `HNavigationInputPreferred.getNavigationkeys()` and `HKeyboardInputPreferred.getValidInput()` allow the platform to determine which `keyCodes` the particular widgets expect. Platform implementations shall provide the user with a means to generate the `keyCodes` expected by all `HxxxInputPreferred` interfaces implemented by the widget having input focus (with the exception of `keyCodes` not supported according to `org.havi.ui.event.HKeyCapabilities`).

HAVi events generated by the platform and sent to a `HComponent` are `HActionEvent`, `HAdjustmentEvent`, `HItemEvent`, `HTextEvent`, `HRcEvent`, `HFocusEvent` and `HKeyEvent`.

A.7.3.2 Overview of HAVi events

`HComponents` indicate they want to receive `HFocusEvents` by implementing the `HNavigationInputPreferred` interface. For `HNavigationInputPreferred`, the `keyCodes` for navigation keystrokes generated on the `HNavigationInputPreferred` will be passed to the `HNavigationInputPreferred` as an `HFocusEvent` `transferId`. The `HNavigationInputPreferred` will process an `HFocusEvent` of id `FOCUS_TRANSFER` in its `processHFocusEvent` method by calling `requestFocus` on the `HNavigable` associated with the `keyCode` returned by `HFocusEvent.getTransferId()`, if there is one.

Implementations of `HNavigationInputPreferred` will not send this `HFocusEvent` to `FocusListeners` or `HFocusListeners`, it is only used by the platform to communicate the transferId `to` the `HNavigationInputPreferred`.

The manner in which the keystrokes are generated is implementation-specific, as some platforms may supply a more extensive hardware keyboard, while other platforms may choose to provide a virtual keyboard to generate these keystrokes.

Also, HAVi allows generation of the HAVi events on top of AWT (in `HComponent.processEvent`) from other events as an implementation option, to allow for platforms unable to generate HAVi event directly. As a result of this, it is platform specific whether `processEvent` is ever called with a HAVi event as argument, or that the event is generated in this method from other events. In such an implementation, a widget may receive the original, unexpected, platform-specific, non-HAVi `java.awt` events as well as the translated HAVi events. To avoid confusion, a HAVi widget is supposed to process only the HAVi events and applications should ignore other events (i.e. not add listeners for `java.awt` events and not use them through `processXxxEvent` methods).

For the handling of navigation keys, an implementation of the `HNavigationInputPreferred` interface receives the keycodes for navigation as the transferId of `org.havi.ui.event.HFocusEvent`, and not as a `java.awt.event.KeyEvent` or `org.havi.ui.event.HKeyEvent.` (On platforms which generate HAVi events from other events, it is possible that the component does receive a `java.awt.event.KeyEvent`, however this is platform-specific and applications should not rely on this).

Hcomponent.processEvent is responsible to dispatch HFocusEvents to the processHFocusEvent method; this method will call requestFocus on the target of a transferId for a FOCUS_TRANSFER event, and send HFocusEvents of type FOCUS_GAINED and FOCUS_LOST to any registered HFocusListeners for classes that support adding these listeners. Depending on which other HAVi interfaces the component implements and on whether it extends HVisible, this method will also change the state of the widget, play appropriate sounds, and notify any listeners specified in these other interfaces for a focus change.

An HComponent implementing HKeyboardInputPreferred will receive input in the form of HKeyEvents. On platforms with limited input devices, the platform can present a virtual keyboard for the user to generate the requested keyCodes. The platform can use the input type of the HKeyboardInputPreferred to determine which keys to present on this virtual keyboard, however, the platform is not required to prevent the user from generating more keyCodes than those requested by the HKeyboardInputPreferred.

HAVi allows to generate the HKeyEvents from other events in HComponent.processEvent, so any KeyEvents received by the component which are not HKeyEvents should be ignored as platform-specific.

Hcomponent.processEvent is responsible for dispatching HKeyEvents to the processHKeyEvent method; this method will send the HKeyEvent to any registered HKeyListeners for classes that support adding these listeners.

If an HComponent implements both HNavigationInputPreferred and HKeyboardInputPreferred, the platform will provide a way for the user to generate the keyCodes for both HFocusEvents and HKeyEvents in an unambiguous way (e.g. while in edit mode, keyCodes are converted into HKeyEvents, otherwise they generate HFocusEvents). The getEditMode method can be called by the platform to determine the current input mode of the widget. The platform will provide a platform specific way to switch between any different input modes as required by any limitations of its input devices, and notify the widget of this change by sending it an appropriate START_CHANGE or END_CHANGE event.

If the same keyCode is expected for different input types (e.g. VK_ENTER is set as navigation code while the widget also expects it as an HKeyEvent), then the platform will present the user with means to separately generate each of the HAVi events for that keyCode (in the case of the example, an HFocusEvent with transferId VK_ENTER and an HKeyEvent). Application authors should realize that to use keyCodes which are likely to have multiple functions may force some platforms to present a less than perfectly user-friendly display.

For platforms that generate HAVi events in HComponent.processEvent, extra events may be received in addition to the HAVi events. For example, for HFocusEvent FOCUS_GAINED and FOCUS_LOST, if the HFocusEvent is generated directly, processEvent should send this HFocusEvent to both processHFocusEvent and to processFocusEvent (the second one will happen in the superclass method). If the platform generates HAVi events in processEvent, when a FocusEvent is received by HComponent.processEvent, it will be sent to processFocusEvent and a new HFocusEvent will be created to send to processHFocusEvent.

For the other HAVi events, like HActionEvent, HAdjustmentEvent, HItemEvent and HTextEvent events, the behaviour is analogous. The platform will provide a way for the user to generate the events, either directly or from other events (translated in HComponent.processEvent), on HComponents that implement the HActionInputPreferred, HAdjustmentInputPreferred, HSelectionInputPreferred, and HKeyboardInputPreferred interfaces, respectively.

Implementations of the interfaces do not have to override processEvent so as to send these events to the appropriate processHxxEvent method, this will be the responsibility of Hcomponent.processEvent. The processHxxEvent method will call any registered listeners and perform any other specified actions, such as changing states, playing sounds, etc.

HAdjustmentInputPreferred and HSelectionInputPreferred, which extend HOrientable, allow the platform to select a way for the user to generate HAdjustmentEvents and HItemEvents which best matches the component's representation.

A.7.3.3 Relation between HAVi events and AWT events

Applications which extend from `java.awt.Component` (and not `org.havi.ui.HComponent`) and which register event listeners from the `java.awt.event` package shall receive the behaviour defined for the `java.awt.event` package. If events from the `org.havi.ui.event` package are generated on such a `Component`, these shall be sent to any registered listeners according to the behaviour defined for their parent class in `java.awt.event`.

HAVi allows implementations that generate `HxxxEvents` from other events, so an `HComponent` may receive the `HxxxEvent` in addition to those other events. For example, you could get both `havi.ui.event.HKeyEvents` sent to `HKeyListeners` and `awt.event.KeyEvents` sent to AWT KeyListeners.

For subclasses that extend from `Component` and not from `HComponent`, it is implementation dependent whether they receive the events defined in `awt.event` or a subclass of these events defined in havi (e.g. `org.havi.ui.event.HKeyEvent` instead of `java.awt.event.KeyEvent`). However, in the latter case the behaviour will be as defined for the parent class, e.g. an `org.havi.ui.event.HKeyEvent` will go to `KeyListeners` added with `Component.addKeyListener`. Also, applications cannot assume that such `Components` will be able to receive `KeyEvents` with `keyCodes` other than those specified in the MHP minimum profile.

A.7.3.4 Application guidelines

Any implementation of a `HxxxInputPreferred` interface shall implement the processing of the `HxxxEvent` and calling of listeners in the `processHxxEvent` method (where this event processing is not inherited from a parent class). It is the platforms' responsibility to provide a way in which the user can generate the events requested by the widget. Since the HAVi events may be generated in the `processEvent` method on some platforms, interface implementers should not assume that the `processEvent` method will receive the HAVi events on every platform. On platforms where the HAVi events are generated in `processEvent`, it is the platform's responsibility to call the `processHxxEvent` method with the HAVi event.

A.7.4 org.havi.ui

A.7.4.1 HActionable

The class `HListGroup` is considered to be removed from the list of "Platform Classes".

A.7.4.1.1 getActionSound

The description of this method shall be considered to be replaced with the following

> Return the last action sound set by the `setActionSound` method or null if no action sound has been set.

A.7.4.1.2 Class description

The following sentence immediately before the heading "Interaction States":

> HAVi action events are discussed in detail in the HActionInputPreferred interface description.

shall be modified to read:

> HAVi action events are discussed in detail in the HActionEvent interface description.

A.7.4.1.3 setActionCommand

The parameters clause for the "command" parameter shall be considered to be extended with the following sentence:

> To remove the command specify a null command parameter.

A.7.4.2 HActionInputPreferred

The description of this method shall be considered to have the following text added:

> If this `HActionInputPreferred` has no action command then an empty string shall be returned.

A.7.4.3 HAdjustmentInputPreferred

A.7.4.3.1 Interface description

In the interface description of `HAdjustmentInputPreferred` after the sentence:

> For platforms with a restricted number of physical keys this may involve a "virtual keyboard" or similar mechanism.

is considered to be extended by the following text:

> The system might use the information returned by the method `getOrientation()` of the super interface to select appropriate key mappings for this event. The mechanisms to generate this event shall not be effective while the component is disabled (see `HComponent.setEnabled()`).

Also, the following text:

> All interoperable implementations of the `HAdjustmentInputPreferred` interface must extend `HComponent`.

Is considered to be replaced with:

> Widgets of HAVi compliant applications implementing the `HAdjustmentInputPreferred` interface must have `HComponent` in their inheritance tree.

Also, in the following text:

> Note that the `java.awt.Component` method `isFocusTraversable` should always return true for a `java.awt.Component` implementing this interface.

the word "should" is considered to be replaced with "shall".

A.7.4.3.2 getAdjustMode

The last sentence of the description of `getAdjustMode()` is considered to be extended with:

> Note that these events are ignored, if the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.3.3 proccessHAdjustmentEvent

The description of `proccessHAdjustmentEvent()` is considered to be extended with:

> Widgets implementing this interface shall ignore `HAdjustmentEvents`, while the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.3.4 setAdjustMode

The description of `setAdjustMode()` is considered to be extended with:

> Calls to this method shall be ignored, if the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.4 HAdjustmentValue

A.7.4.4.1 Class description

The class `HListGroup` is considered to be removed from the list of "Platform Classes".

A.7.4.4.2 getAdjustmentSound

This method is considered to have the following text added to the method description.

> null shall be returned if this method is called before its corresponding set method.

A.7.4.4.3 getBlockIncrement

This method is considered to have the following text added to the method description.

> 1 shall be returned if this method is called before its corresponding set method.

A.7.4.4.4 getUnitIncrement

This method is considered to have the following text added to the method description.

> 1 shall be returned if this method is called before its corresponding set method.

A.7.4.5 HAnimateEffect

A.7.4.5.1 getRepeatCount

This method shall be considered to have the following text added to the method description.

> Except for `HAnimateEffect` implementations that specify a different default, `getRepeatCount()` returns `REPEAT_INFINITE` if no call to `setRepeatCount()` has previously been made.

A.7.4.6 HBackgroundDevice

A.7.4.6.1 setBackgroundConfiguration

In the `setBackgroundConfiguration` method, the sentence below shall be considered to be added to the description of this method:

> Applications can prevent or limit changes to configurations of other, not intended, devices by using constants ZERO_GRAPHICS_IMPACT, ZERO_VIDEO_IMPACT and ZERO_BACKGROUND_IMPACT in their configuration templates.

The following shall be added as the first item in the bulleted list:

> • If an application tries to select a configuration which is not valid for that device at that time or when the device is in a particular mode then an HConfigurationException shall be thrown.

A.7.4.6.2 getConfigurations

The following shall be added to the end of the method description.

> The set of configurations returned may include ones which are only valid for the device at particular times or when the device is in a particular mode.

A.7.4.6.3 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HBackgroundDevice` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HBackgroundDevice` class.

A.7.4.7 HBackgroundImage

A.7.4.7.1 Constructors - HBackgroundImage(String), HBackgroundImage(URL)

The sentence:

> Loading of the data for the object is not required at this time.

shall be considered to be replaced with:

> Loading of the data for the object shall not happen at this time.

A.7.4.7.2 load

The following text is considered to be added to the description of this method:

> Multiple calls to load shall each add an extra listener, all of which are informed when the loading is completed. If load is called with the same listener more than once, the listener shall then receive multiple copies of a single event.

A.7.4.7.3 Constructor(byte[])

In the following sentence:

> If the byte array does not contain a valid image then this constructor shall throw a java.lang.IllegalArgumentException.

"shall" shall be considered to say "may".

A.7.4.8 HComponent

A.7.4.8.1 processEvent

The following text is a clarification of the HAVi specification:

The implementation of the method `HComponent.processEvent()` shall ensure that key events which are translated to HAVi events shall not be reported to `processKeyEvent()` or reported to `KeyListeners`. Key events which are not translated to HAVi events shall be reported to `processKeyEvent()` and `KeyListeners` as defined in the Java specification.

NOTE: If applications override `processEvent` they may terminally disturb these processes. Applications should not do this without extreme care, as the results may be very implementation dependent.

A.7.4.9 HComponentOrdering

A.7.4.9.1 addAfter, addBefore

In the returns clause, the text:

> is successfully added.

shall be considered to read

> is successfully added or was already present.

A.7.4.10 HEventMulticaster

A.7.4.10.1 Class description

The following text is considered to be added to the description of this class:

> The `HEventMulticaster` class is intended to assist platform or subclass implementers with the handling of HAVi events. Implementations are not required to use this class to dispatch HAVi events. Applications should not extend the `HEventMulticaster` class and implementations are not required to behave correctly if an application does extend this class. If an extended multicaster is desired, `AWTEventMulticaster` should be used rather than `HEventMulticaster`.

Also, extend the following paragraph in the class description:

> It is an implementation option for this class to insert other classes in the inheritance tree (for example `java.awt.AWTEventMulticaster`). It is allowed that this may result in `HEventMulticaster` inheriting additional methods beyond those specified here.

with:

> If this class does extend `java.awt.AWTEventMulticaster`, it is allowed for the fields defined in this class to be inherited from that parent class.

A.7.4.10.2 Constructor

The following text is considered to form part of the constructor description:

> The parameters a and b passed to the constructor shall be used to populate the fields a and b of the instance.

A.7.4.10.3 remove

In the description of this method, replace:

> returns the resulting multicast listener

with

> returns the result

A.7.4.11 HFontCapabilities

A.7.4.11.1 getSupportedCharacterRanges

The returns clause of this method shall be considered to be extended with the following text:

> including where the capabilities of the font are unknown.

The following paragraph in the method description:

> Support for a character range does not imply that ALL characters within that range are available in the specified font.

shall be considered to be extended with the following extra sentence:

> Support does require that at lease one character from the range is included in the font.

A.7.4.12 HGraphicsDevice

A.7.4.12.1 getBestConfiguration

The following text shall be considered to be added to the end of the second paragraph of the method description:

> If there are such equally best configurations, the one which is returned by this method is an implementation dependent selection from among those which are equally best.

A.7.4.12.2 setGraphicsConfiguration

In the `setGraphicsConfiguration` method, the sentence below:

> Applications can prevent or limit changes to configurations of other, not intended, devices by using constants `ZERO_GRAPHICS_IMPACT` and `ZERO_VIDEO_IMPACT` in their configuration templates.

shall be considered to be extended as follows:

> Applications can prevent or limit changes to configurations of other, not intended, devices by using constants `ZERO_GRAPHICS_IMPACT`, `ZERO_VIDEO_IMPACT` and `ZERO_BACKGROUND_IMPACT` in their configuration templates.

The following shall be added as the first item in the bulleted list;

> • If an application tries to select a configuration which is not valid for that device at that time or when the device is in a particular mode then an HConfigurationException shall be thrown.

A.7.4.12.3 getConfigurations

The following shall be added to the end of the method description.

> The set of configurations returned may include ones which are only valid for the device at particular times or when the device is in a particular mode.

A.7.4.12.4 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HGraphicsDevice` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HGraphicsDevice` class.

A.7.4.13 HGraphicsConfigTemplate

A.7.4.13.1 setPreference

The following text shall be added to the third paragraph of the method description:

> Calling this method with null for the object parameter shall have no effect if the preference is not currently set in the template.

A.7.4.14 HListElement

A.7.4.14.1 Class description

The class description is considered to be extended by the following:

> The methods `setIcon()` and `setLabel()` of `HListElement` shall not be used for elements, which are part of `HListGroup`. If an application requires to alter the content, it shall either replace the entire element, or remove it temporarily and re-add it after the content was changed.

A.7.4.15 HListGroup

A.7.4.15.1 Class description

In the following text:

> The `HListGroup` is a user interface component representing a list of selectable items (`HListElements`) which contain static read-only graphical and / or textual content.

The phrase "static read-only" is considered to be removed.

Also, extend the following text:

> Interoperable HAVi applications shall not add `HListElement` more than once. If an application requires items with identical contents (label and/or icon), then additional items shall be created. The behaviour of the `HListGroup` if duplicates are added is implementation specific.

With:

> The methods `setIcon()` and `setLabel()` of `HListElement` shall not be used for elements, which are part of `HListGroup`. If an application requires to alter the content, it shall either replace the entire element, or remove it temporarily and re-add it after the content was changed.

Also, in the text:

> the minimum size is the size to present one element or an implementation specific minimum (32 x 32 for example) if no elements are present.

The phrase "if no elements are present" is considered to be replaced with:

> if label and icon size are not set (see `HListGroupLook.getMinimumSize()`).

Also, under the parameters table under heading "Default parameter values exposed in the constructors" the description of the parameter "items" missing is considered to read:

> The initial list of elements for this `HListGroup` or `null` for an empty list.

A.7.4.15.2 Fields

A.7.4.15.2.1 ITEM_NOT_FOUND

In the description:

> A constant which may be returned from `getIndex` if the requested element is not found in the content.

The word "may" is considered to be replaced by "shall".

A.7.4.15.2.2 ADD_INDEX_END

In the description:

> A constant for use with `addItem` and `addItems` which specifies that the new items should be appended to the end of the list.

The word "should" is considered to be replaced by "shall".

A.7.4.15.3 Use of "action" and "actioning"

The use of the words "action" and "actioning" in the following methods in `HListGroup` does not imply any connection between `HListGroup` and `HActionable`. There is no such connection in the API.:

- `getCurrentIndex()`
- `getCurrentItem()`
- `setCurrentItem()`
- `getSelectionIndices()`
- `getSelection()`

A.7.4.15.4 addItem(HListItem item, int index)

In the description of parameter "index" all occurrences of the word "items" is considered to be replaced by "item".

A.7.4.15.5 addItem(HListItem items[], int index)

In the parameter description:

> item - the item to add.

is considered to be replaced by:

> items - the items to add.

A.7.4.15.6 getIconSize

The description of this method is considered to be extended by:

> If label and icon size do not match the size per element, the associated `HListGroupLook` is allowed to use other sizes during the rendering process. This size shall be used by `HListGroupLook` to calculate the size per element.

A.7.4.15.7 getLabelSize

The description of this method is considered to be extended by:

> If label and icon size do not match the size per element, the associated `HListGroupLook` is allowed to use other sizes during the rendering process. This size shall be used by `HListGroupLook` to calculate the size per element.

A.7.4.15.8 getOrientation

The following text:

> The orientation controls how an associated `HLook` lays out the component and affects the visual behaviour of the `HAdjustmentEvent` and `HItemEvent` events. `HListGroups` do not receive `HAdjustmentEvents`.

Is considered to be replaced by:

> The orientation controls how an associated `HLook` lays out the component and affects the visual behaviour of `HItemEvent` events.

A.7.4.15.9 setFocusTraversal

In all cases the phrase "then null should be specified" is considered to be replaced by "then null shall be specified".

A.7.4.15.10 setItemSelected

The following text

> If a successful call to this method causes the selection to change an HItemEvent shall be sent to any registered listeners. If the selection does not change then no HItemEvent shall be sent.

Shall be considered be replaced with:

> If a call to this method causes an item to become deselected an HItemEvent with an ID of ITEM_CLEARED shall be sent to all registered listeners. This can happen because either sel is false or this HListGroup is not in multi selection mode.
>
> If a call to this method causes a non selected item to become a selected item then an HItemEvent with an ID of ITEM_SELECTED shall be sent to all registered listeners.

A.7.4.15.11 setIconSize

The description of this method is considered to be extended by:

> If label and icon size do not match the size per element, the associated `HListGroupLook` is allowed to use other sizes during the rendering process. This size shall be used by `HListGroupLook` to calculate the size per element.

In the description of the size parameter, the following text:

> Dimension(DEFAULT_ICON_SIZE, DEFAULT_ICON_SIZE)

is considered to be replaced by

> Dimension(DEFAULT_ICON_WIDTH, DEFAULT_ICON_HEIGHT)

A.7.4.15.12 setLabelSize

The description of this method is considered to be extended by:

> If label and icon size do not match the size per element, the associated `HListGroupLook` is allowed to use other sizes during the rendering process. This size shall be used by `HListGroupLook` to calculate the size per element.

A.7.4.15.13 setListContent

The sentence:

> Any existing selection is discarded (which may cause an HItemEvent to be generated.)

Is considered to be replaced by

> If any elements are selected, then the selection is discarded and an HItemEvent is generated.

The following text:

> Set the list content for this HListGroup. If any elements are selected, then the selection is discarded and an HItemEvent is generated.

Shall be considered to be replaced with:

> Set the list content for this HListGroup. If any items are selected, then the selection shall be discarded and an HItemEvent with an ID of ITEM_SELECTION_CLEARED shall be generated and sent to all registered listeners.
>
> If elements is null then the current active item index shall be set to ITEM_NOT_FOUND. If elements is non null then the current active item index shall be set to 0. An HItemEvent with an ID of ITEM_SET_CURRENT shall be sent to all registered listeners.

A.7.4.15.14 setMove

In all cases the phrase "then null should be specified" is considered to be replaced by "then null shall be specified".

A.7.4.15.15 setScrollPosition

This method is considered to have the following text added:

> Parameters
>
> scroll - the scroll position

A.7.4.15.16 setSelectionMode

The parameter in the method signature called `adjust` shall be considered to be called `edit` as used in the parameter list.

A.7.4.15.17 removeItem

The following text:

> Remove the HListElement at the specified index. The item is also removed from the selection, if any is set. If this was the last item in the selection the entire selection is destroyed and calls to getSelection shall return null until new content and selections are created.
>
> If the act of removing an item causes the current active item index to change, an HItemEvent shall be sent.
>
> If the act of removing an item causes the selection to change, an HItemEvent shall be sent.

Shall be considered to be replaced with the following text:

> Removes the HListElement at the specified index. All following items are shifted.
>
> If the item is the only HListElement in this HListGroup then the current active item index shall be set to ITEM_NOT_FOUND. If the removal of the item causes a change in the current active item index then an HItemEvent with an ID of ITEM_SET_CURRENT shall be generated and sent to all registered listeners.
>
> If the item is selected then it shall be removed from the selection and an HItemEvent with an ID of ITEM_CLEARED shall be generated and sent to all registered listeners.

A.7.4.15.18 removeAllItems

The following text:

> Remove all the content. The selection is also destroyed and calls to getSelection shall return null until new content and selections are created.

Shall be considered to be replaced with:

> Removes all the content. If any items are selected, then the selection shall be discarded and an HItemEvent with an ID of ITEM_SELECTION_CLEARED shall be generated and sent to all registered listeners.
>
> The current active item index shall be set to ITEM_NOT_FOUND and an HItemEvent with an ID of ITEM_SET_CURRENT shall be generated and sent to all registered listeners.

A.7.4.15.19 setCurrentItem

The following paragraph shall be considered to form part of the description of this method.

> If index is valid for this HListGroup then the current active item index shall be set to index. If this causes a change in the current active item index then an HItemEvent with an ID of ITEM_SET_CURRENT shall be generated and sent to all registered listeners.

Under the Returns subsection, the following paragraph;

> true if the current item was changed, false if index was not a valid index for this HListGroup or the current item was not changed because it is already selected. No exception is thrown if index is not valid.

Shall be considered to be replaced with:

> true if the current item was changed, false if index was not a valid index for this HListGroup or the current item was not changed because it is already the current item. No exception is thrown if index is not valid.

A.7.4.15.20 setMultiSelection

The following text:

> Note that if the HListGroup is switched out of multiple selection mode and more than one item is selected, the selection shall change so that the first of the items is selected and the others are deselected. This will cause an HItemEvent to be sent to any registered listeners.

Shall be considered to be replaced with:

> Note that if the HListGroup is switched out of multiple selection mode and more than one item is selected, the selection shall change so that the first of the items is selected and the others are deselected. An HItemEvent with an ID of ITEM_CLEARED shall be sent to all registered listeners for each deselected item.

A.7.4.16 HListGroupLook

A.7.4.16.1 getMaximumSize

The description of `getMaximumSize()` is considered to be replaced by the following:

> Returns the size to present all elements of the specified `HVisible` plus any additional dimensions that the `HListGroupLook` requires for border decoration etc. If no elements are present, a dimension object is returned with width and height set to `java.lang.Short.MAX_VALUE`.
>
> The extra space required for border decoration can be determined from the `getInsets()` and `getElementInsets()` methods. The behaviour is not defined for the case, when a subclass overrides these methods. Application developers shall not assume any influence on the returned dimensions.
>
> The size per element shall be determined by calls to `getIconSize()` and `getLabelSize()` of `HListGroup`. If any of the values requests a default as specified by `DEFAULT_ICON_WIDTH`, `DEFAULT_ICON_HEIGHT`, `DEFAULT_LABEL_WIDTH` and `DEFAULT_LABEL_HEIGHT`, then an implementation specific default is used for the corresponding value(s).
>
> Parameters:
>
> visible `HVisible` to which this `HLook` is attached.
>
> Returns:
>
> A dimension object indicating this `HListGroupLook's` maximum size. See also:

```
HListGroup.setIconSize()
HListGroup.setLabelSize()
HVisible.getMaximumSize()
```

A.7.4.16.2 getMinimumSize

The description of `getMinimumSize()` is considered to be replaced by the following:

Returns the size to present one element of the specified `HVisible` plus any additional dimensions that the `HListGroupLook` requires for border decoration etc.

The extra space required for border decoration can be determined from the `getInsets()` and `getElementInsets()` methods. The behaviour is not defined for the case, when a subclass overrides these methods. Application developers shall not assume any influence on the returned dimensions.

The size per element shall be determined by calls to `getIconSize()` and `getLabelSize()` of `HListGroup`. If any of the dimensions requests a default as specified by `DEFAULT_ICON_WIDTH`, `DEFAULT_ICON_HEIGHT`, `DEFAULT_LABEL_WIDTH` and `DEFAULT_LABEL_HEIGHT`, then an implementation specific default is used for the corresponding value(s).

Parameters:

visible `HVisible` to which this `HLook` is attached.

Returns:

A dimension object indicating this `HListGroupLook's` minimum size. See also:

```
HListGroup.setIconSize()
HListGroup.setLabelSize()
HVisible.getMinimumSize()
```

A.7.4.16.3 getPreferredSize

The description of `getPreferredSize()` is considered to be replaced by the following:

Gets the preferred size of the `HVisible` component when drawn with this HListGroupLook.

If a default size for width and height was set with `HVisible.setDefaultSize()`, then the dimensions are rounded down to the nearest element (minimum of one) according to the orientation of the associated `HListGroup`, and any dimensions for border decorations etc. are added.

If no default size was set or only for one dimension (i.e. height is `NO_DEFAULT_HEIGHT` or width is `NO_DEFAULT_WIDTH`), then the unset dimension(s) shall be sufficiently large to present five elements according to the `HListGroup's` orientation. Any dimensions for border decoration etc. are added.

The extra space required for border decoration can be determined from the `getInsets()` and `getElementInsets()` methods. The behaviour is not defined for the case, when a subclass overrides these methods. Application developers shall not assume any influence on the returned dimensions.

The size per element shall be determined by calls to getIconSize() and getLabelSize() of HListGroup. If any of the values requests a default as specified by `DEFAULT_ICON_WIDTH`, `DEFAULT_ICON_HEIGHT`, `DEFAULT_LABEL_WIDTH` and `DEFAULT_LABEL_HEIGHT`, then an implementation specific default is used for the corresponding value(s).

Parameters:

visible `HVisible` to which this `HListGroupLook` is attached.

Returns:

A dimension object indicating the preferred size of the `HVisible` when drawn with this `HListGroupLook`. See also:

```
HListGroup.setIconSize()
HListGroup.setLabelSize()
HVisible.getPreferredSize()
HVisible.setDefaultSize()
```

A.7.4.16.4 getValue

The first paragraph of `getValue()` is considered to be extended by the following:

> A non-null value represents the scroll position of the associated `HListGroup`. The value shall never be less than zero.

And the description of returns is considered to be replaced by the following:

> the non-negative scroll position associated with the specified pointer position or null

A.7.4.16.5 hitTest

In the description of `hitTest()` after

> …then this method will return the index of that element.

is considered to be extended by the following:

> The `HListGroup` shall interpret this index as current item. If the value is `ADJUST_THUMB`, then the caller shall use `getValue()` to retrieve the actual scroll position corresponding to the specified pointer position."

And the returns description considered to be extended by the following:

> , or a non-negative element index.

A.7.4.16.6 showLook

The description of `showLook()` is considered to be replaced by the following:

> This method is responsible for repainting the entire visible including the list content set on the `HListGroup`, and the visible background, subject to the clipping rectangle of the graphics object passed to it.
>
> If the method modifies the clipping rectangle of the graphics object, it shall restore the original rectangle upon return.
>
> `showLook()` paints the visible with its current background colour according to the `getBackgroundMode()` method of `HVisible` and draws any (implementation-specific) borders, regardless whether content is available or not. Note that by default the background mode is set to not paint a background. Furthermore on platforms which support transparent colours the background colour may be partially or completely transparent.
>
> Any resources explicitly associated with this look shall be loaded by it during its creation. Note that the "standard" looks do not load content by default.
>
> This method is called from the `paint()` method of `HVisible` and must never be called from elsewhere. Components wishing to redraw themselves shall call their repaint method in the usual way or call `widgetChanged()` under certain circumstances.
>
> The labels of the associated `HListElements` shall be rendered by using the current text layout manager of the `HListGroup`. For each visible label is the `render()` method of `HTextLayoutManager` called. The position and size per label are specified as insets relatively to the bounds of `HListGroup`. Note that the bounds are independent of any borders of the `HListGroup`, but the insets have to include the borders per element, if any. The look shall use the method `getLabelSize()` of `HListGroup` to determine the size for each label. If the returned dimension object has `DEFAULT_LABEL_WIDTH` for the width and/or `DEFAULT_LABEL_HEIGHT` for the height as values, then this method shall use implementation specific value(s) as default(s) for the missing dimension(s) instead. If `getTextLayoutManager()` returns null, then labels shall not be rendered.
>
> If supported, scaling of icons shall reflect the resize mode of the visible within the area of the respective list element. The look shall use the method `getIconSize()` of `HListGroup` to determine the size for each icon. If the returned dimension object has `DEFAULT_ICON_WIDTH` for the width and/or `DEFAULT_ICON_HEIGHT` for the height as values, then this method shall use implementation specific value(s) as default(s) for the missing dimension(s) instead.

Except for the alignment of labels and sizes of labels and icons, it is explicitly not defined, how this look arranges icons and labels within the elements' areas. Additionally, it is an implementation option to render labels and icons in other sizes than specified, if the available size per element is smaller or larger than label and icon size. It is also not defined, how the look presents the current item and selected items, or the current selection mode. The elements shall be layed out as specified by `getOrientation()` of the associated `HListGroup`.

When the associated `HListGroup` contains more elements than presentable, the look shall make the user aware of that condition, e.g. by displaying an additional scrollbar reflecting the current scroll position. Again, the visible means by which this information is conveyed is not defined and implementation dependent. It is an implementation option for `HListGroupLook` to draw elements before the scroll position, in order to fill the available space.

The behaviour of this method, when a subclass overrides the methods `getInsets()` or `getElementInsets()`, is not defined. Application developers shall not assume that the corresponding borders will appear as specified.

Parameters:

g the graphics context.

visible the visible.

state the state parameter indicates the state of the visible, allowing the look to render the appropriate content for that state. Note that the default behaviour of `HListGroupLook` is to ignore this parameter, since the content of `HListGroup` is not state based. See also:

```
java.awt.Component.getBounds()
java.awt.Graphics.getClipBounds()
HListGroup.getCurrentItem()
HListGroup.getListContent()
HListGroup.getOrientation()
HListGroup.getScrollPosition()
HListGroup.setIconSize()
HListGroup.setLabelSize()
HListGroup.isItemSelected()
HTextLayoutManager.render()
```

A.7.4.16.7 Class description

The following sentence shall be considered to be removed.

> Borders are not drawn around the content.

A.7.4.16.8 showLook and renderVisible

The five paragraphs in `showLook` starting with "The labels of the associated HListElements shall be rendered..." and ending "...Application developers shall not assume that the corresponding borders will appear as specified." shall be considered to form part of the `renderVisible` method instead.

A.7.4.16.9 renderVisible

The following shall be considered to be added to the end of this method description:

> The org.havi.ui.HExtendedLook.renderVisible method is responsible for painting any implementation specific borders for each HListElement as well as drawing of an additional scrollbar if required.

A.7.4.17 HLook

A.7.4.17.1 General

In the description of `HLook` and all implementing classes, the term `clipRect` shall be interpreted to mean "clipping rectangle".

A.7.4.17.2 Class description

Only the first paragraph of the "Invocation Mechanism" section shall be considered to be present.

A.7.4.17.3 getPreferredSize

In the description of this method, the text:

> "... then the return value is the size of the largest piece of content..."

shall be considered to be replaced with:

> "...then the return value is a size that is sufficiently large to hold each piece of content..."

The equivalent replacement shall apply for `getMinimumSize()` and `getMaximumSize()`.

In `HLook` and all classes implementing this interface, the following text shall be considered to form part of the method description of getPreferredSize():

> If a default preferred size has been set for this `HVisible` (using `setDefaultSize(Dimension)`) and the default preferred size has an `NO_DEFAULT_WIDTH` then the return value is a `Dimension` with this height (obtained with `getDefaultSize()`) and the preferred width for the content plus any additional dimensions that the `HLook` requires for border decoration etc.

> If a default preferred size has been set for this `HVisible` (using `setDefaultSize(Dimension)`) and the default preferred size has an `NO_DEFAULT_HEIGHT` then the return value is a `Dimension` with this width (obtained with `getDefaultSize()`) and the preferred height for the content plus any additional dimensions that the `HLook` requires for border decoration etc.

A.7.4.17.4 showLook

In `org.havi.ui.HLook.showLook()`, the text;

> The `showLook` method should not modify the `clipRect` of the `Graphics` object that is passed to it.

Shall be clarified as follows:

> The `showLook` method shall not modify the `clipRect` (clipping rectangle) of the `Graphics` object passed to it in a way which includes any area not part of that original `clipRect`. If any modifications are made, the original `clipRect` shall be restored.

A.7.4.18 HMultilineEntry

The following text shall be considered to be added to the class description:

> A call to the inherited method `setDefaultLook(HSinglelineEntry)` shall behave the same as a call to `HSinglelineEntry.setDefaultLook(HSinglelineEntry)`.

A.7.4.19 HMultilineEntryLook

A.7.4.19.1 getCaretCharPositionForLine

The following text:

> If an invalid line is specified an `IllegalArgumentException` is thrown If it cannot be moved the nearest position should be returned

shall be considered to be replaced by:

> If an invalid line is specified an `IllegalArgumentException` is thrown. If the caret cannot be moved to the same column position on this line, the nearest position should be returned.

A.7.4.19.2 getSoftLineBreakPositions

The following text shall be considered to be added to the returns clause of this method

> If there is no text content within the `HVisible`, a zero length array shall be returned.

A.7.4.19.3 getVisibleSoftLineBreakPositions

The following text is considered be added to the returns clause of this method

> If there is no text content within the `HVisible`, a zero length array shall be returned.

A.7.4.20 HNavigable

A.7.4.20.1 Class description

In the following sentence:

> Applications should assume that classes which implement `HNavigable` can only generate events of the type `HFocusEvent` in response to other types of input event.

The word "only" shall be considered to be not present.

A.7.4.20.2 setMove

All occurrences of "then null should be specified" shall be considered to be replaced by "then null shall be specified".

A.7.4.20.3 set FocusTraversal

All occurrences of "then null should be specified" shall be considered to be replaced by "then null shall be specified".

A.7.4.21 HOrientable

A.7.4.21.1 Interface description

The following text:

> All interoperable implementations of the `HOrientable` interface must extend `HComponent`.

Is considered to be replaced with:

> Widgets of HAVi compliant applications implementing the `HOrientable` interface must have `HComponent` in their inheritance tree.

A.7.4.21.2 getOrientation

The following text:

> The orientation controls how an associated `HLook` lays out the component and affects the visual behaviour of the `HAdjustmentEvent` and `HItemEvent` events. For example, the system might use this information to select appropriate key mappings for these events.

Is considered to be replaced with:

> The orientation controls the layout of the component.

A.7.4.21.3 setOrientation

The following text:

> The orientation controls how the associated `HLook` lays out the component.

Is considered to be replaced with:

> The orientation controls the layout of the component.

A.7.4.21.3.1 Orientation constants

In the description of the orientation constants: `ORIENT_LEFT_TO_RIGHT`, `ORIENT_RIGHT_TO_LEFT`, `ORIENT_TOP_TO_BOTTOM` and `ORIENT_BOTTOM_TO_TOP` the word "shall" is considered to replace "should' in each instance of the phrase "should be rendered".

A.7.4.22 HScene

A.7.4.22.1 addAfter, addBefore

In the returns clause, the text:

> is successfully added

shall be considered to read:

> is successfully added or was already present.

A.7.4.22.2 getFocusOwner

The following text shall be considered to be added to the end of the method description:

> if and only if this HScene is active.

A.7.4.22.3 Rendering behavior

The following text shall be considered to form an additional paragraph under this heading.

> An application which sets both of setBackgroundMode(NO_BACKGROUND_FILL) and setImageMode(IMAGE_NONE) shall be responsible for ensuring that all pixels in the Hscene are filled with a value which is either opaque or transparent only to video. Such an application cannot make any assumptions about the previous contents of the graphics objects into which it is drawing. For implementations which double-buffer the display of graphics, these existing contents are implementation dependent.

A.7.4.22.4 show

The following text shall be considered to be appended to the description of this method:

> This method does not cause the HScene to request the input focus.

A.7.4.22.5 setVisible

The following text shall be considered to be present on the end of the method description;

> If this HScene is already visible, then this method brings it to the front. The semantics of show() and setVisible(true) are identical.

A.7.4.23 HScreenConfigurationListener

The parameter "gce" for the report method shall be considered to have the following description.

> gce - The event notifying the listener of the modification.

A.7.4.24 HSceneFactory

A.7.4.24.1 getDefaultHScene

The text:

> … identical to calling org.havi.ui.HScene.getDefaultHscene(

shall be considered to read:

> …identical to calling org.havi.ui.HSceneFactory.getDefaultHscene(

A.7.4.24.2 Class Description

The following text

> Calling resizeScene for an HScene shall apply the same policies as described above for newly created HScenes when deciding whether the resizing operation requested is possible.

Shall be considered to read:

> Calling resizeScene for an HScene shall apply the same policies as described above for newly created HScenes when deciding whether the method call is possible.

A.7.4.25 HSelectionInputPreferred

A.7.4.25.1 Interface description

The following text is considered to be added to the interface description:

> The system must provide a means of generating `HItemEvent` events as necessary. For platforms with a restricted number of physical keys this may involve a "virtual keyboard" or similar mechanism.The system might use the information returned by the method `getOrientation()` of the super interface to select appropriate key mappings for this event. The mechanisms to generate this event shall not be effective while the component is disabled (see `HComponent.setEnabled()`).

Also, the text:

> All interoperable implementations of the `HSelectionInputPreferred` interface must extend `HComponent`.

Is considered to be replaced with:

> Widgets of HAVi compliant applications implementing the `HSelectionInputPreferred` interface must have `HComponent` in their inheritance tree.

Also, in the text:

> Note that the `java.awt.Component` method `isFocusTraversable` should always return true for a `java.awt.Component` implementing this interface.

The word "should" is considered to be replaced with "shall".

A.7.4.25.2 getSelectionMode

The description of this method is considered to be extended by the following text:

> Note that these events are ignored, if the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.25.3 processHItemEvent

The description of this method is considered to be extended by the following text:

> Widgets implementing this interface shall ignore HItemEvents, while the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.25.4 setSelectionMode

The description of this method is considered to be extended by the following text:

> Calls to this method shall be ignored, if the component is disabled. See also: `HComponent.setEnabled()`.

A.7.4.26 HSingleLineEntry

A.7.4.26.1 Class description

The term:

> `TEXT_START_CHANGE` event

is considered to be replaced with:

> an `HTextEvent` event with an id of `TEXT_START_CHANGE`.

A.7.4.26.2 Default parameter values not exposed in the constructors

In the row "Password protection (the echo character)", in the "default value" column, replace

> Entry is "clear", i.e. not password protected.

with:

> Zero (ASCII NUL), i.e. not password protected.

A.7.4.26.3 setType(int)

The following text:

> Set the type of permitted keyboard entry.
>
> Parameters:
>
> type - one of INPUT_ANY, INPUT_ALPHA, INPUT_NUMERIC or INPUT_CUSTOMIZED

Shall be considered to be replaced with:

> Set to indicate to the system which input keys are required by this component. The input type constants can be added to define the union of the character sets corresponding to the respective constants.
>
> Parameters:
>
> type - sum of one or several of INPUT_ANY, INPUT_NUMERIC, INPUT_ALPHA, or INPUT_CUSTOMIZED.

A.7.4.26.4 getValidInput

The following text:

> Retrieve the customized input character range. The return value of this method should reflect the range of input keys which the component wishes to see, should getType return a value with the INPUT_CUSTOMIZED bit set. This method may return null if customized input is not requested.

shall be considered to be replaced with

> Retrieve the customized input character range. If getType returns a value with the INPUT_CUSTOMIZED bit set then this method shall return an array containing the range of customized input keys. If the range of customized input keys has not been set then this method shall return a zero length char array. This method shall return null if getType returns a value without the INPUT_CUSTOMIZED bit set.

A.7.4.27 HStaticAnimation

The following text is considered to be added to the description of this class:

> Calling `setVisible(false)` on `HStaticAnimation` shall not automatically stop the animation hence applications are not required to call the `play()` method again when the animation again becomes visible. It is implementation dependent whether the animation continues from the last visible position or from where it would be if it kept running.

A.7.4.28 HStaticRange

A.7.4.28.1 Fields

A.7.4.28.1.1 SCROLLBAR_BEHAVIOR

The description of this field is considered to be replaced by the following text:

> The `HStaticRange` shall behave as a scrollbar, i.e. the allowable values that may be set / returned for the `HStaticRange` shall be affected by the "thumb" offsets, and hence its value shall be able to vary between `[minimum + minThumbOffset, maximum - maxThumbOffset]`.

A.7.4.28.1.2 SLIDER_BEHAVIOR

The description of this field is considered to be replaced by the following text:

> The `HStaticRange` shall behave as a slider, i.e. the allowable values that may be set / returned for the `HStaticRange` shall not be affected by the "thumb" offsets, and hence its value shall be able to vary between `[minimum, maximum]`.

A.7.4.28.2 getOrientation

The following text:

> The orientation controls how an associated `HLook` lays out the component and affects the visual behaviour of the `HAdjustmentEvent` and `HItemEvent` events. For example, the system might use this information to select appropriate key mappings for these events.

Is considered to be replaced by:

> The orientation controls how the associated `HLook` lays out the component.

A.7.4.28.3 setBehavior

The following text is considered to be appended to the method description:

> If the new behaviour is `SCROLLBAR_BEHAVIOR` and the control's settings for range and thumb offsets are illegal, i.e. `minimum` + `thumbMinOffset` is equal or greater than `maximum` - `thumbMaxOffset`, then an `IllegalArgumentException` shall be thrown. If the control's value is not valid for the offsets, then the value shall be changed to the closest valid value.

A.7.4.28.4 setRange

The following text is considered to be appended to the method description:

> If the maximum is greater than the minimum and the value of the control is outside the new range (subject to the control's current behaviour), then the value is changed to the closest valid value.

A.7.4.28.5 setThumbOffsets

The following text is considered to be appended to the method description:

> If this control's behaviour is `SCROLLBAR_BEHAVIOR`, then the following rules apply: If the thumb offsets are illegal, i.e. `minimum` + `thumbMinOffset` is equal or greater than maximum - `thumbMaxOffset`, then an `IllegalArgumentException` shall be thrown. If the control's value is not valid for the specified offsets, then the value shall be changed to the closest valid value.

A.7.4.28.6 setValue

The method's parameter description is considered to be replaced by:

> value - the value for this HStaticRange

Also, the following text is considered to be appended to the method description:

> If the specified value is not valid, then the method shall round it to the closest valid value. An application can retrieve the corrected value by means of method `getValue()`.

A.7.4.29 HVideoDevice

A.7.4.29.1 getBestConfiguration

The following text is considered to be added to the end of the second paragraph of the descriptions of both methods of this name.

> If there are such equally best configurations, the one which is returned by this method is an implementation dependent selection from among those which are equally best.

A.7.4.29.2 setVideoConfiguration

In the `setVideoConfiguration` method, the sentence below:

> Applications can prevent or limit changes to configurations of other, not intended, devices by using constants ZERO_GRAPHICS_IMPACT and ZERO_VIDEO_IMPACT in their configuration templates.

shall be considered to be extended as follows:

> Applications can prevent or limit changes to configurations of other, not intended, devices by using constants ZERO_GRAPHICS_IMPACT, ZERO_VIDEO_IMPACT and ZERO_BACKGROUND_IMPACT in their configuration templates.

The following additional text is considered to be present;

> NOTE: If a configuration which includes ZERO_GRAPHICS_IMPACT or ZERO_BACKGROUND_IMPACT and this would require changes to already running devices then this will not be possible to apply successfully and hence this method will return False.

A.7.4.29.3 getVideoController

The following text:

> HPermissionDeniedException - (HPermissionDeniedException) if the application does not currently have the right to get the VideoPlayer object.

shall be considered to be replaced by:

> HPermissionDeniedException - (HPermissionDeniedException) this exception shall never be thrown.

A.7.4.29.4 setVideoConfiguration

The following shall be added as the first item in the bulleted list:

> • If an application tries to select a configuration which is not valid for that device at that time or when the device is in a particular mode then an HConfigurationException shall be thrown.

A.7.4.29.5 getConfigurations

The following shall be added to the end of the method description.

> • The set of configurations returned may include ones which are only valid for the device at particular times or when the device is in a particular mode.

A.7.4.29.6 getVideoSource

The following text:

> HPermissionDeniedException - if the application does not currently have the right to get the `VideoSource` object.

shall be considered to be replaced by:

> HPermissionDeniedException - this exception shall never be thrown.

A.7.4.29.7 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HVideoDevice` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HVideoConfiguration` class.

A.7.4.30 HVisible

A.7.4.30.1 Class description

In the class description of `HVisible`, the sentence:

> Most content is stored by reference, but text content is copied as `java.lang.String` objects are immutable.

shall be considered to not be present.

In the table "Default parameter values not exposed in the constructors", row "getDefaultSize", column "Default value" the following text:

> The default preferred size not set (i.e. null) unless specified by width and height parameters

Shall be considered to be replaced with:

> The default preferred size not set (i.e. NO_DEFAULT_SIZE) unless specified by width and height parameters

A.7.4.30.2 Constructors

The following text shall be considered to form part of those constructor descriptions which have an `HLook` as a parameter:

> Applications shall not use `HLooks` with this constructor unless those `HLooks` are specified as working with `HVisible`. If an `HLook` is used which is specified as only working with specific sub-classes of `HVisible` then the failure mode is implementation dependent.

A.7.4.30.3 setDefaultSize

The following text:

> If this parameter or specifies a size smaller than an implementation-defined minimum size a `java.lang.IllegalArgumentException` will be thrown.

Shall be considered to be replaced by:

> If this parameter specifies a size smaller than an implementation-defined minimum size, the preferred size of this component shall be set to that implementation-defined minimum size.

Also, the following text:

> If the parent Container into which the `HVisible` is placed has no layout manager this method has no effect.

Is considered to be removed.

A.7.4.30.4 setLookData

The method description shall be considered to have the following text added.

> If for this specified key a data object has been set, the old data object shall be replaced with the new one.

A.7.4.30.5 setResizeMode

The following text added shall be considered to be replaced:

> Set the scaling mode for scaling any state-based content rendered by an associated HLook. If content is not used in the rendering of this HVisible calls to this method shall change the current alignment mode, but this will not affect the rendered representation.

by:

> Set the resize mode of this HVisible. If the associated HLook does not render content or if scaling is not supported, changing the mode may have no visible effect.

A.7.4.30.6 setTextContent

In the description of this method, the following sentence is considered to not be present:

> Note that unlike `setGraphicContent`, `setAnimateContent` and `setContent`, the content is copied as it is not possible to store a reference to a `java.lang.String`.

A.7.4.30.7 NO_DEFAULT_SIZE

The following text shall be considered to be appended to the end of the field description.

> The contents of the Dimension object cannot be relied upon. Comparisons must always be done using object identity, i.e. using the "==" operator.

A.7.4.31 HVideoConfigTemplate

A.7.4.31.1 setPreference

The paragraph:

> An application which wishes to remove a preference from an existing template (e.g. one generated by the platform) may call this method with null for the object parameter.

Shall be considered to be extended with the following sentence:

> Specifying null as the object parameter shall have no effect if the preference is not in the template.

A.7.4.32 HVideoComponent

A.7.4.32.1 HAVi Specification

In section 8.3.3.6 "Integrating HAVi Video Support into Platforms" the following two sentences shall be removed:

> "The class HVideoComponent is intended to be returned by a platform specific controller for video. In platforms based on the Java Media Framework, the Player.getVisualComponent method shall return objects of this class."

Note that the `HVideoComponent` class must be present, and MHP terminals may choose to use it or not. Interoperable applications should not use `HVideoComponent`.

A.7.4.32.2 removeOnScreenLocationModifiedListener

In this method, the parameters clause shall be changed from:

> slml - listener to be notified when the on-screen location of the component is modified.

to:

> slml - listener to be removed

A.7.4.33 HBackgroundConfiguration

A.7.4.33.1 setColor

The "throws" clause for `HPermissionDeniedException` shall be considered to read as follows

> If the application has not currently reserved the HBackgroundDevice associated with this configuration or this configuration is not the current configuration of that HBackgroundDevice.

A.7.4.33.2 getConfigTemplate

The following text shall be considered to be added to the description of this method:

> Preferences that are not filled in by the platform will return DONT_CARE priority.

A.7.4.33.3 Constructor

In the description of the constructor, the following sentence:

> It is not intended that applications should directly construct `HBackgroundConfiguration` objects.

shall be considered to read;

> An interoperable application shall not subclass the `HBackgroundConfiguration` class.

A.7.4.34 HScreenDevice

A.7.4.34.1 reserveDevice

The following paragraph:

> Once the right to control this device has been granted and not removed in the intervening period further calls to this method shall have no effect and return true.

Shall be considered to be replaced by:

> Once the right to control this device has been granted and not removed in the intervening period further calls to this method re-using the current resource client shall have no effect and return true.

A.7.4.35 HImageMatte

A.7.4.35.1 setMatteData

The method `setMatteData` shall be considered to have the following text added;

> Note that if the size of the image is smaller than the size of the component to which the matte is applied, the empty space behaves as if it were an opaque flat matte of value 1.0. By default images are aligned at the top left corner of the component. This can be changed with the setOffset method.

A.7.4.36 HVersion

A.7.4.36.1 General

The following text;

> Note that it is a valid implementation to return empty strings for the implementation, vendor and name strings.

shall be considered to be replaced with

> Note that it is a valid implementation to return empty strings for HAVI_IMPLEMENTATION_NAME, HAVI_IMPLEMENTATION_VENDOR and HAVI_IMPLEMENTATION_VERSION strings.

A.7.4.36.2 MHP Specific Clarification

In MHP, a call to `getProperty()` when referencing the constants listed in column Constant in the table below shall return a string as listed in column Value.

Table A.1: getProperty

Constant	Value
HAVI_SPECIFICATION_VENDOR	"DVB"
HAVI_SPECIFICATION_NAME	"MHP"
HAVI_SPECIFICATION_VERSION	"<version>"

<version>: this string shall represent the MHP version to which this HAVi implementation is conformant. The encoding shall be, in order, the major, minor and micro values from table 149 "Profile encoding" on page 409 presented as the textual representation of decimal integers with no leading zeros and separated by a single "." character, e.g. "1.0.3".

A.7.4.36.3 Field descriptions

Consider all occurrences of: java.lang.System.getProperty(havi.specification.version)
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_SPECIFICATION_VERSION)

and all occurrences of: java.lang.System.getProperty(havi.specification.vendor)
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_SPECIFICATION_VENDOR),

and all occurrences of: java.lang.System.getProperty(havi.specification.name
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_SPECIFICATION_NAME),

all occurrences of: java.lang.System.getProperty(havi.implementation.version)
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_IMPLEMENTATION_VERSION),

and all occurrences of: java.lang.System.getProperty(havi.implementation.vendor)
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_IMPLEMENTATION_VENDOR)

and all occurrences of: java.lang.System.getProperty(havi.implementation.name)
to be replaced with: java.lang.System.getProperty(HVersion.HAVI_IMPLEMENTATION_NAME).

A.7.4.37 HKeyboardInputPreferred

A.7.4.37.1 INPUT_NUMERIC

The following text:

> This constant indicates that the component only requires alphanumeric input, as determined by the java.lang.Character isDigit method.

shall be considered to be replaced by:

> This constant indicates that the component requires numeric input, as determined by the java.lang.Character isDigit method.

A.7.4.37.2 INPUT_ALPHA

The following text:

> This constant indicates that the component only requires alphanumeric input, as determined by the java.lang.Character isLetter method.

shall be considered to be replaced by:

> This constant indicates that the component requires alphabetic input, as determined by the java.lang.Character isLetter method.

A.7.4.37.3 getValidInput

The following text:

> Retrieve the customized input character range. The return value of this method should reflect the range of input keys which the component wishes to see, should getType return a value with the INPUT_CUSTOMIZED bit set. This method may return null if customized input is not requested.

shall be considered to be replaced with:

> Retrieve the customized input character range. If getType returns a value with the INPUT_CUSTOMIZED bit set then this method shall return an array containing the range of customized input keys. If the range of customized input keys has not been set then this method shall return a zero length char array. This method shall return null if getType returns a value without the INPUT_CUSTOMIZED bit set.

A.7.4.38 HScreenConfigTemplate

A.7.4.38.1 Class description

The following text shall be considered to be added to the end of the class description:

> Several preferences in this class are required to be not filled in by the platform in templates generated by the platform. This shall mean;
>
> - the object for this preference (if there is one) is set to null
>
> - the priority for this preference is set to DONT_CARE

A.7.4.38.2 VIDEO_GRAPHICS_PIXEL_ALIGNED

In the description of this field, the following text shall be considered to be absent:

> Where a video device is moving the video relative to the screen in real time (e.g. implementing pan and scan), graphics configurations shall only support this feature where the implementation of the graphics device can track the position changes in the video device automatically.

A.7.4.38.3 DISABLED

Add the following to the class description of HScreenConfigTemplate

```
*
* A special template indicating that an HScreenDevice is disabled.
* Disabled HScreenDevice instances are not being composited as part of
* the video output signal of the HScreen.
* The preferences, properties and attributes of this HScreenConfigTemplate
* are implementation dependent.
*
public static HScreenConfigTemplate DISABLED;
```

A.7.4.38.4 SCREEN_ASPECT_RATIO

The following additional field shall be considered to be present.

```
/**
 * A value for use in the preference field of the setPreference,
 * getPreferenceObject and getPreferencePriority methods in the
 * HScreenConfigTemplate that indicates that the device configuration
 * supports the screen aspect ratio, as specified in a Dimension object
 * which indicates the (relative) x, y pixel aspect ratio. Typical
 * values are 4:3 and 16:9. <p>
 *
 * Instances of HScreenConfigTemplate generated by the platform and
 * returned to applications (e.g. from getConfigTemplate shall have this
 * preference set to a platform specific value with the REQUIRED
 * priority.
 */
public static final int SCREEN_ASPECT_RATIO=16;
```

A.7.4.39 HGraphicsConfiguration

A.7.4.39.1 getConfigTemplate

The following text shall be considered to be added to the description of this method:

> Preferences that are not filled in by the platform will return DONT_CARE priority.

A.7.4.39.2 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HGraphicsConfiguration` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HGraphicsConfiguration` class.

A.7.4.40 HVideoConfiguration

A.7.4.40.1 getConfigTemplate

The following text shall be considered to be added to the description of this method:

> Preferences that are not filled in by the platform will return DONT_CARE priority.

A.7.4.40.2 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HVideoConfiguration` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HVideoConfiguration` class.

A.7.4.41 HToggleButton

A.7.4.41.1 Default parameter values exposed in the constructors

The following descriptions will be used to replace the ones already in HToggleButton's "Default parameter values exposed in the constructors" table:

> imageFocused - The image to be used as the content for the HState.FOCUSED_STATE and HState.DISABLED_FOCUSED_STATE states of this component.
>
> imageActioned - The image to be used as the content for the HState.ACTIONED_FOCUSED_STATE and HState.DISABLED_ACTIONED_FOCUSED_STATE states of this component.
>
> imageNormalActioned - The image to be used as the content for the HState.ACTIONED_STATE and HState.DISABLED_ACTIONED_STATE states of this component.

A.7.4.42 HGraphicButton

A.7.4.42.1 Default parameter values exposed in the constructors

The following descriptions will be used to replace the ones already in HGraphicButton's "Default parameter values exposed in the constructors" table:

> imageFocused - The image to be used as the content for the HState.FOCUSED_STATE and HState.DISABLED_FOCUSED_STATE states of this component.
>
> imageActioned - The image to be used as the content for the HState.ACTIONED_STATE, HState.ACTIONED_FOCUSED_STATE states of this component.

A.7.4.43 HTextButton

A.7.4.43.1 Default parameter values exposed in the constructors

The rows for textFocus and textAction in HTextButton's "Default parameter values exposed in the constructors" table shall be considered to be removed.

A.7.4.44 HLook and classes implementing HLook

In the getMinimumSize method of HLook and all these classes, the following paragraph shall be considered to be replaced:

> If the HLook supports the scaling of its content (e.g. an HGraphicLook) and content is set then the return value is a size sufficiently large to hold the minimum size of each piece of content plus any additional dimensions that the HLook requires for border decoration etc.

with:

> If the HLook supports the scaling of its content (e.g. an HGraphicLook) and scaling is requested and content is set then the return value is a size containing the width of the narrowest content and the height of the shortest content plus any additional dimensions that the HLook requires for border decoration etc.

A.7.4.45 HTextLook

A.7.4.45.1 General

In getMaximumSize(), getMinimumSize() and getPreferredSize(), the following sentence:

> If the HDefaultTextLayoutManager returns a zero size, then proceed with the following steps.

shall be considered to be replaced with the following:

> If HVisible.getTextLayoutManager() does not return an instance of HDefaultTextLayoutManager, or HDefaultTextLayoutManager returns a zero size, then proceed with the following steps as if content for this HVisible had not been set.

A.7.4.46 HExtendedLook

org.havi.ui

HExtendedLook

Syntax

```
public interface HExtendedLook extends HLook
```

All Superinterfaces:

java.lang.Cloneable, `HLook`

Description

The HExtendedLook interface is derived from the `HLook` interface and abstracts out the drawing of the look into separate background, border and visible data components. The interface allows the programmer to derive new looks from the default looks and have control over which component parts are drawn. This aids interoperability between platforms since no two manufacturer's `HLook` implementation look the same.

See Also:

`setLook(HLook)`, `setLookData(Object, Object)`, `paint(Graphics)`, `setBackgroundMode(int)`, `setHorizontalAlignment(int)`, `setVerticalAlignment(int)`, `setResizeMode(int)`, `HTextLook`, `HGraphicLook`, `HAnimateLook`, `HRangeLook`, `HSinglelineEntryLook`, `HMultilineEntryLook`

Methods

fillBackground(Graphics, HVisible, int)

```
public void fillBackground(java.awt.Graphics g, HVisible visible, int state)
```

The fillBackground(Graphics, HVisible, int) method paints the component with its current background `Color` according to the `setBackgroundMode(int)` method of `HVisible`.

This method is only called from `showLook` within this `HExtendedLook` implementation. It's not the intention to call this method directly from outside of the `HExtendedLook`.

Regardless of the background mode, it is an implementation option for this method to render added decorations which may affect the look's transparency. This method shall not be used to render any HVisible related data or content associated with the HVisible. It is purely for background and decoration only.

The `fillBackground` method should not modify the clipRect (clipping rectangle) of the `Graphics` object that is passed to it in a way which includes any area not part of that original clipRect. If any modifications are made, the original clipRect shall be restored.

Parameters:

`g` - the graphics context.

`visible` - the visible.

`state` - the state parameter indicates the state of the visible

See Also:

`isOpaque(HVisible)`

renderBorders(Graphics, HVisible, int)

```
public void renderBorders(java.awt.Graphics g, HVisible visible, int state)
```

The renderBorders(Graphics, HVisible, int) method paints any implementation specific borders according to the `setBordersEnabled(boolean)` method of `HVisible`. If borders are drawn, the border decoration shall be rendered within the border area as returned by `getInsets`. The behavior of this method, when a subclass overrides the method `getInsets` is undefined, except that it will never draw outside the border area as returned by `getInsets`.

This method is only called from `showLook` within this `HExtendedLook` implementation. It's not the intention to call this method directly from outside of the `HExtendedLook`.

The renderBorders(Graphics, HVisible, int) method should not modify the clipRect (clipping rectangle) of the `Graphics` object that is passed to it in a way which includes any area not part of that original clipRect. If any modifications are made, the original clipRect shall be restored.

Parameters:

`g` - the graphics context.

`visible` - the visible.

`state` - the state parameter indicates the state of the visible

renderVisible(Graphics, HVisible, int)

```
public void renderVisible(java.awt.Graphics g, HVisible visible, int state)
```

The renderVisible(Graphics, HVisible, int) method paints any content or other data associated with the look's HVisible. This method shall not be used to render a background nor any other decoration. Its purpose is purely to render content or other value data stored on the HVisible. This may be set via HVisible methods such as `setTextContent` and `setGraphicContent`. Rendering shall take place within the bounds returned by the `getInsets` method.

This method is only called from `showLook` within this `HExtendedLook` implementation. It's not the intention to call this method directly from outside of the `HExtendedLook`.

For looks which draw content (e.g. `HTextLook`, `HGraphicLook` and `HAnimateLook`), if no content is associated with the component, this method does nothing.

The renderVisible(Graphics, HVisible, int) method should not modify the clipRect (clipping rectangle) of the `Graphics` object that is passed to it in a way which includes any area not part of that original clipRect. If any modifications are made, the original clipRect shall be restored.

Parameters:

`g` - the graphics context.

`visible` - the visible.

`state` - the state parameter indicates the state of the visible

showLook(Graphics, HVisible, int)

```
public void showLook(java.awt.Graphics g, HVisible visible, int state)
```

The showLook(Graphics, HVisible, int) method is the entry point for repainting the entire `HVisible` component. This method delegates the responsibility of drawing the component background, borders and any `HVisible` related data or content to the `fillBackground`, `renderVisible` and `renderBorders` methods respectively, subject to the clipping rectangle of the Graphics object passed to it. This method shall call the methods `fillBackground`, `renderVisible`, and `renderBorders` in that order and shall not do any rendering itself.

The showLook(Graphics, HVisible, int) method should not modify the clipRect (clipping rectangle) of the `Graphics` object that is passed to it in a way which includes any area not part of that original clipRect. If any modifications are made, the original clipRect shall be restored.

Any resources **explicitly** associated with an HExtendedLook should be loaded by the HExtendedLook during its creation, etc. Note that the "standard" looks don't load content by default.

This method is called from the `paint(Graphics)` method of `HVisible` and must never be called from elsewhere. Components wishing to redraw themselves should call their repaint method in the usual way.

Overrides:

showLook(Graphics, HVisible, int) in interface HExtendedLook

Parameters:

`g` - the graphics context.

`visible` - the visible.

`state` - the state parameter indicates the state of the visible, allowing the look to render the appropriate content for that state. Note that some components (e.g. HStaticRange, HRange, HRangeValue) do not use state-based content.

A.7.4.47 HAnimateLook, HGraphicLook, HListGroupLook, HMultilineEntryLook, HRangeLook, HSinglelineEntryLook and HTextLook

The following changes shall be considered to apply to all these implementing looks.

a) The method descriptions in HExtendedLook for fillBackground(), renderBorders() and renderVisible() shall be considered to form part of all the above looks.

b) The description of showLook() in each of the above looks shall be considered to be replaced with the one in HExtendedLook.

c) HAnimateLook, HGraphicLook, HSinglelineEntryLook and HTextLook shall be considered to implement HExtendedLook instead of HLook.

d) HListGroupLook and HRangeLook shall be considered to implement HExtendedLook additionally to HAdjustableLook. The method showLook() shall be implemented as specified by HExtendedLook.

A.7.4.48 HSwitchable

The following sentence:

> Actioned states (i.e. those with the ACTIONED_STATE_BIT bit set may persist after any registered HActionListener listeners have been called, until a further HActionEvent is received.

shall be considered to be modified as follows:

> Actioned states (i.e. those with the ACTIONED_STATE_BIT bit set) may persist after any registered HActionListener listeners have been called, until a further HActionEvent is received.

A.7.4.49 HStillImageBackgroundConfiguration

A.7.4.49.1 Constructor

In the constructor of this class, the following sentence:

> It is not intended that applications should directly construct `HStillImageBackgroundConfiguration` objects.

shall be considered to be replaced with the following:

> An interoperable application shall not subclass the `HStillImageBackgroundConfiguration` class.

A.7.4.50 HTextValue

A.7.4.50.1 Class description

In the description of this interface, the following text:

> HAVi text events are discussed in detail in the HKeyboardInputPreferred interface description.

shall be considered to be replaced by:

> HAVi text events are discussed in detail in the HTextEvent description.

A.7.4.51 HDefaultTextLayoutManager

A.7.4.51.1 getMinimumSize

The following parameters and returns clause shall be considered to be present:

> Parameters:
>
> hvisible - a component within which text will be rendered
>
> Returns:
>
> the minimum size of text rendered in that component

A.7.4.51.2 getMaximumSize

The following parameters and returns clause shall be considered to be present.

> Parameters:
>
> hvisible - a component within which text will be rendered
>
> Returns:
>
> the maximum size of text rendered in that component

A.7.4.51.3 getPreferredSize

The following parameters and returns clause shall be considered to be present.

> Parameters:
>
> hvisible - a component within which text will be rendered

Returns:

the preferred size for text rendered in that component

A.7.4.52 Hscreen

A.7.4.52.1 getHGraphicsDevices, getHVideoDevices, getHBackgroundDevices

Add the following to the method body of each of the following methods - HScreen.getGraphicsDevices, HScreen.getVideoDevices, HScreen.getBackgroundDevices:

```
*
* The devices returned shall be in z-order with each device being in
* front of those devices with a higher index in the array of results.
*
```

A.7.4.52.2 getCoherentScreenConfigurations

Add the following to the method description of HScreen.getCoherentScreenConfigurations(..)

```
*
* Both the input to this method and the output from this method shall be
* sorted in z-order (from front to back) within each type of HscreenConfiguration.
* The ordering of different sub-classes of HScreenConfigTemplate shall be ignored.
* Where more than one template of the same type is
* provided, the returned configurations shall be in the same z-order as
* the templates in the input. e.g. if the template at index 0 in the input
* requests a resolution of 960x540 and the template at index 1 in the
* input requests a resolution of 720x576 then the configuration at index 0
* in the output shall have a resolution of 960x540 and the configuration
* at index 1 in the output shall have a resolution of 720x576. If the
* z-order requirement cannot be met, this function shall return null.
* The special HScreenConfigTemplate DISABLED should not normally be requested
* in this method since more capable MHP terminals may be able to support
* more than what is requested.
*
```

A.7.4.52.3 setCoherentScreenConfigurations

In the method, HScreen.setCoherentScreenConfigurations():

Add the following to the class description:

The HScreenConfigurations shall be in z-order as defined for HScreen.getCoherentScreenConfigurations

Change the @throws clause for HConfigurationException to read as follows:

```
*
* @throws HConfigurationException - if the specified
* HScreenConfiguration[] array is not valid for any of the devices
* or if the z-order of the configurations in the array does not match
* the z-order of the devices.
*
```

A.7.4.52.4 Additional methods

The following additional methods shall be considered to be present;

```
/**
 * Return the aspect ratio of the video output signal represented
 * by this HScreen.
 * @return a Dimension object specifying the aspect ratio of the video
 * output signal
 */
public Dimension getScreenAspectRatio()

/**
 * Return the aspect ratio of the the physical display that is
 * connected to this HScreen as far as that is known. The extent to
 * which this is known depends on the connector and protocol used
 * to connect the display. Some connectors may support a protocol
```

```
 * signalling the display aspect ratio. Otherwise the display aspect
 * ratio may be a user setting entered as part of the configuration
 * process of the MHP terminal.
 *
 * @return a Dimension object specifying the aspect ratio of the display
 * @see VideoFormatControl#getDisplayAspectRatio
 */
public Dimension getDisplayAspectRatio()
```

A.7.5 org.havi.ui.event

A.7.5.1 HActionEvent

A.7.5.1.1 getModifiers

The text:

> Modifiers are not used with the HAVi platform. Interoperable HAVi applications shall not use the return value of this method.

shall be considered to be replaced by:

> Modifiers are not used for `HActionEvents` with the HAVi platform. Interoperable HAVi applications shall not use the return value of this method.

A.7.5.2 HItemEvent

A.7.5.2.1 Constructor

The following text:

> item - The item which caused the change, or null if this information is not available. This information shall be provided if the event id is one of ITEM_SELECTED, ITEM_CLEARED, ITEM_SET_CURRENT, ITEM_SET_NEXT or ITEM_SET_PREVIOUS.

Shall be considered to be replaced with the following:

> item - The item which caused the change, or null if this information is not available.
>
> If the event is sent to listeners, this information shall be provided if the event id is one of ITEM_SELECTED, ITEM_CLEARED, ITEM_SET_NEXT or ITEM_SET_PREVIOUS."

A.7.5.2.2 ITEM_SET_CURRENT

The following paragraph:

> An item event with this id is sent from the component whenever the current item of an HItemValue component changes.

Shall be considered to be replaced with:

> An item event with this id is sent to or from the component whenever the current item of an HItemValue component changes.

A.7.5.3 HKeyEvent

The following paragraph shall not apply in this specification:

> Note that the HAVi system should only generate KEY_PRESSED events. Neither KEY_TYPED nor KEY_RELEASED events should be generated. Furthermore, the system should collapse combined events. For example, a usual Java Virtual Machine generates for the letter A three events: KEY_PRESSED for modifier key Shift, KEY_PRESSED for letter "A" and KEY_TYPED for "A". This should be collapsed into one single KEY_PRESSED event with the letter "A" and the Shift modifier set. This is to simplify the key event handling of applications.

A.7.5.3.1 Constructors

The description of the "id" parameter shall be considered to have the following text added:

> This is the value that will be returned by the event object's getID method.

A.7.5.4 HRcEvent

The following changes shall be considered to apply in this class:

- Replace all occurrences of "action id" in the descriptions of the VK constants by "key code".
- Replace all occurrences of "event ids" in the descriptions of RC_FIRST and RC_LAST by "key codes".Tag both constants as being deprecated. Add for RC_FIRST a specific deprecated text:

  * @deprecated The value of this field is useless, since it mixes event ids and key codes. It does **not** reflect any of the remote control key codes listed in this class.
- Remove the following sentence from the class description: "Note that it is an implementation constraint that the HrcEvent event range should not intersect with the Java AWT key event range."
- Add to the parameter descriptions of "id" for both constructors: "in the range KEY_FIRST to KEY_LAST".
- In the definition of the field, VK_COLORED_KEY_0, the paragraph starting with “Up to six colored soft keys can be included on a remote control.” shall be considered to be extended with the following; “In markets where text is written from right to left, these keys may be oriented from right to left in ascending order.”

A.7.5.5 HRcCapabilities

A.7.5.5.1 getRepresentation

In the method `getRepresentation(int aCode)`, all references to the parameter `id` shall be considered to be replaced with `keyCode`.

A.7.5.5.2 Constructor

The following sentence:

> It is not intended that applications should directly construct `HRcCapabilities` objects.

shall be considered to be replaced by:

> An interoperable application shall not subclass the `HRcCapabilities` class.

A.7.5.6 HEventGroup

A.7.5.6.1 getKeyEvents

This class shall be considered to be extended with the following method:

```
/**
 * Return the key codes contained in this event group
 */
   public int[] getKeyEvents() {}
```

A.7.5.7 HKeyCapabilities

A.7.5.7.1 Constructor

The following sentence:

> It is not intended that applications should directly construct `HKeyCapabilities` objects.

shall be considered to be replaced by:

> An interoperable application shall not subclass the `HKeyCapabilities` class.

A.7.5.8 HEventRepresentation

A.7.5.8.1 Constructor

The following sentence:

> It is not intended that applications should directly construct `HEventRepresentation` objects.

shall be considered to be replaced by:

> An interoperable application shall not subclass the `HEventRepresentation` class.

A.7.6 References to ISO/IEC10646-1:1993

All references to ISO/IEC10646-1:1993 are considered to be non-specific references to ISO 10646-1 [18]. Also, the term "support for Unicode ranges" is considered to be "support for character ranges as specified by ISO 10646-1 [18]".

A.7.7 Chapter 8

A.7.7.1 Section 8.2.3.3.2 "Compatibility with Existing java.awt Methods"

In this section, the following sentence:

> The `java.awt.Toolkit.getScreenSize` method shall be equivalent to the pixel resolution of the current configuration of the default screen device returned by HScreen.getDefaultGraphicsDevice.

shall be considered to read:

> The `java.awt.Toolkit.getScreenSize` method shall be equivalent to the pixel resolution of the current configuration of the default screen device returned by HScreen.getDefaultHGraphicsDevice.

A.8 ISO/IEC 13818-6

With reference to ISO/IEC 13818-6 [26].

A.8.1 Reconstruction of NPT

In equation 8-3, SCR_Reference is considered to be STC_Reference.

A.9 void

A.10 CSS 2

With reference to CSS 2 [101].

This specification is considered to include:

11.1.2 Clipping: the "clip" property

A clipping region defines what portion of an element's rendered content is visible. By default, the clipping region has the same size and shape as the element's box(es). However, the clipping region may be modified by the "clip" property.

"clip"

Value:þþ <shape> | auto | inherit

Initial:þþ auto

Applies to:þþ block-level and replaced elements

Inherited:þþ no

Percentages:þþ N/A

Media:þþ visual

The "clip" property applies to elements that have a "overflow" property with a value other than "visible". Values have the following meanings:

auto

The clipping region has the same size and location as the element's box(es).

<shape>

In CSS2, the only valid <shape> value is: rect (<top> <right> <bottom> <left>) where <top>, <bottom> <right>, and <left> specify offsets from the respective sides of the box.

<top>, <right>, <bottom>, and <left> may either have a <length> value or "auto". Negative lengths are permitted. The value "auto" means that a given edge of the clipping region will be the same as the edge of the element's generated box (i.e. "auto" means the same as "0".)

When coordinates are rounded to pixel coordinates, care should be taken that no pixels remain visible when <left> + <right> is equal to the element's width (or <top> + <bottom> equals the element's height), and conversely that no pixels remain hidden when these values are 0.

The element's ancestors may also have clipping regions (in case their "overflow" property is not "visible"); what is rendered is the intersection of the various clipping regions.

If the clipping region exceeds the bounds of the UA's document window, content may be clipped to that window by the native operating environment.

Example(s):

The following two rules:

P { clip: rect(5px, 10px, 10px, 5px); }

P { clip: rect(5px, -5px, 10px, 5px); }

will create the rectangular clipping regions delimited by the dashed lines in the following illustrations:

þþþ[D]

Note. In CSS2, all clipping regions are rectangular. We anticipate future extensions to permit non-rectangular clipping.

While CSS2 specifies that values of "rect()" specify offsets from the respective sides of the box, current implementations interpret values with respect to the top and left edges for all four values (top, right, bottom, and left). The Working Group proposes to revise CSS2 to conform to current practice.

A.11 OCAP

No errata against the referenced clauses of OCAP 1.0 [120] have been identified.

Annex B (normative): Object carousel

B.1 Introduction

The broadcast applications are transmitted using the DSM-CC User-to-User Object Carousels.

The present document is based on the following specifications:

- ISO/IEC 13818-1 [23] - MPEG 2 systems.
- ISO/IEC 13818-6 [26] - DSM-CC.
- EN 301 192 [5] - DVB specification for data broadcasting.
- TR 101 202 [i.5] - Implementation Guidelines for Databroadcasting.

With the constraints and extensions described here.

B.1.1 Key to notation

Certain notations are used in the "value" columns of the syntax tables:

Table B.1: Key to notation

Symbol	
+	A value that is "allocated" e.g. configuration parameter of the object carousel server.
*	A value that is "calculated" e.g. a field whose value is calculated by the carousel server as a consequence of the number of bytes in other fields

B.2 Object Carousel Profile

In the following clause, the message structures of the Object carousels are introduced with associated additional restrictions. Each section contains a table specifying the restrictions on the usage of the fields. The table also indicates the source for these restrictions: the DSM-CC standard, DVB guidelines or a specific restriction for the present document.

For the object carousel messages, also the message syntax is included. **In the syntax tables grey shading indicates parts that the broadcaster may put in, but an MHP terminal compliant with the present document may ignore.**

B.2.1 DSM-CC Sections

All object carousels messages are transmitted using DSM-CC section format. The DSM-CC Section format is defined in chapter 9.2 of the DSM-CC specification.

The DSM-CC standard provides an option to use either a CRC32 or a checksum for detecting bit errors. For the present document, we make the following restriction:

Table B.2: Restrictions on DSM-CC Section format

Field	Restrictions	Source
section_syntax_indicator	1 (indicating the use of the CRC32)	The present document
last_section_number	For sections transporting DownloadDataBlock fragments: - all modules intended to be retrieved shall have the last section number ≤ 0xFE - if last section number = 0xFF receiver behaviour is undefined	

The maximum section length is 4 096 bytes for all types of sections used in Object Carousels. The section overhead is 12 bytes, leaving a maximum of 4 084 bytes of payload per section.

B.2.1.1 Sections per TS packet

Parts of no more than four sections shall be delivered in a single TS packet.

B.2.2 Data Carousel

This clause defines the content of the data carousel messages when used in the object carousel.

Usage of data carousel descriptors not listed below in an MHP object carousel is not defined by this specification. They should not be used by broadcasters and receivers should ignore them.

B.2.2.1 General

The definitions in Table B.3 apply to both the dsmccDownloadDataHeader and the similar dsmccMessageHeader.

Table B.3: Restrictions on DSM-CC DownloadData and Message headers

Field	Restrictions	Source
TransactionId	See clause B.2.5 "Assignment and use of transactionId values" on page 502	The present document
AdaptationLength	The MHP terminal may ignore the possible contents of the dsmccAdaptationHeader field.	

B.2.2.2 DownloadInfoIndication

The DownloadInfoIndication is a message that describes a set of modules and gives the necessary parameters to locate the module and retrieve it.

Table B.4: Restrictions on the DII

Field	Restrictions	Source
blockSize	maximum size 4 066 (max. section payload - DDB-header size (18)) The recommended blockSize is 4 066.	DSM-CC (The present document rec.)
windowSize	0 (not used for Object Carousels)	DSM-CC
ackPeriod	0 (not used for Object Carousels)	DSM-CC
tCDownloadWindow	0 (not used for Object Carousels)	DSM-CC
tCDownloadScenario	0 (not used for Object Carousels)	DSM-CC
compatibilityDescriptor(): compatibilityDescriptorLength	0 (no compatibility descriptor for Object Carousels)	DSM-CC
PrivateDataLength	The MHP terminal may ignore the possible contents of the privateData field	DVB

B.2.2.3 DownloadServerInitiate

The DownloadServerInitiate is used in the case of object carousels to provide the object reference to the ServiceGateway (i.e. root directory) of the object carousel.

Table B.5: Restrictions on DSI

Field	Restrictions	Source
compatibilityDescriptor(): compatibilityDescriptorLength	0 (no compatibility descriptor for Object Carousels)	DSM-CC
privateData	Contains the ServiceGatewayInfo structure	DSM-CC
serverId	Shall be set to 20 bytes each with the value of 0xFF	DVB / The present document

B.2.2.4 ModuleInfo

The moduleInfo structure is placed in the moduleInfo field of the DownloadInfoIndication of the data carousel. It contains the information needed to locate the module.

Table B.6: Restrictions on the DII moduleInfo field

Field	Restrictions	Source
BIOP::ModuleInfo::Taps	The first tap shall have the "use" value 0x0017 (BIOP_OBJECT_USE). The id and selector fields are not used and the MHP terminal may ignore them. The MHP terminal may ignore possible other taps in the list.	DVB
BIOP::ModuleInfo:: UserInfo	The userInfo field contains a loop of descriptors. These are specified in the DVB Data Broadcasting standard and/or the present document. The MHP terminal shall support the compressed_module_descriptor (tag 0x09) used to signal that the module is transmitted in compressed form. The userInfo field may also contain a caching_priority_descriptor and one or more label_ descriptors.	DVB / The present document
moduleTimeOut blockTimeOut minBlockTime	These fields are defined in units of µs. An appropriate value must be explicitly encoded by carousel generation equipment. There is no default value that may be encoded, i.e. 0xFFFFFFFF has no special meaning. Receivers shall not employ an inbuilt default instead of the signalled value, as there is no way to define these without knowledge of the construction of a particular carousel.	The present document

Table B.7: BIOP::ModuleInfo syntax

Syntax	bits	Type	Value	Comment
BIOP::ModuleInfo() {				
moduleTimeOut	32	uimsbf	+	
blockTimeOut	32	uimsbf	+	
minBlockTime	32	uimsbf	+	
taps_count	8	uimsbf	N1	≥ 1
{				
id	16	uimsbf	0x0000	user private
use	16	uimsbf	0x0017	BIOP_OBJECT_USE
assocTag	16	uimsbf	+	
selector_length	8	uimsbf	0x00	
}				
for (j=1; j<N1; j++) {				Possible additional taps that may be ignored by MHP terminals.
id	16	uimsbf	+	
use	16	uimsbf	+	
assocTag	16	uimsbf	+	
selector_length	8	uimsbf	N2	
for (j=0; j<N2; j++) {				
selector_data	8	uimsbf	+	
}				
}				
userInfoLength	8	uimsbf	N3	
for (k=0; k<N3; j++) {				
userInfo_data	8	uimsbf	+	
}				
}				

B.2.2.4.1 Label descriptor

The label_descriptor may be placed in the userInfo field of the moduleInfo structure. It attaches a label to the corresponding module. Multiple labels can be attached to a module by including multiple label descriptors in the same userInfo field. Labels can be used for pre-fetching modules (see clause 10.8.3.2 "Pre-fetch descriptor" on page 242).

Within one object carousel, the same label may not be used in multiple DII messages. This implies that all modules that share a label are signalled in the same DII message.

Table B.8: Label descriptor syntax

Syntax	bits	Type	Value	Comment
label_descriptor() {				
descriptor_tag	8	uimsbf	0x70	
descriptor_length	8	uimsbf	N1	
for (n=0; n<N1; n++) {				
label_byte	8	uimsbf		The label
}				
}				

descriptor_tag: This 8 bit integer value with 0x70 identifies this descriptor.

label_byte: .These 8-bit fields carry an array of bytes that are a module label. This label matches a label used in one of the pre-fetch descriptors clause 10.8.3.2 "Pre-fetch descriptor" on page 242. The match shall be done as a byte-by-byte comparison between the two byte arrays.

B.2.2.4.2 Caching priority descriptor

To indicate priorities for the objects, a caching_priority_descriptor may be included in the userInfo field of the moduleInfo in the DownloadInfoIndication message.

This descriptor provides a priority value for the caching. The same priority applies for each object in the module. The priority indicated in the descriptor is only a hint to the MHP terminal and implementations may use that in combination with other caching strategies.

The descriptor includes also the transparency level (see clause B.5.2 "Transparency levels of caching" on page 510) that shall be used by the terminal implementation if it caches objects in this module.

Table B.9: Caching priority descriptor syntax

Syntax	bits	Type	Value	Comment
caching_priority_descriptor() {				
descriptor_tag	8	uimsbf	0x71	
descriptor_length	8	uimsbf		
priority_value	8	uimsbf		
transparency_level	8	uimsbf		
}				

descriptor_tag: This 8 bit integer value with 0x71 identifies this descriptor.

priority_value: indicates the caching priority for the objects within this module. A higher value indicates more importance for caching.

transparency_level: Transparency level that shall be used by the MHP terminal if it caches objects contained in this module. The possible values are listed in table B.10. The semantics of the policies are defined in clause B.5.2 "Transparency levels of caching" on page 510.

Table B.10: Transparency level values

Value	Description
0	reserved
1	Transparent caching
2	Semi-transparent caching
3	Static caching.
4 to 255	reserved for future use

When this descriptor is not included in the userInfo field of the moduleInfo for a module, the default values that shall be assumed are:

- priority_value: 128.
- transparency_level: 1 (transparent caching).

B.2.2.5 ServiceGatewayInfo

The ServiceGatewayInfo structure is carried in the DownloadServerInitiate message and provides the object reference to the ServiceGateway object.

Table B.11: Restrictions on the ServiceGatewayInfo

Field	Restrictions	Source
BIOP::ServiceGatewayInfo::downloadTaps	The MHP terminal may ignore the downloadTap list.	The present document
BIOP::ServiceGatewayInfo::serviceContextList	The MHP terminal may ignore the service context list.	
BIOP::ServiceGatewayInfo::UserInfo	The MHP terminal may ignore the user info.	

Table B.12: ServiceGatewayInfo() syntax

Syntax	bits	Type	Value	Comment
`ServiceGatewayInfo(){`				
`  IOP::IOR()`			+	See table B.22 "IOP::IOR syntax" on page 486
`  downloadTaps_count`	8	uimsbf	N1	software download Taps
`  for (i=0; i<N1; i++) {`				
`    DSM::Tap()`				
`  }`				
`  serviceContextList_count`	8	uimsbf	N2	serviceContextList
`  for (i=0; i<N2; i++) {`				
`    context_id`	32	uimsbf		
`    context_data_length`	16	uimsbf	N3	
`    for (j=0; j<N3; j++) {`				
`      context_data_byte`	8	uimsbf	+	
`    }`				
`  }`				
`  userInfoLength`	16	uimsbf	N5	user info
`  for (i=0; i<N5; i++) {`				

Syntax	bits	Type	Value	Comment
userInfo_data	8	uimsbf	+	
}				
}				

B.2.2.6 Download Cancel

There is no semantic for this message in this profile. Receivers may ignore them.

B.2.2.7 DownloadDataBlock

Table B.13: Restrictions on the DDB

Field	Restrictions	Source
moduleId	Module ids are unique within the scope of the object carousel. See ISO/IEC 13818-6 [26] 11.2.3.	DSM-CC

B.2.3 The Object Carousel

B.2.3.1 BIOP Generic Object Message

The BIOP Generic Object Message is a common structure used by all the BIOP (Broadcast Inter-ORB Protocol) messages.

Table B.14: Restrictions on the BIOP Generic Object Message

Field	Restrictions	Source
MessageHeader::byte_order	0 (indicating big-endian byte order)	DVB
MessageSubHeader::objectKey	Maximum length of the key shall be four bytes.	DVB
MessageSubHeader::objectKind	The short three-letter aliases shall be used, plus the null-terminator.	DVB
Access attributes	Access attributes are not transmitted in object carousels	DSM-CC

B.2.3.2 CORBA strings

In a number of places Object Carousel messages include text strings. These are formatted in accordance with 12.3.2 of CORBA/IIOP [2] and using the so-called "CDR-Lite" encoding as described by ISO/IEC 13818-6 [26], Clause 5.6.3.4. I.e. the text is preceded by an integer specifying the length of the string and followed by a null terminator. The size of this integer depends on the string concerned and can be seen clearly in the syntax tables that follow. However, for clarity CORBA format strings and the size of their length fields are summarized in table B.15:

Table B.15: Location of CORBA format strings (Sheet 1 of 2)

string	length field size (bits)	location
objectKind_data	32	Table B.17 "BIOP::FileMessage syntax" on page 482
objectKind_data id_data kind_data	32 8 8	Table B.20 "BIOP::DirectoryMessage syntax" on page 484
objectKind_data	32	Table B.29 "BIOP::StreamMessage syntax" on page 491

Table B.15: Location of CORBA format strings (Sheet 2 of 2)

string	length field size (bits)	location
objectKind_data eventName_data	32 8	Table B.31 "BIOP:: StreamEventMessage syntax" on page 493
type_id_byte	32	Table B.22 "IOP::IOR syntax" on page 486
id_data kind_data	32 32	Table B.26 "Syntax of Lite Options Profile Body with ServiceLocation component." on page 489

B.2.3.3 BIOP FileMessage

The BIOP FileMessage is used for carrying file objects.

Table B.16: Restrictions on the BIOP File Message

Field	Restrictions	Source
MessageSubHeader:: ObjectInfo	The ObjectInfo may be empty (have a length of zero). If not empty the first 8 bytes of the ObjectInfo shall contain the DSM::File::ContentSize attribute. This is optionally followed by a loop of descriptors. The descriptors defined for possible use in this location are: Content type descriptor	The present document
MessageSubHeader:: ServiceContextList	The MHP terminal may skip the possible serviceContextList structures.	

Table B.17: BIOP::FileMessage syntax (Sheet 1 of 2)

Syntax	bits	Type	Value	Comment
BIOP::FileMessage() {				
magic	4 x 8	uimsbf	0x42494F50	"BIOP"
biop_version.major	8	uimsbf	0x01	BIOP major version 1
biop_version.minor	8	uimsbf	0x00	BIOP minor version 0
byte_order	8	uimsbf	0x00	Big endian byte ordering
message_type	8	uimsbf	0x00	
message_size	32	uimsbf	*	
objectKey_length	8	uimsbf	N1	1 to 4
for (i=0; i<N1; i++) {				
objectKey_data	8	uimsbf	+	
}				
objectKind_length	32	uimsbf	0x00000004	
objectKind_data	4 x 8	uimsbf	0x66696C00	"fil" type_id alias
objectInfo_length	16	uimsbf	N2	
DSM::File::ContentSize	64	uimsbf	+	objectInfo (note)
for (i=0; i<N2 - 8; i++) {				
descriptor()	8	uimsbf	+	
}				
serviceContextList_count	8	uimsbf	N3	serviceContextList
for (i=0; i<N3; i++) {				
context_id	32	uimsbf		
context_data_length	16	uimsbf	N4	
for (j=0; j<N4; j++) {				

Table B.17: BIOP::FileMessage syntax (Sheet 2 of 2)

Syntax	bits	Type	Value	Comment
context_data_byte	8	uimsbf	+	
}				
}				
messageBody_length	32	uimsbf	*	
content_length	32	uimsbf	N5	
for (i=0; i<N5; i++) {				
content_byte	8	uimsbf	+	actual file content
}				
}				
NOTE: If present and non-zero, this shall be the same as the content_length of the referenced FileMessage.				

B.2.3.4 Content type descriptor

Zero or one content type descriptors can be carried in the file `MessageSubHeader::ObjectInfo` or the `BIOP::Binding::ObjectInfo`. Where more than one content type descriptor is used they shall express the same content format. Also, the content type (if any) signalled in the directory binding shall be identical to that signalled in the bound file's header. This optional descriptor identifies the media type of the file.

This content type signalling only applies to objects of type file and is not appropriate for other object types.

If this descriptor is absent or not sufficient to categorize the content type then the extension portion of the file name shall be used be used to provide the media type mapping via table 7 "File type identification" on page 77. The extension portion of the filename shall not be used if this descriptor is provided.

The format of the content type descriptor is shown in table B.18.

Table B.18: Content type descriptor syntax

Syntax	bits	Type	Value	Comment
content_type_descriptor() {				
descriptor_tag	8	uimsbf	0x72	
descriptor_length	8	uimsbf		
for (i=0; i<descriptor_length; i++) {				
content_type_data_byte	8	uimsbf		A MIME type
}				
}				

descriptor_tag: This 8-bit integer with value 0x72 identifies this descriptor.

descriptor_length: This 8-bit integer identifies the number of bytes following it.

content_type_data_byte: These bytes form a string that indicates the MIME content type of the object. The string is specified as follows:

```
content_type_data = type "/" subtype *(";" parameter)
```

Where `type`, `subtype` and `parameter` are as defined in section 5 of RFC 2045 [64] and hence `content_type_data` carries the payload of the Content-Type header defined in RFC 2045 [64].

B.2.3.5 BIOP DirectoryMessage

The BIOP DirectoryMessage is used for carrying the directory objects.

Table B.19: Restrictions on the BIOP Directory Message

Field	Restrictions	Source
MessageSubHeader:: ObjectInfo	The MHP terminal may skip the N2 possible bytes in the objectInfo field.	The present document
MessageSubHeader:: ServiceContextList	The MHP terminal may skip the N3 possible serviceContextList structures.	The present document
BIOP::Name	The name shall contain exactly one NameComponent. The id_length shall be 2 or greater. The id_data shall not be replicated for other name components within this directory.	The present document
BIOP::Binding:: BindingType	Either "ncontext" (in the case of a Directory object) or "nobject" (in the case of a File or a Stream object). Binding type "composite" shall not be used.	DVB
BIOP::Binding:: ObjectInfo	The ObjectInfo for bound objects may be empty (have a length of zero). If the bound object is a file and the ObjectInfo is not empty the first 8 bytes of the ObjectInfo shall contain the ContentSize attribute. This is optionally followed by a loop of descriptors. The descriptors defined for possible use in this location are: Content type descriptor	The present document

Table B.20: BIOP::DirectoryMessage syntax

Syntax	bits	Type	Value	Comment
BIOP::DirectoryMessage() {				
magic	4 x 8	uimsbf	0x42494F50	"BIOP"
biop_version.major	8	uimsbf	0x01	BIOP major version 1
biop_version.minor	8	uimsbf	0x00	BIOP minor version 0
byte_order	8	uimsbf	0x00	big endian byte ordering
message_type	8	uimsbf	0x00	
message_size	32	uimsbf	*	
objectKey_length	8	uimsbf	N1	1 to 4
for (i=0; i<N1; i++) {				
objectKey_data	8	uimsbf	+	
}				
objectKind_length	32	uimsbf	0x00000004	
objectKind_data	4 x 8	uimsbf	0x64697200	"dir" type_id alias
objectInfo_length	16	uimsbf	N2 = 0 (note)	objectInfo
for (i=0; i<N2; i++) {				
objectInfo_data	8	uimsbf	+	
}				
serviceContextList_count	8	uimsbf	N3	serviceContextList
for (i=0; i<N3; i++) {				
context_id	32	uimsbf		
context_data_length	16	uimsbf	N4	
for (j=0; j<N4; j++) {				
context_data_byte	8	uimsbf	+	
}				
}				

Syntax	bits	Type	Value	Comment
messageBody_length	32	uimsbf	*	
bindings_count	16	uimsbf	N5	
for (i=0; i<N5; i++) {				Binding
BIOP::Name() {				
nameComponents_count	8	uimsbf	N6 = 1	See Table B.16.
for (i=0; i<N6; i++) {				
id_length	8	uimsbf	N7	NameComponent id
for (j=0; j<N7; j++) {				
id_data	8	uimsbf	+	The "/" character shall not be used.
}				
kind_length	8	uimsbf	N8	NameComponent kind
for (j=0; j<N8; j++) {				
kind_data	8	uimsbf	+	as type_id (see Table 4-4 in TR 101 202 [i.5])
}				
}				
}				
BindingType	8	uimsbf	+	0x01 for nobject 0x02 for ncontext
IOP::IOR()			+	objectRef see table B.22 "IOP::IOR syntax" on page 486
objectInfo_length	16	uimsbf	N9	
if(kind_data == "fil"){				
DSM::File::ContentSize	64	uimsbf	+	0 means that file size is not signalled
for (j=0; j<N9 - 8; j++) {				
descriptor_byte	8	uimsbf	+	
}				
}				
else {				
for (j=0; j<N9; j++) {				
descriptor_byte	8	uimsbf	+	
}				
}				
}				
}				
NOTE: See item 2 under 11.3.2.2 "Directory Message Format" in DSM-CC "the objectInfo field shall be empty".				

B.2.3.6 BIOP ServiceGateway message

The syntax of the BIOP ServiceGateway message is identical to that of the BIOP DirectoryMessage (described above) with the following exceptions:

- The object kind is "srg" rather than "dir".
- Use is made of the service context list.

B.2.3.7 BIOP Interoperable Object References

The Interoperable Object References (IOR) are references to objects and contain the necessary information to locate the object. The IOR structure may contain different options to be able to point to objects that can be reached via different types of connections. For the present document, the use of IORs is limited to references to objects carried in broadcast object carousels. For object carousels, there are two types of object references: one to be used to reference objects carried in the same object carousel and one to be used to reference objects in other object carousels.

Table B.21: Restrictions on the BIOP IOR

Field	Restrictions	Source
IOP::IOR::type_id	Contains the objectKind of the referenced object. A short three-letter aliases shall be used, plus a null-terminator.	The present document
IOP::IOR:: taggedProfileList	There shall be at least 1 taggedProfile included in an IOR. For objects carried in a broadcast object carousel, the first taggedProfile shall be either a TAG_BIOP profile or a TAG_LITE_OPTIONS. If the first tagged profile is some other profile, the object is not carried in a broadcast object carousel and the MHP terminal may ignore the object subject to its own capabilities.	The present document

Table B.22: IOP::IOR syntax

Syntax	bits	Type	Value	Comment
IOP::IOR {				
type_id_length	32	uimsbf	N1	
for (i=0; i<N1; i++) {				
type_id_byte	8	uimsbf	+	Short alias type_id (e.g. "dir")
}				
taggedProfiles_count	32	uimsbf	N2	Profile bodies
IOP::taggedProfile()				For objects in broadcast carousels: either BIOPProfileBody or LiteOptionsProfileBody.
for (n=0; n<N2 - 1;n++) {				MHP terminal may ignore other profiles (2...N1) if present
IOP::taggedProfile()				
}				
}				

B.2.3.7.1 BIOPProfileBody

The BiopProfileBody is used for references to objects within the same object carousel.

Table B.23: Restrictions on the BIOP Profile Body

Field	Restrictions	Source
BiopProfileBody::byte_ order	0 (indicating big-endian byte order)	DVB
BiopProfileBody:: LiteComponent	The list shall contain exactly 1 BiopObjectLocation and exactly 1 DSM:: ConnBinder as the first two components in that order. The MHP terminal may ignore possible other components in the list.	The present document
DSM::ConnBinder	For objects carried in the broadcast object carousel, the first Tap shall be of type BIOP_DELIVERY_PARA_USE. If there is another type of tap in the first position, the MHP terminal may ignore this object reference, as it is a reference for object accessed using another type of protocol (e.g. for return channel use). The MHP terminal may ignore possible other taps in the list.	The present document
DSM::Tap	In the BIOP_DELIVERY_PARA_USE tap, the id field is not used and may be ignored by the MHP terminal.	The present document
DSM::Tap::timeout	This field is defined in units of µs. An appropriate value must be explicitly encoded by carousel generation equipment. There is no default value that may be encoded, i.e. 0xFFFFFFFF has no special meaning. Receivers shall not employ an in-built default instead of the signalled value, as there is no way to define these without knowledge of the construction of a particular carousel.	The present document

Table B.24: BIOP Profile Body syntax

Syntax	bits	Type	Value	Comment
BIOPProfileBody {				
profileId_tag	32	uimsbf	0x49534F06	TAG_BIOP (BIOP Profile Body)
profile_data_length	32	uimsbf	*	
profile_data_byte_order	8	uimsbf	0x00	big endian byte order
lite_component_count	8	uimsbf	N1	
BIOP::ObjectLocation {				
componentId_tag	32	uimsbf	0x49534F50	TAG_ObjectLocation
component_data_length	8	uimsbf	*	
carouselId	32	uimsbf	+	
moduleId	16	uimsbf	+	
version.major	8	uimsbf	0x01	BIOP protocol major version 1
version.minor	8	uimsbf	0x00	BIOP protocol minor version 0
objectKey_length	8	uimsbf	N2	1 to 4
for (k=0; k<N2; k++) {				
objectKey_data	8	uimsbf	+	
}				
}				
DSM::ConnBinder {				
componentId_tag	32	uimsbf	0x49534F40	TAG_ConnBinder
component_data_length	8	uimsbf	N4	
taps_count	8	uimsbf	N3	
DSM::Tap {				
id	16	uimsbf	0x0000	user private

Syntax	bits	Type	Value	Comment
use	16	uimsbf	0x0016	If BIOP_DELIVERY_PARA_USE is provided it shall be the first tap. If there is another type of tap in the first position, the MHP terminal may ignore this object reference, as it is a reference for an object accessed using another type of protocol (e.g. for return channel use).
assocTag	16	uimsbf	+	
selector_length	8	uimsbf	0x0A	
selector_type	16	uimsbf	0x0001	
transactionId	32	uimsbf	*	
timeout	32	uimsbf	*	
}				
for (n=0; n<N4 - 18; n++) {				The MHP terminal may skip over the possible additional taps
additional_tap_byte	8	uimsbf		
}				
}				
for (n=0;n<N6;n++) {				N6=N1 - 2
BIOP::LiteComponent{				
componentId_tag	32	uimsbf	+	
component_data_length	8	uimsbf	N7	
for (i=0; i<N7; i++) {				
component_data_byte	8	uimsbf		
}				
}				
}				
}				

B.2.3.7.2 LiteOptionsProfileBody

The LiteOptionsProfileBody is used for making links to objects carried in other object carousels.The LiteOptionsProfileBody can be used to make references to objects carried in other carousels within the same Transport Streams or in other Transport Streams. The following constraints are put on the use of the LiteOptionsProfileBody;

- LiteOptionsProfileBody references shall never be used in an IOR which is in the DSI referencing the service gateway.
- The target carousel is never mounted automatically by the implementation, but the application may do so using the MHP DSMCC API and where necessary, the tuning API.
- When the LiteOptionsProfileBody is encountered the application will get a ServiceXFRErrorEvent or a ServiceXFRException unless the object carousel which is the target of the lite options profile body reference is already mounted by the MHP terminal. In this latter case, the access to the object shall succeed unless the object is unavailable, e.g. the target file does not exist in the target carousel or the target carousel has lost its connection.

Table B.25: Restrictions on the Lite Options Profile Body (Sheet 1 of 2)

Field	Restrictions	Source
LiteOptionsProfileBody:: profile_data_byte_order	0 (indicating big-endian byte order)	DVB
LiteOptionsProfileBody:: LiteOptionComponents	The list shall contain a ServiceLocation component as the first component. The MHP terminal may ignore possible other components in the list.	The present document

Table B.25: Restrictions on the Lite Options Profile Body (Sheet 2 of 2)

Field	Restrictions	Source
DSM::ServiceLocation	For objects carried in the broadcast object carousel, the service domain NSAP address shall follow the Carousel NSAP address format.	The present document
DSM::ServiceLocation::InitialContext	The MHP terminal may ignore the initial context	The present document

Table B.26: Syntax of Lite Options Profile Body with ServiceLocation component.

Syntax	bits	Type	Value	Comment
LiteOptionsProfileBody {				
profileId_tag	32	uimsbf	0x49534F05	TAG_LITE_OPTIONS (Lite Options Profile Body)
profile_data_length	32	uimsbf	*	
profile_data_byte_order	8	uimsbf	0x00	big endian byte order
lite_component_count	8	uimsbf	N1	
DSM::ServiceLocation {				
componentId_tag	32	uimsbf	0x49534F46	TAG_ServiceLocation
component_data_length	8	uimsbf	*	
serviceDomain_length	8	uimsbf	0x14	Length of carousel NSAP address
serviceDomain_data()	160	uimsbf	+	Table B.27 "DVB Carousel NSAP Address" on page 490
CosNaming::Name() {				pathName
nameComponents_count	32	uimsbf	N2	
for (i=0; i<N2; i++) {				
id_length	32	uimsbf	N3	NameComponent id
for (j=0; j<N3 j++) {				
id_data	8	uimsbf	+	
}				
kind_length	32	uimsbf	N4	NameComponent kind
for (j=0; j<N4 j++) {				
kind_data	8	uimsbf	+	as type_id (see Table 4-4 in TR 101 202 [i.5])
}				
}				
}				
initialContext_length	32	uimsbf	N5	
for (n=0; n<N5 n++) {				
InitialContext_data_byte	8	uimsbf		
}				
}				
for (n=0;n<N6;n++) {				N6=N1-1
BIOP::LiteComponent{				
componentId_tag	32	uimsbf	+	
component_data_length	8	uimsbf	N7	
for (i=0; i<N7; i++) {				
component_data_byte	8	uimsbf		
}				
}				
}				
}				

Table B.27: DVB Carousel NSAP Address

Syntax	bits	Type	Value	Comment
DVBcarouselNSAPaddress {				
AFI	8	uimsbf	0x00	NSAP for private use
Type	8	uimsbf	0x00	Object carousel NSAP Address.
carouselId	32	uimsbf	+	To resolve this reference a carousel_identifier_descriptor with the same carousel_id as indicated in this field must be present in the PMT signalling for the service identified below.
specifierType	8	uimsbf	0x01	IEEE OUI
specifierData { IEEE OUI }	24	uimsbf	0x00015A	Constant for DVB OUI
dvb_service_location () {				
transport_stream_id	16	uimsbf	+	This may be set to 0x0000 which indicates that the MHP terminal shall not use the transport_stream_id when locating the service. For any other value then this field shall be used.
original_network_id	16	uimsbf	+	
service_id	16	uimsbf	+	(= MPEG-2 program_number)
reserved	32	bslbf	0xFFFFFFFF	
}				
}				

B.2.3.8 BIOP StreamMessage

Table B.28: Restrictions on the BIOP Stream Message

Field	Restrictions	Source
MessageSubHeader:: ObjectInfo	The ObjectInfo field contains the DSM::Stream::Info_T structure and optionally other data after the Stream Info structure. MHP terminals may ignore the aDescription_bytes in the DSM::Stream::Info_T structure and the possible other object info data following the structure. Broadcasts may set the duration field to zero to indicate undefined duration.	The present document
MessageSubHeader:: ServiceContextList	The MHP terminal may skip the possible serviceContextList structures.	The present document
MessageSubHeader:: MessageBody	The MessageBody carries a sequence of taps. There shall be at most one tap of use BIOP_PROGRAM_USE. This tap identifies the service that provides the media stream associated with the Stream object (via a deferred_association_tags_descriptor in the PMT). The tap may only reference programs that are broadcast on the same multiplex (i.e. MHP terminals shall not need to tune to a different multiplex in order to receive the referenced media stream). There shall also be at most one tap with use STR_NPT_USE or STR_ DVBTIMEL_USE indicating a timebase to be associated with the Stream object. Taps with use STR_NPT_USE shall be interpreted as described in ISO/IEC 13818-6 [26]. Taps with use STR_DVBTIMEL_USE shall be interpreted according to clause B.2.3.10. MHP terminals may ignore possible other Taps (such as BIOP_ES_USE).	The present document

Table B.29: BIOP::StreamMessage syntax

Syntax	bits	Type	Value	Comment
BIOP::StreamMessage() {				
magic	4 x 8	uimsbf	0x42494F50	"BIOP"
biop_version.major	8	uimsbf	0x01	BIOP major version 1
biop_version.minor	8	uimsbf	0x00	BIOP minor version 0
byte_order	8	uimsbf	0x00	big endian byte ordering
message_type	8	uimsbf	0x00	
message_size	32	uimsbf	*	
objectKey_length	8	uimsbf	N1	1 to 4
for (i=0; i<N1; i++) {				
objectKey_data	8	uimsbf	+	
}				
objectKind_length	32	uimsbf	0x00000004	
objectKind_data	8	uimsbf	0x73747200	"str" type_id alias
objectInfo_length	16	uimsbf	N2	
DSM::Stream::Info_T {		uimsbf		objectInfo
aDescription_length	8	uimsbf	N3	aDescription
for (i=0; i<N3; i++) {				
aDescription_bytes	8	uimsbf	+	
}				
duration.aSeconds	32	simsbf	+	may be set to 0 to indicate undefined
duration.aMicroSeconds	32	uimsbf	+	may be set to 0 to indicate undefined
audio	8	uimsbf	+	Flag: 0x00 = false, non-zero = true.
video	8	uimsbf	+	Flag: 0x00 = false, non-zero = true.
data	8	uimsbf	+	Flag: 0x00 = false, non-zero = true.

Syntax	bits	Type	Value	Comment
}				
for (i=0; i<N2-(N3+10); i++) {				
objectInfo_byte	8	uimsbf	+	
}				
serviceContextList_count	8	uimsbf	N4	serviceContextList
for (i=0; i<N4; i++) {				
context_id	32	uimsbf		
context_data_length	16	uimsbf	N5	
for (j=0; j<N5; j++) {				
context_data_byte	8	uimsbf	+	
}				
}				
messageBody_length	32	uimsbf	*	
taps_count	8	uimsbf	N6	
for (i=0; i<N6; i++) {				
id	16	uimsbf	(note)	see clause B.2.4.4
use	16	uimsbf	+	see clause B.2.3.10 and Table 4-12 in DVB Guidelines for Data Broadcasting
assocTag	16	uimsbf	+	
selector_length	8	uimsbf	0x00	no selector
}				
}				

NOTE: If the tap use is STR_NPT_USE then the value of this 16 bit integer corresponds to the value of the contentId field of the NPTReferenceDescriptor that defines the time base for this stream. If the tap use is STR_DVBTIMEL_USE then the value of this 16 bit integer corresponds to the value of the broadcast_ timeline_id field of the DVB Timeline that defines the timebase for this stream. For other values of tap use the value of this field is undefined.

B.2.3.9 BIOP StreamEventMessage

Table B.30: Restrictions on the BIOP StreamEvent Message

Field	Restrictions	Source
MessageSubHeader:: ObjectInfo	The ObjectInfo field contains the DSM::Stream::Info_T and DSM::Stream:: EventList_T structures followed optionally by other object info data (which may be ignored by MHP terminals). See table B.28 "Restrictions on the BIOP Stream Message" on page 491 regarding the DSM::Stream::Info_T. MHP terminals may ignore the possible other data following the DSM::Stream::EventList_T. The EventList_T defines a sequence of event names that correlates to the sequence of event ids in the MessageBody. eventNames_count shall equal eventIds_count.	The present document
MessageSubHeader:: ServiceContextList	The MHP terminal may skip the possible serviceContextList structures.	The present document
MessageSubHeader:: MessageBody	The MessageBody carries a sequence of taps followed by a sequence of event ids. The sequence of taps follows the following rules: • There shall be at most one tap of use BIOP_PROGRAM_USE. This tap identifies the service that provides the media stream associated with the Stream object (via a deferred_association_tags_descriptor in the PMT). The tap may only reference programs that are broadcast on the same multiplex (i.e. MHP terminals shall not need to tune to a different multiplex in order to receive the referenced media stream). • There shall be at most one tap with use STR_NPT_USE or STR_ DVBTIMEL_USE indicating a timebase to be associated with the StreamEvent object. Taps with use STR_NPT_USE shall be interpreted as described in ISO/IEC 13818-6 [26]. Taps with use STR_DVBTIMEL_USE shall be interpreted according to clause B.2.3.10. • There shall be at most one tap with use STR_EVENT_USE STR_ STATUS_AND_EVENT_USE or STR_DVBEVENT_USE. This tap indicates the PID where event data relating to the StreamEvent object is broadcast. MHP terminals may ignore possible other taps (such as BIOP_ES_USE).	The present document

Table B.31: BIOP::StreamEventMessage syntax

Syntax	bits	Type	Value	Comment
BIOP::StreamEventMessage() {				
magic	4 x 8	uimsbf	0x42494F50	"BIOP"
biop_version.major	8	uimsbf	0x01	BIOP major version 1
biop_version.minor	8	uimsbf	0x00	BIOP minor version 0
byte_order	8	uimsbf	0x00	big endian byte ordering
message_type	8	uimsbf	0x00	
message_size	32	uimsbf	*	
objectKey_length	8	uimsbf	N1	
for (i=0; i<N1; i++) {				
objectKey_data	8	uimsbf	+	
}				
objectKind_length	32	uimsbf	0x00000004	
objectKind_data	4 x 8	uimsbf	0x73746500	"ste" type_id alias
objectInfo_length	16	uimsbf	N2	
DSM::Stream::Info_T {		uimsbf		
aDescription_length	8	uimsbf	N3	aDescription
for (i=0; i<N3; i++) {				
aDescription_bytes	8	uimsbf	+	see BIOP StreamMessage
}				
duration.aSeconds	32	simsbf	+	see BIOP StreamMessage
duration.aMicroSeconds	32	uimsbf	+	see BIOP StreamMessage

Syntax	bits	Type	Value	Comment
audio	8	uimsbf	+	see BIOP StreamMessage
video	8	uimsbf	+	see BIOP StreamMessage
data	8	uimsbf	+	see BIOP StreamMessage
}				
DSM::Event::EventList_T {				
eventNames_count	16	uimsbf	N4	
for (i=0; i<N4; i++) {				
eventName_length	8	uimsbf	N5	
for (j=0; j<N5; j++) {				
eventName_data	8	uimsbf	+	(including zero terminator)
}				
}				
}				
for (i=0; i<N2 - (N3 + 14 + N4 + sum(N5)); i++) {				
objectInfo_byte	8	uimsbf	+	
}				
serviceContextList_count	8	uimsbf	N6	
for (i=0; i<N6; i++) {				
context_id	32	uimsbf		
context_data_length	16	uimsbf	N7	
for (j=0; j<N7; j++) {				
context_data_byte	8	uimsbf	+	
}				
}				
messageBody_length	32	uimsbf	*	
taps_count	8	uimsbf	N8	
for (i=0; i<N8; i++) {				
id	16	uimsbf	(note)	see B.2.4.4
use	16	uimsbf	+	see clause B.2.3.10 and Table 4-12 in DVB Guidelines for Data Broadcasting
assocTag	16	uimsbf	+	
selector_length	8	uimsbf	0x00	no selector
}				
eventIds_count	8	uimsbf	N4	(= eventNames_count)
for (i=0; i<N4; i++) {				
eventId	16	uimsbf	+	
}				
}				

NOTE: If the tap use is STR_NPT_USE then the value of this 16-bit integer corresponds to the value of the contentId field of the NPTReferenceDescriptor that defines the time base for this stream. If the tap use is STR_DVBTIMEL_USE, the value of this 16-bit integer corresponds to the value of the broadcast_timeline_id field of the DVB Timeline that defines the timebase for this stream. If the tap use is STR_DVBEVENT_USE, the value of this 16-bit integer field corresponds to the value of the synchronised_event_context of all events relevant to this stream. For other values of tap use the value of this field is undefined.

B.2.3.10 Additional tapUse values

Two additional tapUse values are defined for use in referencing DVB synchronised auxiliary data EN 3XX XXX [119] from an Object Carousel as shown in table B.32.

Table B.32: tapUse values for referencing DVB synchronised auxiliary data

tapUse	Value
STR_DVBTIMEL_USE	0x8000
STR_DVBEVENT_USE	0x8001

The semantics of the fields of a Tap pointing to a DVB broadcast_timeline_descriptor are described below:

- The use field indicates the use of the Tap. The value of this field shall be STR_DVBTIMEL_USE.
- The value of the id field shall specify the broadcast_timeline_id of the timeline to be referenced.
- The assocTag identifies the connection on which the broadcast_timeline_descriptor is broadcast.
- The selector field shall be empty.

The semantics of the fields of a Tap pointing to a DVB synchronised_event_descriptor are described below:

- The use field indicates the use of the Tap. The value of this field shall be STR_DVBEVENT_USE.
- The value of the id field shall specify the synchronised_event_context of the events to be referenced.
- The assocTag identifies the connection on which the synchronised_event_descriptors are broadcast.
- The selector field shall be empty.

B.2.4 Broadcast timebases and events

MHP terminals are required to support two mechanisms for broadcast timebase delivery: DSM-CC NPT and DVB Timeline.

MHP terminals are also required to support broadcast events as follows:

- DSM-CC scheduled stream events. These are defined with reference to a broadcast timebase defined using either DSM-CC NPT or the DVB Timeline mechanism.
- DSM-CC "do it now" stream events. These are stand-alone events that are independent of a broadcast timebase.
- DVB synchronised events. These are stand-alone events that are independent of a broadcast timebase but which can provide much greater temporal accuracy than DSM-CC "do it now" events.

The BIOP StreamMessage and StreamEventMessage are used within a DSM-CC object carousel to reference timebases and to define events. A BIOP StreamMessage can only be used to reference a broadcast timebase. A BIOP StreamEventMessage can be used to define broadcast events with or without reference to a broadcast timebase.

NOTE: The NPT mechanism and scheduled stream events that depend on it are known to be vulnerable to disruption in many digital TV distribution networks. Existing deployed network equipment that re-generates the STC is unlikely to be aware of NPT and hence will not make the necessary corresponding modification to STC values inside NPT reference descriptors. This may cause stream events scheduled against NPT to fire at the wrong time or to never fire at all. Applications should only use scheduled stream events with NPT when they are confident that the network where they are to be used does not have this problem. DVB Timeline, DSM-CC "do it now" events and events carried within DVB synchronised auxiliary data offer more reliable alternatives to NPT.

B.2.4.1 Stream and StreamEvent messages

B.2.4.1.1 Association with time bases

The id field of the STR_NPT_USE or STR_DVBTIMEL_USE tap of a StreamMessage or StreamEventMessage identifies the timebase associated with that Stream/StreamEvent object. Multiple StreamMessage or StreamEventMessage may be used at the same time to allow subscriptions to multiple timebases of the same service. See clause B.2.4.4 "Broadcast timebases" on page 499.

B.2.4.1.2 Event names and event ids

In StreamEventMessages the EventList_T defines a sequence of event names that correlates 1:1 to the sequence of event ids in the MessageBody. Within each BIOP::StreamEventMessage the event names uniquely associate to event id values.

- The eventNames_count shall equal eventIds_count.
- The names in the EventList_T are zero-terminated strings.
- The eventID values in the StreamEventMessage correspond to the eventID values carried in StreamEventDescriptors or the synchronised_event_id values in DVB synchronised_event descriptors.

B.2.4.1.3 Stream event life time

In StreamEventMessages the set of events described in the BIOP::StreamEvent message is possibly a subset of the events that may be used by the application during the course of a programme. Therefore, applications may need to accommodate the dynamic change of such messages. Cache transparency (see clause B.5.2.1 "Transparent caching" on page 510) and version listener mechanisms (see DSMCCObject methods in annex P "(normative): Broadcast Transport Protocol Access" on page 746) provide applications with the means to do this.

Similarly the set of stream event descriptors being transmitted at any time may not correspond to the set of events described in the BIOP::StreamEventMessage.

The event id for an event name shall not change while the name exists. If a name is removed it shall not be reintroduced within 60 seconds.

B.2.4.2 Stream Descriptors

B.2.4.2.1 NPT Reference descriptor

B.2.4.2.1.1 Syntax

MHP terminals shall interpret this descriptor as it is described in ISO/IEC 13818-6 [26] with the following clarifications and additions.

With regard to contentId:

- This 7 bit field identifies the "timebase" see clause B.2.4.4 "Broadcast timebases" on page 499.

With regard to scaleNumerator and scaleDenominator:

- 1/1 - means normal play.

  i.e. NPT and STC advance at the same rate.

- 0/m (m > 0) - means the NPT value does not advance.

  As a consequence no scheduled stream events will be raised. However, the "do it now" events continue to be effective.

- 0/0 - means that the scaleNumerator and scaleDenominator fields are not defined in the NPT Reference descriptor and should be derived as described in ISO/IEC 13818-6 [26] "8.1.2 Reconstruction of NPT".

  MHP terminals are not required to support this mode of operation.

- m/0 (m > 0) - this is not allowed by ISO/IEC 13818-6 [26].

With regard to broadcast repetition rate:

- NPT Reference descriptors shall be transmitted at least once per second.

With regard to postDiscontinuity indicator:

- It is optional for broadcasters to broadcast descriptors with this set to one however if they are broadcast then the following conditions shall be met:

  • It shall be broadcast for at least 5 seconds before the underlying PCR discontinuity.

  • The descriptors with both states of postDiscontinuity indicator shall be carried within the same DSMCC descriptor list section.

  • Within one second of the underlying PCR discontinuity, the NPTReferenceDescriptor must be updated to reflect the new underlying PCR. See `org.dvb.dsmcc.NPTDiscontinuityEvent` in annex P "(normative): Broadcast Transport Protocol Access" on page 746.

- It is optional for MHP terminals to take advantage of this signalling but terminals which do not take advantage of this must ignore descriptors with postDiscontinuity indicator set to 1.

B.2.4.2.2 Stream event descriptor

B.2.4.2.2.1 Association of event ids to event time

Where the timebase for a scheduled stream event is provided by NPT, the eventNPT field conveys the NPT value at which the event will occur (or has occurred). Where the timebase for an event is provided by DVB Timeline, the eventNPT field conveys the tick value at which the event will occur (or has occurred) and shall be interpreted in units of the tick_rate used to define the DVB Timeline.

Each StreamEventDescriptor provides a single association between an eventID and an eventNPT. If the MHP terminal detects a change in the eventNPT associated with a value of eventID this redefines the time at which the event should fire.

MHP terminals shall ignore scheduled events where the eventNPT has passed.

See also clauses B.2.4.2.4.1 "number range for NPT" on page 498 and B.2.4.2.2.3 "Signalling of "do it now events"" on page 497.

B.2.4.2.2.2 Re-use of event ids

Event ID values may be re-used any number of times. For example, after an event has fired then stream event descriptors with the same eventID but different eventNPT may be broadcast.

B.2.4.2.2.3 Signalling of "do it now events"

ISO/IEC 13818-6 [26] is silent on the broadcast signalling of "do it now" events.

These events shall be identified by the value of eventID and hence table id extension (see clause B.2.4.3.5 "Encoding of table id extension" on page 498).

Where the value of eventID identifies a "do it now" event then the value of eventNPT shall be ignored by the MHP terminal.

B.2.4.2.2.4 Private data

The contents of the privateDataByte field do not need to be interpreted by the MHP terminal. However, the application can access the privateDataByte field using the `org.dvb.dsmcc.StreamEvent.getEventData` method.

B.2.4.2.3 Unused descriptors

MHP terminals may ignore the following descriptors if present:

- NPT Endpoint descriptor.
- Stream Mode descriptor.

B.2.4.2.4 Clarification of number encoding

B.2.4.2.4.1 number range for NPT

There is some ambiguity in ISO/IEC 13818-6 [26] regarding the data type used to carry NPT values in the signalling (tcimsbf or uimsbf). The following requirements insulate this profile from this ambiguity:

- The range of values used shall be in the range 0 to 0x0FFFFFFF (which is unambiguous for both tcimsbf or uimsbf).

B.2.4.2.4.2 number range for scaleDenominator

There is some ambiguity in ISO/IEC 13818-6 [26] regarding the data type used to carry `scaleDenominator` values in the signalling (tcimsbf or uimsbf). The following requirements insulate this profile from this ambiguity:

- The range of values used shall be in the range 0 to 0x7FFF (which is unambiguous for both tcimsbf or uimsbf).

B.2.4.3 DSM-CC Sections carrying Stream Descriptors

B.2.4.3.1 Section version number

The section version number field increments to reflect changes in stream descriptor(s) carried by sections with the same value of table_id (0x3D) and table_id_extension.

The version number shall increment for reasons including the change in value of eventNPT for a given eventId.

B.2.4.3.2 Single firing of "do it now" events

MHP terminals shall respond to the first instance of a "do it now" event detected under a particular combination of table id, table id extension and version number. Reception of subsequent copies of the particular event shall be ignored until a different version number is detected.

B.2.4.3.3 Section number

For the present document MHP terminals shall only consider section number zero.

B.2.4.3.4 DSM-CC sections for DSMCC_descriptor_list()

If the `table_id` field equals 0x3D the `current_next_indicator` bit shall be set to "1".

B.2.4.3.5 Encoding of table id extension

The section's table id extension field provides information on the stream descriptor(s) carried by the section:

Table B.33: Encoding of table id extension for DSMCC_descriptor_lists

table_id_extension bits			Payload of DSM-CC section with table ID 0x3D
[15]	[14]	[13 to 0]	
0	0	eventID[13 to 0]	Section carries a single "do it now" event
0	1	xx xxxx xxxx xxxx	Section carries NPT reference descriptors
1	0	xx xxxx xxxx xxxx	Section carries one or more other stream descriptors. I.e - Stream event descriptor(s) with a future eventNPTs - Stream mode descriptor (can be ignored in the present document) - NPT endpoint descriptor (can be ignored in the present document)
1	1	reserved for future use	

The value of eventID for "do it now" events shall be in the range 0x0001 to 0x3FFF. The value of eventID for scheduled events shall be in the range 0x8000 to 0xBFFF. The value 0 is not allowed (see 5.5.2.2.1 in ISO/IEC 13818-6 [26]).

B.2.4.4 Broadcast timebases

Multiple concurrent timebases may be defined for a single MPEG program but only a single time base is allowed to progress at any instant (the other timebases shall be paused). Timebases can be provided by two means: DSM-CC NPT and DVB Timeline.

B.2.4.4.1 DSM-CC NPT

The relationship between each NPT timeline and the MPEG timebase (STC) is defined by an NPTReferenceDescriptor. The contentId field of the NPTReferenceDescriptor (a 7-bit unsigned integer) identifies the timebase.

The value of the id field of the STR_NPT_USE tap (a 16 bit unsigned integer) of a StreamMessage or StreamEventMessage identifies the timebase associated with that Stream/StreamEvent object. Multiple StreamMessage or StreamEventMessage may be used at the same time to allow subscriptions to multiple timebases of the same service.

In this profile NPTReferenceDescriptors can indicate two states:

- Non-paused. The scaleNumerator and scaleDenominator are both non-zero.
- Paused. The scaleNumerator is zero and the scaleDenominator is non-zero.

When a timebase is signalled as paused then the NPT value for that timebase is frozen at NPT_Reference (as specified by equation 8-4 in DSM-CC).

All of the NPTReferenceDescriptors for all of the currently signalled timebases shall be carried in a single DSMCC_ descriptor_list section and shall be transmitted at least once every second. In any such set of NPTReferenceDescriptors at most one shall be non-paused and there shall be at most one instance of each value of contentId. The set of signalled timebases can change through time. When a timebase is not signalled then the behaviour of the MHP terminal shall be identical to that of the timebase being paused.

Timebases can be added or subtracted from the current set. The set of current timebases can be empty.

A value of contentId shall not be reused for a new timebase within 60 seconds of the removal of the timebase.

In normal use the NPT of a non-paused timebase progresses at a constant rate. Discontinuities should either be the results of errors in the broadcast or transient conditions (for example, while an NPT reference generator catches up with an MPEG PCR discontinuity). Transient discontinuities should be tolerated by the MHP Terminal. The behaviour of the MHP terminal when subject to a permanent discontinuity is not specified, apart from the generation of the NPTDiscontinuityEvent to registered listeners.

The broadcaster shall start generating corrected NPTReferenceDescriptors within at most 1 second of a PCR discontinuity (ideally the descriptors should be generated before the PCR discontinuity). If the receiver is sampling the NPTReferenceDescriptor at the lowest allowed rate (once every 5 seconds) then the receiver may not receive a correct NPTReferenceDescriptor for 5 seconds. During this period the receiver should linearly extrapolate the NPT from previous NPT values in the expectation that a corrected NPTReferenceDescriptor will be delivered shortly. See also clause B.2.4.2.1.1 "Syntax" on page 496 on use of the postDiscontinuity.

There is a window of uncertainty around a segment of paused timebase due to the time taken for all receivers to acquire the new NPTReferenceDescriptor. During this window scheduled events cannot be used reliably.

NOTE: It is suggested that broadcasters use "do it now" events near junctions between different timebases.

B.2.4.4.2 DVB Timeline

The relationship between each DVB Timeline and the MPEG timebase (STC) is defined using the broadcast_timeline_ descriptor carried in DVB Synchronised Auxiliary Data EN 3XX XXX [119]. The broadcast_timeline_id field of the broadcast_timeline_descriptor (an 8-bit unsigned integer) identifies the timebase.

The value of the id field of the STR_DVBTIMEL_USE tap (a 16-bit unsigned integer) of a StreamMessage or StreamEventMessage identifies the timebase associated with that Stream/StreamEvent object. Multiple StreamMessages or StreamEventMessages may be used at the same time to allow subscriptions to multiple timebases of the same service.

In this profile, broadcast_timeline_descriptors can indicate two states:

- Non-paused. The running_status field set to "Running".
- Paused. The running_status field set to "Paused".

The DVB Timeline referenced may be defined using either the direct or offset encoding method specified in EN 3XX XXX [119].

Descriptors other than the broadcast_timeline_descriptor may be present within the Synchronised Auxiliary Data stream. MHP terminals shall skip descriptors which they do not support and continue processing the next descriptor. Not supported descriptors include those defined but not supported (e.g. the TVA_id descriptor in devices not required to support that descriptor by another specification) and descriptors whose tag value is either reserved or user private. See also clause B.2.4.5.3.

The Synchronised Auxiliary Data specification EN 3XX XXX [119] describes the management of DVB Timeline discontinuities.

MHP terminals shall comply with the recommendations for receivers in clause D.5 of EN 3XX XXX [119] including those defined by "should" in that clause. MHP terminals shall not fire events synchronised to a DVB Timeline in circumstances where the state of the timeline is unknown or where the timeline has been removed from the PMT of the service in which it is carried.

B.2.4.5 Broadcast events

B.2.4.5.1 DSM-CC "do it now" stream events

MHP terminals shall support DSM-CC "do it now" stream events as defined in clause B.2.4.2.2. This provides a means for delivering stand-alone events without the need for a broadcast timebase.

As these events are delivered in the payload of an MPEG Section, they cannot be accurately synchronised with linear media streams.

B.2.4.5.2 DSM-CC scheduled stream events

MHP terminals shall support DSM-CC scheduled stream events as defined in clause B.2.4.2.2. These are defined with reference to a broadcast timebase defined using either DSM-CC NPT or the DVB Timeline mechanism.

For DSM-CC scheduled stream events, the following usage scenarios are envisaged:

- A single continuous timebase (i.e. a single progressing value of time) can be used. In this case, the broadcast is logically a single continuing interactive production, and the broadcaster is responsible for pre-processing the applications, etc. before broadcast to ensure that they are suitable.
- The signal received by the MHP terminal can include a unique timebase for each programme needing one. This timebase could be suspended during any insertion into a programme and discontinued at the end of the programme.

B.2.4.5.3 DVB synchronised events

MHP terminals shall support DVB synchronised events as defined by EN 3XX XXX [119]. This mechanism allows for the accurate generation of events without the need for a timebase.

DVB synchronised events are defined using the synchronised_event_descriptor.

The synchronised_event_context field of this descriptor identifies the application-specific context for a set of events and is referenced using the id field of the STR_DVBEVENT_USE tap of a DSM-CC StreamEventMessage.

The contents of the synchronised_event_data_byte field does not need to be interpreted by the MHP terminal. However, the application can access the synchronised_event_data_byte field using the org.dvb.dsmcc.StreamEvent.getEventData method.

MHP terminals shall support the cancellation of DVB synchronised events that have not yet fired using the synchronised_event_cancel_descriptor.

Cancellation shall be supported for individual events and for sets of events with a common synchronised_event_context.

Descriptors other than the synchronised_event_descriptor and synchronised_event_cancel_descriptor may be present within the Synchronised Auxiliary Data stream. MHP terminals shall skip descriptors which they do not support and continue processing the next descriptor. Not supported descriptors include those defined but not supported (e.g. the TVA_id descriptor in devices not required to support that descriptor by another specification) and descriptors whose tag value is either reserved or user private. See also clause B.2.4.4.2.

DVB synchronised events have a specified presentation time, determined by the presentation timestamps of the auxiliary data structures carrying synchronised_event_descriptors and the reference_offset_ticks field of the synchronised_event_descriptors. As such, the events are synchronised to a point in time within linear media streams such as video or audio. Receivers shall deliver events to applications timed so as to retain this synchronisation with the linear media.

B.2.4.6 Monitoring broadcast timebases and events

B.2.4.6.1 Timebase reference monitoring

When applications have registered for timebase stimulated events, the MHP terminal shall allocate resources sufficient to ensure that updates to the set of timebases is detected within 5 seconds for conformant broadcasts.

B.2.4.6.2 Timebase stimulated event monitoring

When applications have registered for timebase stimulated events the MHP terminal shall allocate resources sufficient to ensure that updates to the set of timebase stimulated events is detected within 5 seconds for conformant broadcasts. So, if an event is introduced or the time at which it is specified to fire is changed then the MHP terminal will respect this change within 5 seconds. If the fire time for an event changes less than 5 seconds before it was previously scheduled to fire then there is no guarantee that all receivers will detect the change in time.

The receiver shall deactivate any event listeners dependant on a timebase (and may free resources associated with those listeners) if:

- the timebase is an NPT timebase and it is deleted (reference to it is removed from the set of `NPTReferenceDescriptors`);
- the timebase is an NPT timebase and a discontinuity is detected (i.e. `NPTDiscontinuityEvent` generated) in that timebase;
- a service selection operation changes the current service, either through the MHP API or through the service selection feature of the MHP navigator.

B.2.4.6.3 DSM-CC "do it now" stream events

"do it now" events are single shot events, accordingly MHP terminals need to make special efforts to ensure a high probability that they can be reliably received.

For each application, the MHP terminal is not required to monitor more than a single component delivering "do it now" stream events. So, if events from more than one DSM-CC StreamEventMessage are subscribed to no more than one stream component shall be specified as the source of StreamEventDescriptors carrying "do it now" events (i.e. the taps with use STR_EVENTUSE or STR_STATUS_AND_EVENT_USE shall have the same value when referring to "do it now" events).

MHP terminals shall dedicate a section filter to monitoring the possible transmission of "do it now" events while there are any applications subscribed to these events.

B.2.4.6.4 DSM-CC scheduled stream events

The stream descriptors for scheduled events are transmitted several times in the period before the time that they should fire. This allows a high probability that they will be effective even if they are not monitored continuously by the MHP terminal.

Any scheduled stream event descriptors shall be transmitted at least once each second.

MHP terminals shall raise an event in response to a scheduled stream event provided that the stream event descriptors are broadcast for at least 5 seconds before the scheduled time.

For each application, the MHP terminal is not required to monitor more than a single component delivering scheduled stream events. So, if events from more than one DSM-CC StreamEventMessage are subscribed to no more than one stream component shall be specified as the source of StreamEventDescriptors carrying scheduled events (i.e. the taps with use STR_EVENT_USE or STR_STATUS_AND_EVENT_USE shall have the same value when referring to scheduled events).

NOTE: Scheduled and "do-it-now" stream events can be carried on different stream components. The MHP terminal is required to be able to monitor one stream of each.

B.2.4.6.5 number of timebase components

The MHP terminal is only required to monitor a single timebase component. So, if events from more than one DSM-CC StreamEventMessages are subscribed, each StreamEventMessage that references a timebase shall reference the same type (NPT or DVB Timeline) and shall contain a STR_NPT_USE or STR_DVBTIMEL_USE tap specifying the same association tag.

B.2.4.6.6 DVB synchronised events

DVB synchronised events are transient events (i.e. only broadcast for a short period of time). Accordingly, MHP terminals need to make special efforts to ensure a high probability that they can be reliably received.

For each application, the MHP terminal is not required to monitor more than a single component delivering DVB synchronised events. So, if events from more than one DSM-CC StreamEventMessage are subscribed to, no more than one stream component shall be specified as the source of DVB synchronised events (i.e. the taps with use STR_ DVBEVENT_USE shall have the same value of assocTag).

MHP terminals shall dedicate a filter to monitoring the possible transmission of such events while there are any applications subscribed to them.

MHP terminals are not required to monitor DSM-CC "do it now" stream events at the same time as monitoring DVB synchronised events.

B.2.5 Assignment and use of transactionId values

B.2.5.1 Informative Background

The use of the transactionId in the object carousel is inherited from its use as defined by the DSM-CC specification, and as such it can appear somewhat complex. The transactionId has a dual role, providing both identification and versioning mechanisms for control messages, i.e. DownloadInfoIndication and DownloadServerInitiate messages. The transactionId should uniquely identify a download control message within a data carousel, however it should be "incremented" whenever any field of the message is modified.

NOTE: The term "incremented" is used in the DSM-CC specification. Within the scope of the present document this should be interpreted as "changed".

The object carousel is carried on top of one or more data carousels. By a data carousel used below the object carousel, we mean in the present document a set of DownloadInfoIndication message transmitted on a single PID and the DownloadDataBlock messages carrying the modules described in the DownloadInfoIndication messages. The DownloadDataBlock messages may be spread on other elementary streams than the DownloadInfoIndication messages. The DownloadServerInitiate message in the context of object carousels is considered to be part of the top level of the object carousel and not associated with any data carousel.

When a module is changed, the version number of the module needs to be changed. This implies that the DownloadInfoIndication message that references the module needs to be also updated. Since the DownloadInfoIndication is updated, the transactionId needs to be also changed. However, the transactionId of the DownloadInfoIndication message is used in other messages also, but the need to change the other messages should specifically be avoided and the implications of updating a module should be limited to the module itself and the DownloadInfoIndication that references the module. Therefore, additional rules on the usage of the transactionId have been specified as follows.

B.2.5.2 DVB semantics of the transactionId field

The transactionId has been split up into a number of sub-fields defined in Table B.34. This reflects the dual role of the transactionId (outlined above) and constraints imposed to reduce the effects of updating a module. However, to increase interoperability the assignment of the transactionId has been designed to be independent of the expected filtering in target MHP terminals.

Table B.34: Sub-fields of the transactionId

Bits	Value	Sub-field	Description
0	User-defined	Updated flag	This must be toggled every time the control message is updated
1 to 15	User-defined	Identification	This must and can only be all zeros for the DownloadServerInitiate message. All other control messages must have one or more non-zero bit(s).
16 to 29	User-defined	Version	This shall be incremented every time the control message is updated. The value by which it is incremented should be one.
30 to 31	Bit 30 - zero Bit 31 - non-zero	Originator	This is defined in the DSM-CC specification ISO/IEC 13818-6 [26] as 0x02 if the transactionId has been assigned by the network - in a broadcast scenario this is implicit.

Due to the role of the transactionId as a versioning mechanism, any change to a control message will cause the transactionId of that control message to be incremented. Any change to a Module will necessitate incrementing its moduleVersion field. This change must be reflected in the corresponding field in the description of the Module in the DownloadInfoIndication message(s) that describes it. Since a field in the DownloadInfoIndication message is changed its transactionId must be incremented to indicate a new version of the message. Also, any change in the DownloadServerInitiate message implies that its transactionId must also be incremented. However, when the transactionId is divided into subfields as specified above, updating a message will change only the Version part of the transactionId while the Identification part remains the same.

Since the transactionId is used also for identifying the messages when referencing the messages in other structures, it is very desirable that these referenced would not need to be updated every time the control message is update. Therefore the following rule shall be applied when locating the messages based on the references:

When locating a message based on the transactionId value used for referencing the message, only the Identification part (bits 1 to 15) shall be matched.

Using this rule, the implications of updating a module can be limited to the module itself and the DownloadInfoIndication message describing the module. Also, this implies that if an MHP terminal wants to find out if a particular module that it has retrieved earlier has changed, it needs to filter the DownloadInfoIndication message that described that module and check if it has been changed.

B.2.6 Mapping of objects to data carousel modules

The DSM-CC Object Carousels allow one or more objects to be carried in one module of the data carousel. In order to optimize the performance and memory requirements three additional requirements are specified:

- When mapping objects to modules of a data carousel, only closely related objects should be put into one module. Objects that are not closely related should not be put into the same module. If in the process of retrieving an object from the carousel an MHP terminal acquires a module containing multiple objects, it should attempt to cache these since the expectation should be that the other objects are related to the object requested and probably will be needed soon.
- The size of a module that contains multiple objects should not exceed 65 536 bytes when decompressed (i.e. when the file has been decompressed from the file transport but before the content decoding has started.). MHP terminals complying to the present document are only required to handle modules containing multiple objects where the module size when decompressed is 65 536 bytes or less. Modules containing a single file message can exceed 65 536 bytes with upper size only limited by the memory resources in the MHP terminal.
- In addition to the limitations imposed by the 65 536 byte limit, directory and service gateway messages are limited to 512 object bindings per message.

B.2.7 Compression of modules

The modules may be transmitted either in uncompressed or compressed form. If the module is transmitted in compressed form, this is signalled by including the compressed_module_descriptor in the userInfo field of the moduleInfo in the DownloadInfoIndication message.

Table B.35 shows the syntax of the compressed_module_descriptor:

Table B.35: compressed_module_descriptor

	No. of bytes	Mnemonic	Value
compressed_module_descriptor(){			
descriptor_tag	1	uimsbf	0x09
descriptor_length	1	uimsbf	
compression_method	1	uimsbf	
original_size	4	uimsbf	
}			

Presence of the compressed_module_descriptor indicates that the data in the module has the "zlib" structure as defined in RFC 1950 [76].

The MHP terminal shall support the Deflate compression algorithm as specified in RFC 1951 [77]. This is signalled by setting the least significant nibble of the compression_method to 0x8 (i.e. compression_method is xxxx1000). The MHP terminal is not required to support other compression algorithms.

B.2.8 Mounting an Object Carousel

The ServiceGateway object is the root directory of the file system delivered by an Object Carousel and must be acquired before any other object can be downloaded. This may be achieved by two compatible mechanisms. The signalling of which mechanisms are being supported by a broadcast is provided by the carousel_identifier_descriptor.

In the present document the use of the carousel_identifier_descriptor for signalling is mandatory in the second descriptor loop of a PMT (corresponding to a PID on which the DSI message for an Object Carousel is broadcast, i.e. the boot-PID). The consequence is that if a PMT second descriptor loop contains a data_broadcast_id_descriptor that provides signalling for the present document, it shall also contain a carousel_identifier_descriptor.

NOTE: A single PID shall only contain messages from a single Object Carousel and so only one carousel_identifier_descriptor shall be present in any second descriptor loop. However, a single service may contain more than one Object Carousel. Consequently, the carousel_identifier_descriptor may appear more than once in any single PMT.

The acquisition of the ServiceGateway object may be via the standard DSI-DII mechanism. This shall be supported by all broadcasts regardless of signalling in the carousel_identifier_descriptor and shall be sufficient for all MHP terminals.

See also clause 10.2 "Program Specific Information" on page 221.

A broadcast may also contain additional information in the carousel_identifier_descriptor to support the "enhanced" boot mechanism. This is signalled by setting the formatId field for this descriptor to 0x01. This additional information is an aggregation of all the fields necessary to locate the ServiceGateway, also found in the DSI and DII messages. However, in such a case the module containing the ServiceGateway object shall be broadcast on the PID identified by the data_broadcast_id_descriptor. It is optional for both broadcasts and MHP terminals to support this mechanism.

B.2.8.1 carousel_identifier_descriptor

This descriptor is MPEG defined and in the present document may be included in the second descriptor loop of a PMT.

Table B.36: Carousel identifier descriptor syntax

Syntax	bits	Type	Value
carousel_identifier_descriptor {			
descriptor_tag	8	uimsbf	0x13
descriptor_length	8	uimsbf	N1
carousel_id	32	uimsbf	
FormatID	8	uimsbf	
if(FormatID == 0x00) {			
for(i=0; i<N1 - 5; i++){			
private_data_byte	8		
}			
}			
if(FormatID == 0x01) {			
ModuleVersion	8	uimsbf	
ModuleId	16	uimsbf	
BlockSize	16	uimsbf	
ModuleSize	32	uimsbf	
CompressionMethod	8	uimsbf	
OriginalSize	32	uimsbf	
TimeOut	8	uimsbf	
ObjectKeyLength	8	uimsbf	N2 ≤ 4
for(i=0; i<N2; i++){			
ObjectKeyData	8	bslbf	
}			
for(i=0; i<N1 - N2 - 21; i++){			
private_data_byte	8		
}			
}			
}			

carousel_id: This 32 bit field identifies the object carousel with the corresponding carouselId, with the carousel_identifier_descriptor carrying the broadcaster's OrgID in the most significant 24 msbs if carousel is sharable across multiple transport streams or between 0 - 255 otherwise.

FormatID: This 8 bit integer identifies whether the carousel supports the "enhanced boot" mechanism or not. The value 0x00 indicates "standard boot", 0x01 indicates that "enhanced boot" is possible.

ModuleVersion: This 8 bit integer is the version number of the module containing the service gateway. This is equivalent to moduleVersion in the DII.

ModuleId: This 16 bit integer is the identifier of the module in the carousel. This is equivalent to moduleId in the DII.

BlockSize: This 16 bit integer is the size in bytes of every block in the module (except for the last block which may be the same or smaller). This is equivalent to blockSize in the DII.

ModuleSize: This 32 bit integer is the size of the module in bytes. This is equivalent to moduleSize in the DII.

CompressionMethod: This 8 bit field identifies the compression algorithm defined in RFC 1950 [76] used to compress the module. It is equivalent to compression_method carried in the compressed_module_descriptor in the DII.

OriginalSize: This 32 bit integer is the size of the data (in bytes) carried by the module before it was compressed. It is equivalent to original_size carried in the compressed_module_descriptor in the DII.

If the module has not been compressed the values of OriginalSize and ModuleSize shall be equal and the value of CompressionMethod is not defined.

TimeOut: This 8 bit integer specifies the timeout in seconds for acquisition of all blocks of the module.

ObjectKeyLength: This 8 bit integer specifies the number of bytes of ObjectKeyData.

ObjectKeyData: These 8 bit values form an octet string that identifies the BIOP message that is the ServiceGateway message.

B.2.8.2 DVB-J mounting of an object carousel

DVB-J causes an object carousel to be mounted using `ServiceDomain.attach()`. It can be unmounted using `ServiceDomain.detach()`.

An application manager is also allowed to call these methods implicitly when launching or killing an application in order to access the signalled base directory of the application.

B.2.9 Unavailability of a carousel

Broadcast carousels become permanently unavailable due to changes in the signalling including the following:

- The component signalled as carrying the DSI is removed from the PMT.
- The value of carousel ID associated with the carousel changes.
- The program disappears from the PAT.
- After an implementation dependent time general failure of the signalling (e.g. non-transmission of the PMT).

Additionally, carousels also become permanently unavailable when loss of connection to a temporarily disconnected carousel becomes permanent, as defined in clause 6.2.5.3.

B.2.10 Delivery of Carousel within multiple services

Carousels shall be considered identical if, in the PMTs of the services, all the following hold:

Either:

a) Both services are delivered within the same transport stream, and:

- Both services list the boot component of the carousel on the same PID.

- The carousel_identifier_descriptor for the carousel are identical in both services (so the carousels have the same carousel_Id and boot parameters).

- All association tags used in the carousel map to the same PIDs in both services.

In this case, the carousel is transmitted over a single path, but the services are allowed to reference the carousel via a number of routes, including deferral to a second PMT via deferred association tags.

Or:

b) Both services are delivered over multiple transport streams, and:

- The carousel_id in the carousel_identifier_descriptor is in the range of 0x100 - 0xffffffff (containing the broadcaster's OrgID in the most significant 24 msbs of carousel_id).

- The carousel_identifier_descriptor for the carousel are identical in both services (so the carousels have the same carousel Id and boot parameters).

B.3 AssociationTag Mapping

B.3.1 Decision algorithm for association tag mapping

B.3.1.1 TapUse is **not** BIOP_PROGRAM_USE

The following figure illustrates the decision tree for identifying the elementary stream(s) by which the object carousel is distributed:

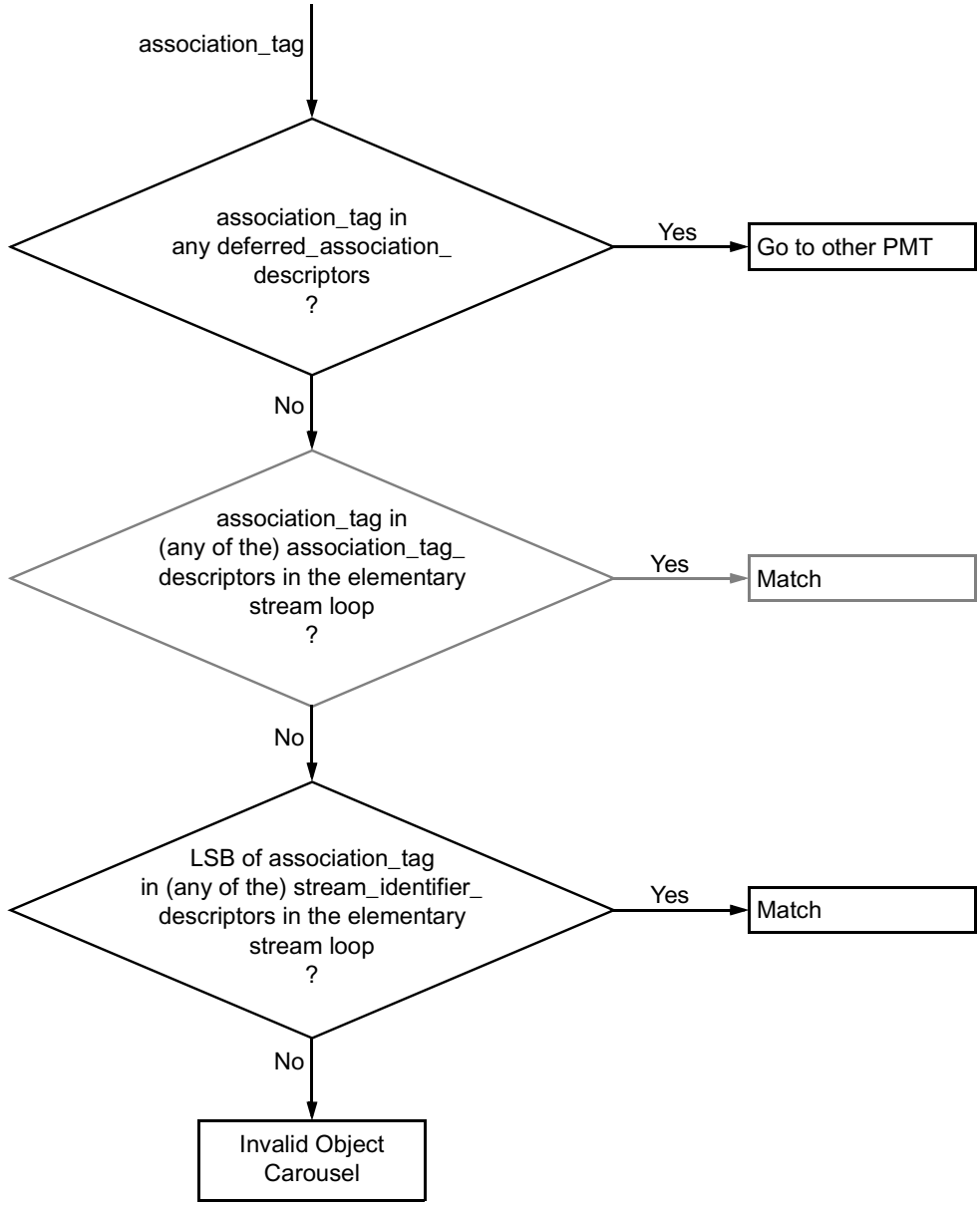


Figure B.1: Object Carousel ES identification decision tree

In the present document, the stream_identifier_descriptor shall always be used for assigning a component_tag for the elementary streams. Use of association_tag_descriptors is not required. If the association_tag_descriptor is optionally used, a stream_identifier_descriptor (as defined in EN 300 468 [4]) shall still be present and the tag values shall be set consistently in each descriptor. This restriction simplifies the decision tree above so that the second decision can be skipped.

B.3.1.2 TapUse **is** BIOP_PROGRAM_USE

The decision tree in clause B.1 is not followed when resolving a `BIOP_PROGRAM_USE` tap as the only valid broadcast encoding is for a tap of use `BIOP_PROGRAM_USE` to resolve to `deferred_association_tags_descriptor` in the PMT even if the `deferred_association_tags_descriptor` identify the current service (i.e `stream` or `streamEvent` reference itself). If this resolution fails then the service from which the object carousel is mounted shall be returned as the referenced service.

B.3.2 DSM-CC association_tags to DVB component_tags

The component_tag in a PMT's stream_identifier_descriptor (as defined in EN 300 468 [4]) is used to relate SI service component information with an elementary stream without directly referring to a PID value. Likewise, assocation_tags are used by DSM-CC in order to refer to an elementary stream without directly referencing a PID value. An assocation_tag value is mapped to an elementary stream by matching the LSB of the assocation_tag with a component_tag. The stream_identifier_descriptor is mandatory for all components referenced by an application and/or object carousel.

Broadcasters may choose to use assocation_tag_descriptors (as defined by ISO/IEC 13818-6 [26]) which should (theoretically) be tested for a match before trying component_tags. However, the LSB of the assocation_tag value in an assocation_tag_descriptor has to be equal to the component_tag for that PID. Since the component_tag is unique within a PMT this removes the need to match against assocation_tag_descriptors.

The deferrered_assocation_tags_descriptor required by the present document is the adaptation of the ISO/IEC 13818-6 [26] descriptor defined in TR 101 202 [i.5]. This latter definition standardizes a mechanism to signal the original network id.

When attempting to map an assocation_tag to an elementary stream the assocation_tag must first be checked against any deferred_association_tags_descriptors in the current PMT (current in this context means the PMT of the service within which the assocation_tag is being mapped). If the association_tag matches any of the association_tags present in a deferred_assocation_tags_descriptor then the matching process proceeds to the service indicated in that descriptor. The MHP terminal is not required to continue its search beyond this second service.

If the transport_stream_id field in the deferred_association_tags_descriptor is set to 0x0000 then it shall be ignored and the MHP terminal is free to choose which transport stream ID it selects when obtaining a service.

B.3.3 deferred_association_tags_descriptor

The transport_stream_id field may take value 0x0000 in which case it shall be ignored in resolving the reference.

B.4 Example of an Object Carousel (informative)

The figure below illustrates an object carousel that is distributed over three elementary streams belonging to the same service.

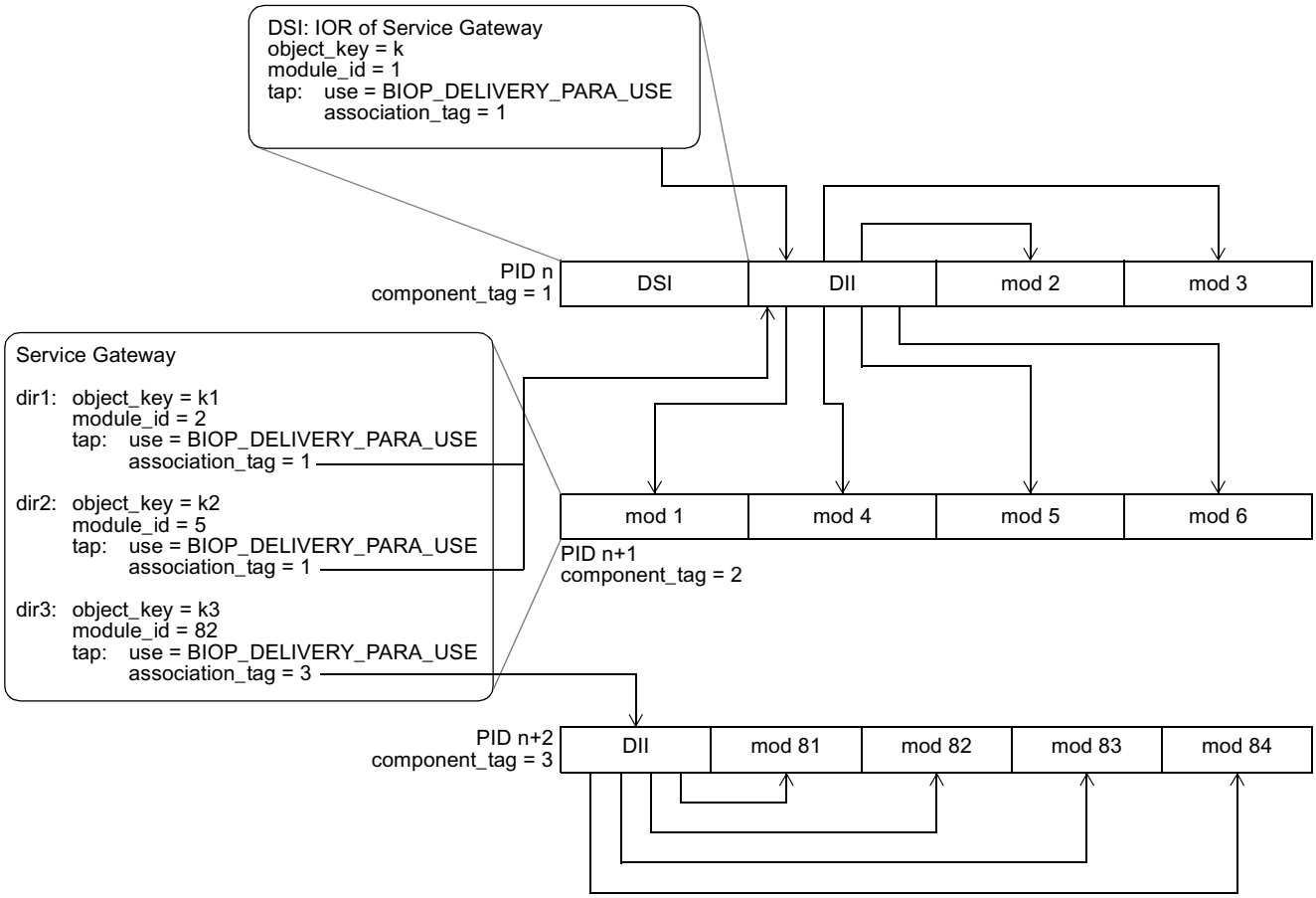


Figure B.2: Example carousel

The DownloadServerInitiate (DSI) message is carried on the first elementary stream. It contains the object reference that points to the ServiceGateway. The tap with the BIOP_DELIVERY_PARA_USE points to a DownloadInfoIndication (DII) message that provides the information about the module and the location where the module is being broadcasted. In the example, the ServiceGateway object is in the module number 1 that is carried on the second elementary stream (indicated by a BIOP_OBJECT_USE tap structure in the DII message).

The ServiceGateway object is a root directory that, in this example, references three subdirectories. Taps with BIOP_DELIVERY_PARA_USE are used in the object references of the subdirectories to provide links to the modules via the DownloadInfoIndication (DII) message. The two first subdirectories "dir1" and "dir2" are referenced in the DII message that is carried in the first elementary stream. The third subdirectory is referenced in the DII message carried in the third elementary stream.

In this example, the two first elementary streams carry the messages of one logical data carousel while the third elementary stream carries the messages of another logical data carousel. All these belong to the same object carousel. In the example, the third elementary stream contains the objects in the "dir3" subdirectory and the objects in the "dir1" and "dir2" subdirectories are distributed over the first and second elementary stream.

NOTE: It is important to note that the third elementary stream may originate from a completely separate source than the first two elementary streams. The directory hierarchy and objects contained in the third elementary stream are "mounted" in the root directory by providing the "dir3" directory entry with the appropriate location information.

This type of structure could be used, for example, in a national information service that contains some regional parts. The common national parts could be carried in this example case on the two first elementary streams that are distributed unmodified in the whole country. The regional parts are carried in the third elementary stream that is locally inserted at each region. From the application's point of view, the common national parts are in the "dir1" and "dir2" subdirectories while the regional parts are in the "dir3" subdirectory.

Another example where this type of structure could be used is if the service contains multiple independent applications. In this case, each application could be placed in its own subdirectory and these subdirectories might be carried as separate data carousels on different elementary streams.

B.5 Caching

This clause describes the constraints that an MHP terminal compliant with the present document shall implement when caching any content from the object carousel in the memory of the MHP terminal. Caching is optional for the MHP terminal, but if implemented shall conform to the constraints set in this clause.

B.5.1 Determining file version

There is no version number directly related to files (or other BIOP messages), the closest association is the moduleVersion in the DII that references the module that contains the BIOP message. Therefore, to ensure that a file is up to date the MHP terminal must determine that the moduleVersion for the appropriate module is current and reacquire if necessary. The circumstances under which this checking is required are defined by the transparency level as specified in the following clause.

B.5.2 Transparency levels of caching

The definition of transparency levels describes the behaviour that the MHP terminal shall implement when the content in the object carousel is changing. The transparency level determines how certain the MHP terminal is required to be about the validity of the content when returning the content to the application. The object carousel provides a mechanism for determining version changes of the content by monitoring the DII messages.

Validity of content is specified here in terms of the version number of the module that is broadcast in the DII message. The contents of an object as cached in the memory of the MHP terminal are defined to be valid at a certain point in time when the version number of the module in the cache matches the version number of the module as signalled in the DII message describing that module as it was last broadcast.

NOTE: The definition is based on the DII message that was last broadcast and it may be that the MHP terminal was not filtering for this message at that time and did not receive it.

From the MHP terminal point of view, the transparency level indicates the constraints that the terminal needs to implement for monitoring the DII messages.

The broadcaster can indicate the appropriate transparency level that shall be applied for a given piece of content by using a descriptor associated with a module in the DII message (see clause B.2.2.4.2 "Caching priority descriptor" on page 479). In the absence of this descriptor from a module, the transparent caching is the default level.

B.5.2.1 Transparent caching

The transparent caching is a caching level that ensures that the application can not practically notice a difference in the validity of the returned content between an implementation that caches content and an implementation that does not cache any content. Naturally, an implementation that caches the content will return it to the application faster.

When returning content from the cache to the application, the MHP terminal shall ensure that the version number of the cached content matches the version number indicated in the current DII message describing that module. Once a DII has been received it can be assumed that it is current at least for 500 ms and after that period until receiving the next instance of the relevant DII. If filtering for that DII has not resumed by the end of this period, the state of that DII is to be considered unknown until it is received again.

Therefore, terminals must not return transparently cached data if it has waited more than half a second between receiving the relevant DII and *starting to filter* for that DII again. If the terminal does not resume filtering within the 500ms grace period, it must download the relevant DII again when it wishes to use that DII to check cache validity.

The choice of 500 ms is based on the normal timing uncertainty in data delivery through the broadcast chain and is independent of the repetition rate of the DII messages.

B.5.2.1.1 Active caching

There are several ways the MHP terminal can organize its caching strategy. One possible strategy is so-called active caching. This means that the terminal has a dedicated section filter for each DII message it needs to monitor. Keeping that filter continuously filtering for the DII guarantees that the terminal will notice the update of a module as soon as it happens and can thus be aware of the validity of all the content it has cached.

However, in some cases the DII messages might be sent with a very high repetition rate that may cause a high processing load because the terminal needs to do some processing every DII message that it receives. The 500 ms grace period is designed to help this, as it allows the terminal to stop the section filter for 500 ms after receiving the DII message. This lessens the processing burden on the terminal as it only needs to process each DII message twice a second, even if it may be repeated on the transmission much more frequently.

B.5.2.1.2 Passive caching

With active caching, the terminal may need to have a dedicated section filter reserved for each DII message that it needs to monitor. This would effectively limit the amount of content that can be cached, possibly to a very small number. Therefore, the terminal may choose a so-called passive caching strategy. This means that the terminal does not even try to monitor for the DII messages continuously, but each time an application wants to retrieve an object, it at that time retrieves the current DII and checks if the cached content is still valid. Although, this strategy imposes a delay before returning the content to the application, this delay is usually significantly smaller than having to retrieve the content from the broadcast stream.

B.5.2.1.3 DII repetition rate

It should be noted that the description of active and passive caching are only informative here and terminal implementations can use any strategy fulfilling the normative constraints set above. However, broadcasters should set the repetition rate of the DIIs so that a terminal implementing the passive caching strategy will provide the expected benefits of caching over a terminal implementing no caching.

B.5.2.2 Semi-transparent caching

The semi-transparent caching level allows the MHP terminal to cache the data and also return slightly out-dated data to the application. The benefit of this caching level is that it allows terminals to cache larger quantities of content with a reasonable resource usage while allowing the data to be returned usually immediately to the application. The semi-transparent caching level provides less guarantees about validity of the content, but does not cause the delay implied by the passive caching strategy with the transparent caching level.

When returning content from the cache to the application, the terminal shall ensure that the version number of the cached content matches the version number indicated in a valid DII message describing that module. Once a DII has been received it can be assumed to be valid at least for 30 s and after that period until receiving the next instance of the relevant DII. If filtering for that DII has not resumed by the end of this period, the state of that DII is to be considered unknown until it is received again.

Therefore, terminals must not return semi-transparently cached data if it has waited more than 30 seconds between receiving the relevant DII and starting to filter for that DII again. If the terminal does not resume filtering within the 30 s grace period, it must download the relevant DII again when it wishes to use that DII to check cache validity.

B.5.2.2.1 Implications for the terminal (informative)

Reasons for selecting the 30 s value for the grace period in the semi-transparent caching level are different from the reasons for the 500 ms grace period in the transparent level. The 30 s grace period in this level is intended e.g. to allow terminals to keep typically a valid copy of each DII by retrieving each DII in a round robin fashion using a single section filter. Naturally, whether this goal can be achieved, depends on the repetition rate of the DIIs and the amount of content that is cached. If this is not possible, the terminal might use the passive caching strategy with this transparency level as well. These strategies are only examples and the terminal may implement any strategy as long the normative constraints defined above are fulfilled (this includes implementing no caching as it is optional, as well as treating the semi-transparent level the same as the transparent level).

B.5.2.3 Static caching

When using the static caching transparency level, the MHP terminal shall check the validity of the cached content from the version number in the DII message when it is used for the first time during the lifetime of an application instance. After the first usage time, the MHP terminal does not need to check the validity of the content during the lifetime of that application instance.

B.5.2.3.1 Implications for the broadcaster (informative)

This has the implication, that content with this transparency level is appropriate for very static content that is updated only rarely and where the possible update of the content does not need to be noticed by the application during the lifetime of one application instance.

B.5.2.3.2 Implications for the terminal (informative)

The MHP terminal, however, is allowed to update the contents of the statically cached files if it notices that they have been updated in the carousel as well as use any caching strategy as long as the normative constraint defined above are fulfilled (this includes implementing no caching as it is optional, as well as treating the static level the same as the semi-transparent and/or the transparent level).

B.5.3 Dynamic carousel structure

The Object Carousel may change structure over time, i.e. both files and directories may be added or deleted. Also, modules are not guaranteed to carry the same objects over the lifetime of the carousel. Therefore receivers shall not assume that directory structures are static or that a given path will resolve always to the same object. All cached directory information shall be cached according to the signalled cache priority. This means that before using an object that has been cached, receivers shall validate the path to it.

NOTE: Validating a path does not necessarily mean downloading all elements in the path every time. For example, simply determining that none of the objects on the path have changed since it was last fully traversed is sufficient to confirm that the path itself has not changed.

Annex C (informative): Bibliography

Reference	Edition	Description
MHP045	Rev.11	Digital Video Broadcasting (DVB); Commercial requirements
UK MHEG Profile	1.05	Digital Terrestrial Television MHEG-5 Specification, U.K. DTG
Compilers	ISBN: 0201100886	Compilers: Principles, Techniques, and Tools by Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman (Contributor); Addison-Wesley Pub Co
Porter-Duff		T. Porter and T. Duff, "Compositing Digital Images", SIGGRAPH 84, 253-259.
Java Media Player guide	1.03, Nov 6, 1997	Sun Microsystems Java Media Player guide, Java Media Players. Version. http://java.sun.com/products/java-media/jmf/forDevelopers/playerguide/index.html.
Java VM2	ISBN: 0-201-43294-3	The Java Virtual Machine Specification (2nd edition), T. Lindholm and F. Yellin, Addison-Wesley.
Java Class Libraries Vol. 1	ISBN 0-2011002-3	The Java Class Libraries, Second Edition, Volume 1 by Patrick Chan, Rosanna Lee and Douglas Kramer.
Java Class Libraries Vol. 2	ISBN 0-201-31003-1	The Java Class Libraries, Second Edition, Volume 2 by Patrick Chan and Rosanna Lee.
E-Book	1.1	EACEM Technical Report Number TR-030, Baseline Digital Terrestrial TV Receiver Specification.
RFC 2068	January 1997	Hypertext Transfer Protocol version 1.1
RFC 2838	May 2000	Uniform Resource Identifiers for Television Broadcasts
Accessibility	5 May 1999	W3C Recommendation: "Web Content Accessibility Guidelines 1.0" http://www.w3.org/TR/WAI-WEBCONTENT
MHEG-5 Broadcast Profile	1.1.1 (2004-11)	ETSI ES 202 184.
GEM	1.2	Globally Executable MHP (GEM) Specification.
JSR-927	1.1	Java TV 1.1
J2SE 5.0	5	JavaTM 2 Platform Standard Edition 5.0 Development Kit (JDK 5.0).
PKCS11	5	PKCS11 Cryptographic Token Interface Standard. See http://www.rsasecurity.com/rsalabs/node.asp?id=2133
EN 50049-1		Peritelevision connector

Annex D (normative): Text presentation

D.1 Scope

This clause addresses the following topics:

- How downloaded fonts are associated with applications and accessed by them.
- The DVB-J APIs that are used for presenting text and their behaviour.

Two levels of interface are addressed:

- Simple string rendering as supported by `java.awt.Graphics.drawString`.
- More complex object rendering as supported by DVB Text Layout Manager as described in annex U "(normative): Extended graphics APIs" on page 892.

Other parts of the present document that are related to this topic are:

- For character sets supported by implementations see annex E "(normative): Character set" on page 533.
- For the font families, sizes, styles and weights supported by implementations see and the presentation of this to the API clause G.4 "Resident fonts and text rendering" on page 546.
- For the content formats used to deliver fonts see clause 7.4 "Downloadable Fonts" on page 72.

D.2 Fonts

D.2.1 Embedded fonts

See clause G.4 "Resident fonts and text rendering" on page 546.

D.2.2 Downloaded fonts

D.2.2.1 Font technology

See clause 7.4 "Downloadable Fonts" on page 72.

D.2.2.2 Font index files

D.2.2.2.1 Format of file

The font index file provides a mapping between a font face name and a file containing the font data. The file syntax is defined by the XML DTD shown in table D.1.

Table D.1: Font index file syntax definition

```
<!ELEMENT fontdirectory (font+)>
   <!-- a font definition -->

<!ELEMENT font (name,fontformat,filename,style*,size?)>
   <!-- filename of the font file.
   Because the font directory is per directory, this should
   not contain any directories, but just be a file in that
   directory -->

<!ELEMENT filename (#PCDATA)>
   <!-- font format, e.g. "PFR", "OTF", "TTF" or "TTC" -->

<!ELEMENT fontformat (#PCDATA)>
   <!-- symbolic name of the font -->

<!ELEMENT style (#PCDATA)>
   <!-- font style -->

<!ELEMENT name (#PCDATA)>

<!ELEMENT size EMPTY>
<!ATTLIST size
   min CDATA "0"
   max CDATA "maxint"
>
```

The `PublicLiteral` to be used for specifying this DTD in document type declarations of the XML files is:

```
"-//DVB//DTD Font Directory 1.0//EN"
```

and the URL for the `SystemLiteral` is:

```
"http://www.dvb.org/mhp/dtd/fontdirectory-1-0.dtd"
```

The `Name` used in the document type declaration shall be "fontdirectory".

D.2.2.2.2 Element semantics

font: There shall be one font element per font file included in the font directory.

name : Contains the font face name of the font (e.g. "Helvetica")

fontformat : The file format of the font. For font formats used in this specification, this shall be the following:

- For OpenType fonts with TrueType outlines, this shall be "TTF" or "OTF".
- For OpenType fonts with TrueType collections, this shall be "TTC" or "OTF".
- For PFR fonts, this shall be "PFR".

filename: Relative path to the font file. This is relative to the directory containing the font index file. The separator character for directories is "/". As this is a relative path, it shall not begin with a "/" character.

style : The style elements contain the names of the styles of the font that are contained in this font file. The possible values for the present document are "PLAIN", "BOLD", "ITALIC" and "BOLD_ITALIC". There is one style element included per style contained in the indicated font file, except when all the usable styles of the font are in the same file in which case the style elements can be left out. When different styles of the font are contained in separate files, these are included in the directory as separate font entities with the same name but different style and filename.

size: Indicates the size range for which this font file can be used. The min. attribute contains the minimum size in points (default is "0"). The max attribute contains the maximum size in points or "maxint" if the maximum size is not limited (default is "maxint").

If all the usable sizes of the font are generated using the same font file, the size element can be left out. If there are separate files for different sizes, these are included in the directory as separate font entities with the same name and style but different size definition and filename.

D.2.2.2.3 Example

Table D.2: Example index file

```
<?xml version="1.0"?>

   <!DOCTYPE fontdirectory PUBLIC "-//DVB//DTD Font Directory 1.0//EN"
   "http://www.dvb.org/mhp/dtd/fontdirectory-1-0.dtd">
   <fontdirectory>
      <font>
         <name>Tiresias</name>
         <fontformat>PFR</fontformat>
         <filename>tiresias.pfr</filename>
         <style>BOLD</style>
      </font>
      <font>
         <name>Broadcaster X Screen Font</name>
         <fontformat>PFR</fontformat>
         <filename>brxsf.pfr</filename>
      </font>
   </fontdirectory>
```

D.2.2.3 Name and location of font index files

D.2.2.3.1 General

The specification of font paths and fonts by an application are private to that application, they are not available to other applications.

D.2.2.3.2 Name of file

The file name shall be:

```
"dvb.fontindex"
```

D.2.2.3.3 Location

The font index file shall be placed in the base directory of the application.

D.2.2.4 Specification of fonts at run time

D.2.2.4.1 DVB-J

The implementation locates the font file using the parameters passed to `org.dvb.ui.FontFactory.createFont()`.

The font file is located by searching the directory for a file where the name element matches the name parameter of a call to `FontFactory.createFont`, a `style` element matches the style parameter and the `size` parameter is within the limitations in the size element.

It is font format specific how the font information for a given name, style and size is encoded in the font file. The name and style need to match the corresponding entry in the font file. The font size needs to be within the range supported by the font file.

D.3 Text rendering

D.3.1 Low and high level rendering

Two levels of interface are addressed:

D.3.1.1 Low level rendering

Simple string rendering as supported by:

- `java.awt.Graphics.drawString.`
- `java.awt.Graphics.drawChars.`
- `java.awt.Graphics.drawBytes.`

This is referred to as "low level" rendering implying that the application author has significant responsibilities for ensuring that the text is visible. This rendering obeys the normal AWT rules. For example, the author is responsible for placing individual words or lines of text on to a component.

`org.havi.ui.HDefaultTextLayoutManager` shall also be considered as supporting low level rendering except that implementations shall respect the rendering settings on the `HVisible` passed as argument to the render method (such as alignment, font and foreground colour).

D.3.1.2 High level rendering

More complex object rendering as supported by:

- `org.dvb.ui.DVBTextLayoutManager`

This is referred to as "high level" rendering implying that the application author may need less effort to ensure that the text is visible. For example, the author could use the text layout manager to handle flowing paragraphs of text into an `org.havi.ui.HText` object.

D.3.2 Philosophy

This clause describes "logical" rules that ensure text flows predictably on all receivers and defines some rendering requirements to ensure that a minimum acceptable level of text legibility is achieved. The scope of this is much broader for "high level" rendering, where rules address text flow in addition to just string rendering.

No restriction is placed on the rendering technology used in a receiver provided that it achieves the deterministic text flow characteristics and the minimum rendering requirements described in this clause.

D.3.2.1 High level rendering conceptual process

The conceptual rendering process can be described as follows:

a) Based on:
- The size of the object to render into.
- The characteristics of the font (e.g. see clause D.3.3.1 "Font bounds" on page 518).
- Any automatic or application controlled insets (see clause D.3.5 "Rendering within limits and insets" on page 520).

Calculate:
- The maximum number of lines of text that may be rendered (see clause D.3.8.1 "Number of lines" on page 525).
- The width available for rendering on each line (see clause D.3.9.1 "Available width" on page 527).

b) Determine how the text to render flows, effectively defining a series of lines to render using:
- The "logical" rules for calculating the width of rendered text (see clause D.3.6 ""logical" text width rules" on page 522)
- The available width for rendering (see clause D.3.9.1 "Available width" on page 527)
- The rules for breaking text (see clause D.3.7 "Line breaking" on page 524)

c) Determine where each line of text to render is placed vertically within the object (see clause D.3.8 "Positioning lines of text vertically within an object" on page 525).
This needs to consider that:
- If the number of lines of text to render (from step b) exceeds the maximum number of lines of text that may be rendered (from step a) "vertical truncation" may be required, i.e. discard some of the lines to render.
- The positioning of lines to render is affected by the vertical justification setting of the object.

d) Determine the placement of individual characters in a line to render (see clause D.3.9 "Rendering lines of text horizontally" on page 527). This needs to consider that:
- Even having correctly applied the rules relating to the flow of text, in some extreme circumstances the length of the line of text to render can be wider than the available width for rendering (from step a). To handle this "horizontal truncation" may be required, i.e. discard some of the characters from the line to render.
- The placement of characters in the line to render is affected by the horizontal justification setting of the object.
- The placement of characters in the line to render should ensure sensible and consistent spacing between adjacent characters (see clause D.3.12 "Placing runs of characters and words" on page 529).

In addition special rules exist for handling tabulation (clause D.3.11 "Tabulation" on page 529) which need to be taken into account in the implementation of many of these steps.

Behaviour equivalent to the above is required to ensure conformant rendering. The order of these steps is illustrative and may vary between implementations for reasons of convenience or efficiency.

D.3.3 Font Definition

The nomenclature used in this clause is derived from the resident font format(s). The nomenclature and the numerics provided here are directly applicable to downloaded fonts.

D.3.3.1 Font bounds

The font definition induces a set of parameters `xMin`, `xMax`, `yMin` and `yMax` that are **properties of the font**. These define the maximum extent of the outline representation of characters within the physical font, and as such are defined in terms of outline resolution units (outlineResolution).

(`xMin`, `yMin`) and (`xMax`, `yMax`) are the bottom-left and top-right corners of an imaginary bounding rectangle within which all characters in the font can be completely enclosed.

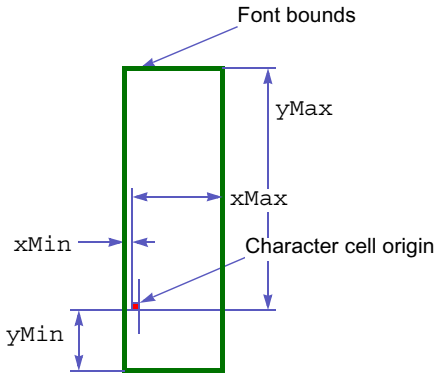


Figure D.1: Font bounds

In "Low level rendering" the author is responsible for using knowledge of these values to correctly position text.

In "High level rendering" the text layout manager uses this information when managing text flow to guarantee that the extremities of all characters are completely within the object. See clause D.3.5 "Rendering within limits and insets" on page 520.

D.3.3.2 "Physical" font data

"Physical" font data such as horizontal escapement and kerning is defined in font metrics resolution units. This is a high-resolution representation, abstracted from any actual rendering system.

In OpenType, the same font resolution units are used for font metric (metric resolution) and outline coordinates (outline resolution), the value is defined by `unitsPerEm` value in the Font Header table. In PFR fonts, the font metrics resolution is defined by the `metricsResolution` field of the Physical Font Record.

NOTE: The `outlineResolution` and `metricsResolution` defined in the PFR are not necessarily the same.

D.3.3.3 Ligatures and Glyph Substitution

When ligatures and glyph substitution are not required by the font, MHP terminals shall not automatically transform letter pairs to ligatures. If ligatures and glyph substitution are supported by the font format, MHP terminals shall automatically select appropriate glyph forms and transform character combinations to ligatures.

MHP applications that utilise PFR fonts and wish to see ligatures rendered should use the appropriate Unicode value (if available) and shall ensure that the glyph associated with this Unicode character is found in the font being used.

D.3.4 Converting font metrics to display pixels

Many of the calculations in this clause are in a high resolution physical coordinate system, either metrics or outline resolutions. These values need to be converted into the pixel resolution of the HGraphicsDevice to allow characters to be rendered.

Values in terms of these high level resolutions can be simply converted to values in terms of points by multiplying by the font size (in points) and dividing by the resolution, i.e. metricsResolution or outlineResolution as appropriate. However, this value in points still needs to be converted into a value in pixels.

Computer display systems typically assume a 72 pixel per inch display. So, as each point is 1/72 inch, the horizontal and vertical size of each pixel is 1 point.

D.3.4.1 Vertical resolution

Each pixel in the graphics device (HGraphicsDevice for DVB-J applications) containing the component is equivalent to a single point.

D.3.4.2 Horizontal resolution

The horizontal relationship depends on the characteristics of the graphics device (HGraphicsDevice for DVB-J applications). For a square pixel graphics device the 1 pixel = 1 point convention can be preserved.

However, for a graphics device whose pixel aspect ratio is given by `org.havi.ui.HScreenConfiguration.getPixelAspectRatio` the horizontal resolution is the pixel aspect ratio x 1 point.

The following table defines the pixel aspect ratios which shall be used when converting typographic pixels for rendering in the graphics system of an MHP terminal for each graphics device aspect ratio.

Table D.3: Pixel width for non-square pixel graphics devices

Graphics device resolution	Graphics device aspect ratio	Typographic pixel size width in points
720 x 480	4:3	40/45
	14:9	47/45 (note)
	16:9	53/45 (note)

Table D.3: Pixel width for non-square pixel graphics devices

Graphics device resolution	Graphics device aspect ratio	Typographic pixel size width in points
720 x 576	4:3	48/45
	14:9	56/45
	16:9	64/45
NOTE: Approximated value.		

An emulated graphics could be constructed with 14:9 aspect ratio. This could be used where text is required to be acceptable when viewed on either a 4:3 or 16:9 display. The 14:9 aspect ratio is an artificial construct intended to allow easier authoring but text will always be slightly distorted when displayed. 14:9 should be used when maintaining character aspect ratio is less important to the application than text occupying the same number of pixels regardless of the display size which the MHP terminal is using. A possible example of this is illustrated in figure D.2.

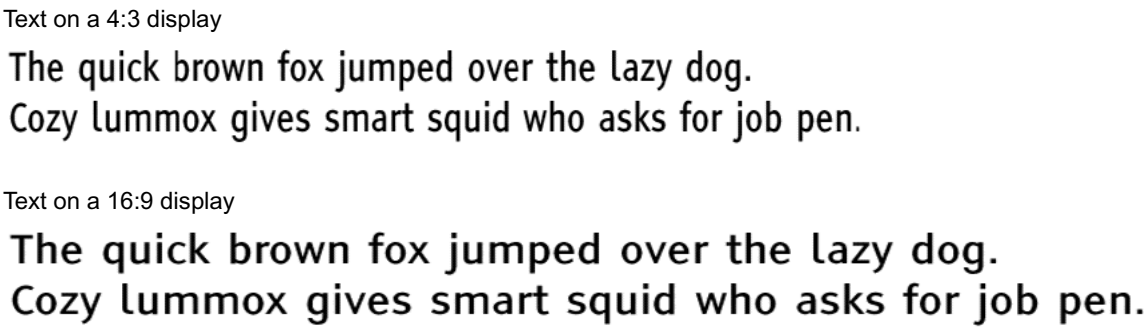


Figure D.2: Example of 14:9 text on either 4:3 or 16:9 display

D.3.5 Rendering within limits and insets

When typesetting for print, character extremities may extend beyond the nominal text flow area. However, print has margins so the edge of the text flow is not the technical limit to the area that can be printed.

D.3.5.1 Low level rendering

In "Low level rendering" the author is responsible for placing the text so that it is not clipped.

D.3.5.2 High level rendering

In "High level rendering" text is automatically rendered with at least a sufficient inset from the object edge (derived from the font properties `xMin`, `yMin`, `xMax` and `yMax`) to ensure that all presented characters are completely rendered within the bounds of the object. Applications can increase or decrease this minimum (font property determined) inset in the following ways:

- The `Insets` parameter on the `org.dvb.ui.DVBTextLayoutManager.render` method.
- The `org.dvb.ui.DVBTextLayoutManager.setInsets` method.

Each of these mechanisms can be used independently. Their effect is cumulative.

For simplicity, these application controlled insets are not described in the specification clauses that follow. In relation to the rendering process their behaviour is equivalent to a reduction in the size of the object within which the rendering processes acts.

D.3.5.3 Conversion of units

As stated previously, these parameters are defined in outline resolution units and so need to be converted to device pixels. Based on the principles described previously (see clause D.3.4 "Converting font metrics to display pixels" on page 519) this can be achieved by the following:

D.3.5.3.1 yOffsetTop

$$yOffsetTop_{pixels} = \begin{cases} div(yMax_{outlineResolution} \times fontSize, outlineResolution) & yMax > 0 \\ 0 & yMax \leq 0 \end{cases}$$

D.3.5.3.2 yOffsetBottom

$$yOffsetBottom_{pixels} = \begin{cases} div(-yMin_{outlineResolution} \times fontSize, outlineResolution) & yMin < 0 \\ 0 & yMin \geq 0 \end{cases}$$

D.3.5.3.3 xOffsetLeft

D.3.5.3.3.1 With 14:9 graphics

For 720x576 graphics device resolution:

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 56) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

For 720x480 graphics device resolution:

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 47(56)) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

D.3.5.3.3.2 With 4:3 graphics

For 720x576 graphics device resolution:

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 48) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

For 720x480 graphics device resolution:

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 40) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

D.3.5.3.3.3 With 16:9 graphics

For 720x576 graphics device resolution

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 64) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

For 720x480 graphics device resolution

$$xOffsetLeft_{pixels} = \begin{cases} div(-xMin_{outlineResolution} \times fontSize \times 45, outlineResolution \times 53) & xMin < 0 \\ 0 & xMin \geq 0 \end{cases}$$

D.3.5.3.4 outlineResolution

outlineResolution is extracted from the font data (see clause 11.4.1.5 "Font bindings" on page 270 and D.3.3.2), div (A, B) = ceil (A / B), "/" is a rational divide and ceil(A) is the first integral number greater than or equal to A.

D.3.5.3.5 Font bounds

yOffsetTop, *yOffsetBottom* and *xOffsetLeft* are all greater than or equal to zero and represent the number of available pixels required above, below and to the left of the character origin to prevent clipping of any character in the font. A value *xOffsetRight* could be defined along similar lines but is not relevant to the present document.

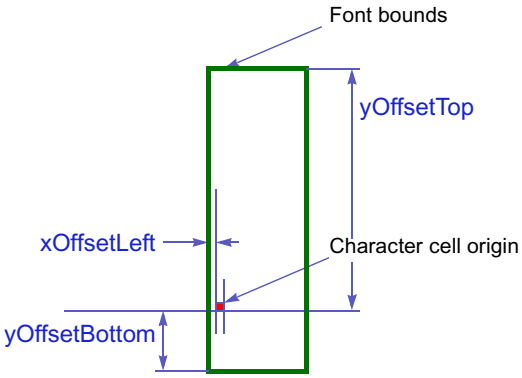


Figure D.3: Font bounds

D.3.6 "logical" text width rules

This clause applies to both "Low level rendering" and "High level rendering". Its purpose is to ensure that text will flow predictably on different receivers and authoring stations, regardless of the quality of the character rendering, a set of "logical" text width rules are defined here.

NOTE: I.e. lines and words will break at the same character position.

These rules are a simplification of the rules that might be applied in a typographic rendering system. The objective of these simplifications is to reduce the receiver complexity required to ensure exact correlation of text flow behaviour.

The calculation of "logical" text width is based on "physical" font data. This data provides a description of the font at a very high resolution, abstracted from any actual rendering system. Consequently, the calculation of the "logical" width of a string of characters involves, computing their width at this high resolution and then converting to units appropriate to the rendering system, e.g. device pixels, before making decisions about text flow (see "Converting font metrics to display pixels").

In the case of "Low level rendering" it defines the internal computation performed by the AWT routines that measure the width of text:

- `java.awt.FontMetrics.charWidth.`
- `java.awt.FontMetrics.stringWidth.`
- `java.awt.FontMetrics.bytesWidth.`

Due to the rounding processes within the calculations invoking these methods on subsets of a string may not yield the same total result as invoking the methods on the complete string. In particular the total of the values returned by `java.awt.FontMetrics.getWidths` may be different from the value returned by `java.awt.FontMetrics.stringWidth` for the same string.

In the case of "High level rendering" it defines the computations that the layout manager uses in the following cases:

- To determine when to wrap lines of text within an object.
- To determine which tab stops text has passed when implementing tab characters.

D.3.6.1 Computing "logical" text width

The key parameters when calculating the width of a string of N characters are:

- Text font size.
- charSetWidth.
- The metricsResolution.
- Any kerning adjustment.

D.3.6.1.1 Font sizes

Font sizes are expressed as the size of an "Em" in units of "points".

NOTE 1: Broadly speaking an Em is the minimum distance between the baselines of consecutive lines of text in the given font. If text is 48 point then the Em at that size is 48 points.

NOTE 2: The point is an archaic typographical unit. Traditionally there were 72,27 points to an inch. Computerized systems now use 72 points per inch for simplicity.

D.3.6.1.2 Character widths

The font definition gives the width of each character relative to the size of an Em in metricsResolution units.

NOTE: If metrics are specified in 1/1 000 ths of an Em a character with a width of 0,6 Em will have a set width of 600.

D.3.6.1.3 Kerning

For certain character combinations (a "kerning pair") a kerning adjustment may also be provided. Typically kerning reduces character spacing for pairs such as AV instead of A V, these provide a signed adjustment to the nominal charSetWidth of the first character.

Like charSetWidth kerning adjustments are in terms of metricsResolution units.

Kerning adjustments only apply between non whitespace characters, not between the start of a line of text and the edge of the object. If justification is being used, only whitespace between words may be adjusted.

D.3.6.1.4 Letter spacing

Letter spacing allows for expansion/condensation of the character spacing for all of the characters in a object including whitespace.

NOTE: In printing, this is sometimes referred to as tracking.

D.3.6.2 Logical text width

The equation below shows how the width of a string of N characters is computed.

$$\text{logical width of N characters}_{\text{points}} =$$

$$\text{div}((N-1)\times \text{letterspace},256) + \text{div}\left(\text{fontsize}\times\left(\sum_{1}^{N}\text{charSetWidth}[i] + \sum_{1}^{N-1}\text{kern}[i,i+1]\right),\text{metricsResolution}\right)$$

$$\text{logical width of N characters}_{\text{pixels}} = \text{div}(\text{logical width of N characters}_{\text{points}}\times H,W)$$

Where in div(A, B):

- B is unsigned and A is signed.

  and

- div(A, B) = ceil(A / B).

Where '/' is a rational divide and ceil(A) is the first integral number greater than or equal to A. So, the calculations round up when reducing precision and tend to over estimate the width of text.

Where H and W are respectively the height and width returned by `org.havi.ui.HScreenConfiguration.getPixelAspectRatio()`.

D.3.7 Line breaking

D.3.7.1 Text wrapping setting is false

When the text wrapping setting is false, text shall break onto a new line only where a Carriage Return character is present in the text. The number of lines to render shall be equal to the number of Carriage Returns present, plus one.

NOTE: The "plus one" ensures that the last line of any text can be presented even if it has not been terminated with a Carriage Return.

D.3.7.2 Text wrapping setting is true

When the text wrapping setting is true, the text flow may break on to new lines at positions in addition to those caused by Carriage Return characters. These additional break positions are defined below. This behaviour is independent of the object's horizontal alignment settings and is considered to take place before any truncation (see clause D.3.8.2 "Truncation" on page 525).

The effect of text wrapping on the rendering process is equivalent to substituting "breaking characters" (defined in table D.4 "Special characters" on page 530) with Carriage Return characters at positions determined by the wrapping rules.

The behaviour of the wrapping process is described below:

a) Based on the "logical" width of the text, receivers shall determine for each line, the first contiguous sequence of non-breaking characters that meets both of the following requirements:

   • Would not completely fit within the available width (see clause D.3.9.1 "Available width" on page 527).

   • That follows one or more breaking characters.

   If such a sequence exists, the breaking character preceding it shall be replaced with a Carriage Return character.

b) All trailing breaking characters shall be discarded from all lines of text. (Preceding breaking characters are not affected).

NOTE 1: In general use this identifies the word in a body of text that if rendered would cause the current line to spill outside of the text object. This word becomes the first word in the next line. However, if a line starts with a single word that is longer than the width of the object then the line is broken just before a following word.

Example 1: This illustrates the most common case where the word "won't" does not fit and so is broken to the next line.

Example 2: This illustrates the particular case of a long first word. In this case "is" is the first word that does not fit AND is preceded by a breaking character.

Example 3: This illustrates the consumption of trailing spaces. The line breaks just before the second "spaces" (so the next line starts with this word) and all trailing spaces (e.g. after the first "spaces,") are discarded).

NOTE 2: The importance of the removal of trailing breaking characters is particularly visible if the text is centred or right justified. For example, the text to be centred becomes "spaces" rather than " spaces".

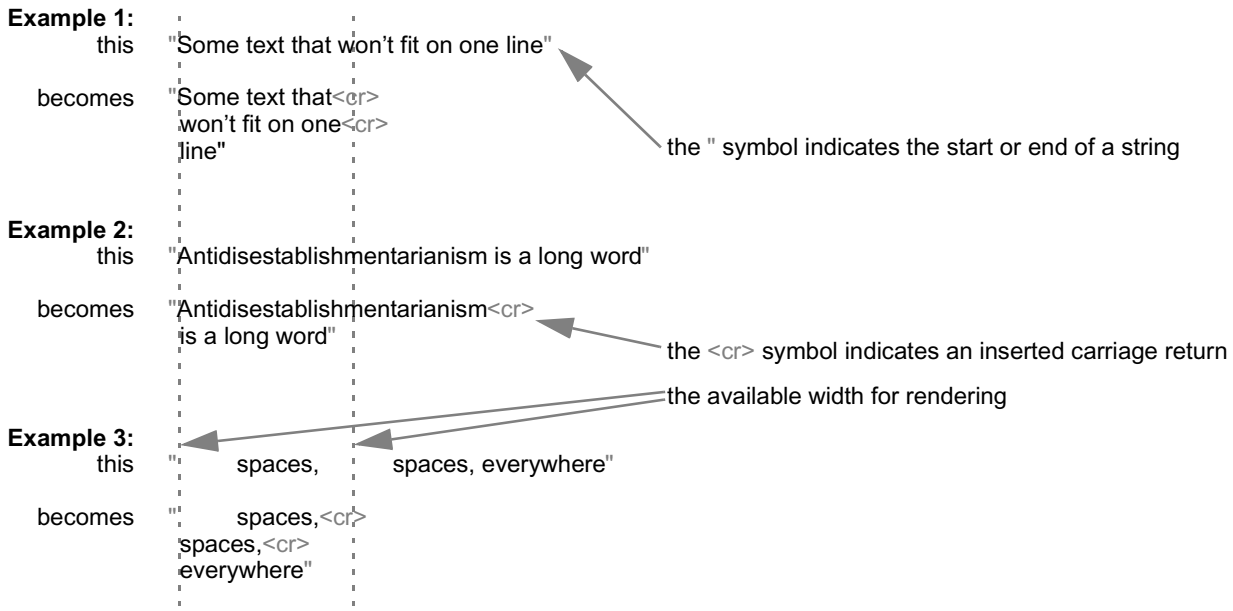


Figure D.4: Text wrapping examples

After text wrapping the text truncation rules have to be considered. For example, in example 2 in figure D.4 the word "Antidisestablishmentarianism" will be truncated (see clause D.3.9.2 "Truncation" on page 527).

D.3.8 Positioning lines of text vertically within an object

D.3.8.1 Number of lines

Assuming that all characters in a line of text share a common baseline then, **regardless of the vertical alignment setting** the number of lines of text that can be presented within an object is:

```
num_lines = floor((object_height - (yOffsetBottom + yOffsetTop)) / linespace) + 1
```

All values are in pixels.

object_height: is the height of the component less any margin.

linespace: is an attribute of the object that defines the space between the baselines of consecutive lines of text. This is defined in units of points but is converted to pixels (see clause D.3.4 "Converting font metrics to display pixels" on page 519).

The function floor(A) rounds A to the first integral number less than or equal to A.

D.3.8.2 Truncation

When the number of lines of text to be rendered exceeds the available height within the object then lines of text shall be discarded as follows:

- If the vertical alignment setting is VERTICAL_CENTER or VERTICAL_START_ALIGN then lines are discarded from the end of the text.
- If the vertical alignment setting is VERTICAL_END_ALIGN then lines are discarded from the beginning of the text.

This truncation will result in a number of lines that can be completely displayed within the object. These shall be presented according to clause D.3.8.3 "Positioning" on page 526.

See also clause D.3.10 "Text overflow" on page 528.

D.3.8.3 Positioning

The origin of any character shall be at least `yOffsetTop` inside the top edge of the object and at least `yOffsetBottom` inside its bottom edge. The spacing between the baselines of text shall be `linespace`.

D.3.8.3.1 Vertical alignment setting is VERTICAL_START_ALIGN

When the text is top aligned the baseline of the top most line shall be `yOffsetTop` below the top of the object.

D.3.8.3.2 Vertical alignment setting is VERTICAL_END_ALIGN

When the text is bottom aligned the baseline of the bottom most line shall be `yOffsetBottom` above the bottom of the object.

D.3.8.3.3 Vertical alignment setting is VERTICAL_CENTER

When the text is vertically centred the positioning of the lines shall be such that the space above the first line of text equals the space below the last line of text (to allow for rounding the lower gap may be up to one pixel greater than the upper gap).

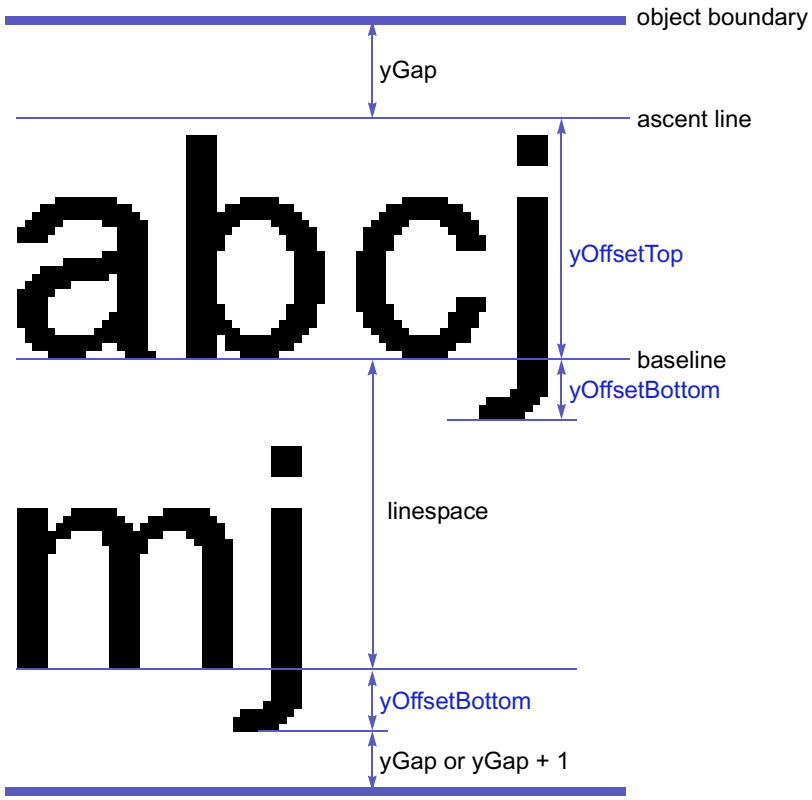


Figure D.5: Vertical measures

D.3.8.3.4 Examples

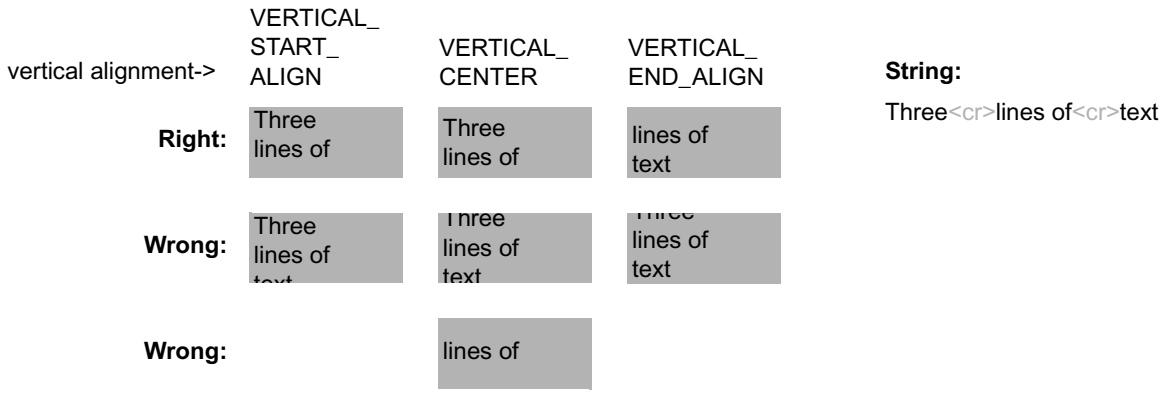


Figure D.6: Vertical positioning example 1

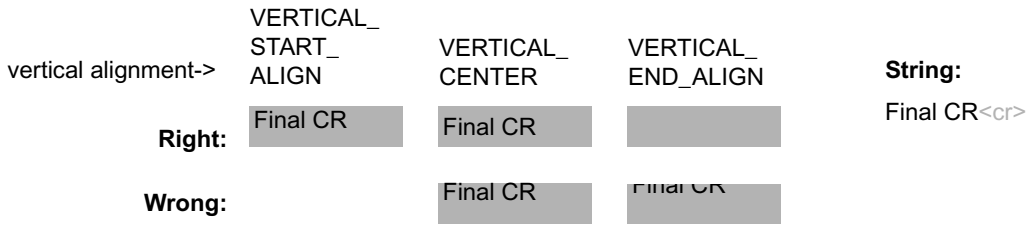


Figure D.7: Vertical positioning example 2

D.3.9 Rendering lines of text horizontally

D.3.9.1 Available width

The number of characters that may be rendered on a line is not simply dependent upon the width of the object and the horizontal escapement for each character, but also needs to consider that the rendering of the first character in a line may extend to the left of its origin. Thus, **regardless of the horizontal alignment setting** the space available for rendering a line of text within an object is:

```
available_width = object_width - xOffsetLeft
```

All values are in pixels. This derivation of `available_width` shall be used with the "logical" text width rules to determine text flow.

D.3.9.2 Truncation

Where a line of text is too long to fit within the `available_width` of the object, the line shall be truncated.

NOTE: This addresses the case where text wrapping has not made the text fit. This can happen either because the text wrapping setting is false, or because a single word is too long to fit.

The result shall be as if the complete line were aligned appropriately on the object (taking into account the horizontal alignment setting) with only those characters which can be completely presented being rendered. That is those characters:

- Whose origin is more than `xOffsetLeft` right of the left hand edge of the object.
- Whose right hand edge falls inside the right hand edge of the object.

For example:

- If the horizontal alignment setting is `HORIZONTAL_END_ALIGN` then a portion of text from the right end of the line will be rendered with its edge aligned to the right edge of the object.
- If the horizontal alignment setting is `HORIZONTAL_CENTER` the centre of the string will appear at the centre of the object with excess characters being truncated from each end.

See also clause D.3.10 "Text overflow" on page 528.

D.3.9.3 Placement

- When the horizontal alignment setting is `HORIZONTAL_START_ALIGN` the origin of the left most character shall be `xOffsetLeft` inside the left edge of the object.
- When the horizontal alignment setting is `HORIZONTAL_CENTER` the positioning of the characters shall be such that the gap to the left of the text equals the gap to the right (to within one pixel).
- When the horizontal alignment setting is `HORIZONTAL_END_ALIGN` the origin of the right most character shall be as necessary to ensure that it is completely visible when rendered.

NOTE 1: `xOffsetLeft` allows for characters (such as capital "J") that extend to the left of their origin. `xOffsetLeft` is a property of the font and so represents a consistent indent, i.e. it is independent of the first character.

NOTE 2: There are characters (e.g. fractional divisor) that can extend beyond the escapement indicated by their charSetWidth value. These can theoretically extend beyond the right hand edge of the object if the character is at the end of a word and that word is at the end of a line and the "logical width" of the line just fits the object. With the "fractional divisor" character this is a very unlikely combination of circumstances as this character is normally embedded within a "word". The handling of cases such as this by the MHP Terminal is implementation dependant.

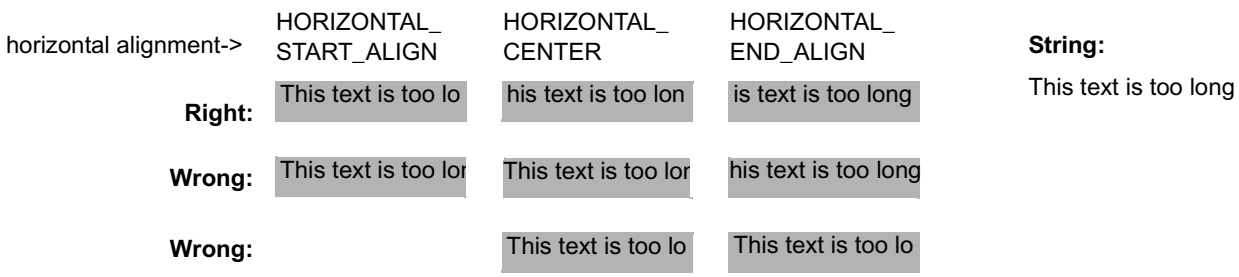


Figure D.8: Horizontal positioning examples

D.3.10 Text overflow

The `org.dvb.ui.TextOverflowListener.notifyTextOverflow` method is called if truncation occurs.

NOTE: This can be used by an application to alert the viewer or take other remedial action.

D.3.11 Tabulation

In left aligned text (the horizontal alignment setting is `HORIZONTAL_START_ALIGN`) tab stops are defined at intervals of `horizontalTabSpace` from the left edge of the object. By default the value of `horizontalTabSpace` is 56 points. "Horizontal Tabulation" advances the origin of the next character to be rendered to the next tab stop in the direction that the text is currently flowing (the character repertoire in Table E.1 only requires left to right text).

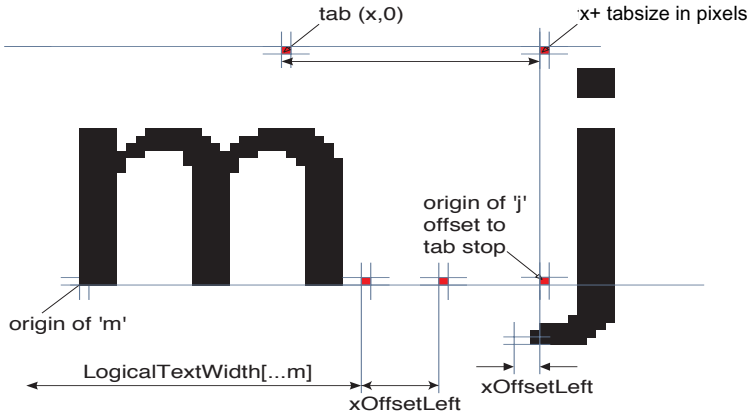


Figure D.9: Effect of horizontal tabulation

- Tab characters only have meaning in left aligned text (the horizontal alignment setting is `HORIZONTAL_START_ALIGN`). If the text is right aligned, centred or justified then tab character shall be treated as a space character.
- A tab logically advances the rendering of the text by at least the width `xOffsetLeft`. If the normal origin of the next character to be rendered after the tab character is after a tab stop, a tab character will advance the rendering to the subsequent tab stop.
- The tab stops are at regular intervals from the left edge of the object and are not affected by the `xOffsetLeft` offset to the origin of the first character.
- The tab size of 56 points shall be converted to pixels using table D.3.

D.3.12 Placing runs of characters and words

A run of characters starts from a well defined point:

- The start edge of the object.
- A tab stop.

After this origin the fine positioning of character cells and the gaps between words is not fully specified.

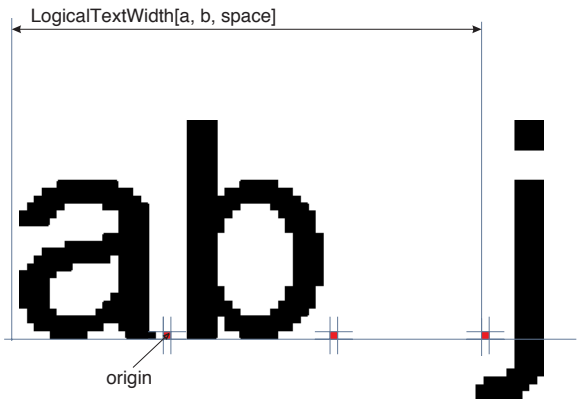


Figure D.10: Calculation of character placement

However, the following rendering requirements shall be observed to ensure that a minimum acceptable level of text legibility is achieved:

- The spacing between any pair of non whitespace characters should be consistent wherever that pair of characters is displayed.
- At the default character spacing no two non-whitespace characters should "appear" to touch, except for special cases such as where ligatures dipthongs etc. are being used. The definition of the underlying font may make this requirement impossible.
- The physical rendering of a run of text as determined by the "logical" rules shall be achieved completely within the space used for the "logical" calculation.
- No partially rendered characters shall be presented.

NOTE: The "logical" position of each character as determined by the "logical" rules is likely to be a non-integer. For renderers unable to support suitable sub-pixel positioning, e.g. a 1-bit/pixel bitmap renderer, this is impossible to implement. Thus, whilst the "logical" rules must be used to determine the flow of text, they are not required to be observed for individual character placement within this flow and other strategies may be employed as long as the requirements above are satisfied.

D.3.13 Control of text flow

See the definition of the DVB text layout manager.

D.4 Text mark-up

This clause on text mark-up applies to "High level rendering".

D.4.1 White Space Characters

Certain non-printing characters have special meaning. These are identified in Table D.4.

Table D.4: Special characters

UTF8 Value(s)	Character	Name	Breaking/ Non-breaking	Meaning
0x09	0x0009	Tab	Breaking	See clause D.3.11 "Tabulation" on page 529
0x0A	0x000A	Carriage Return	N/A	Causes the text flow to break. The origin for the next character to be rendered moves to a new baseline "linespace" below that just rendered. The horizontal position of the next line will depend on the horizontal alignment setting.
0x0D	0x000D			
0x0D0A (note)	0x000D 0x000A			
0x20	0x0020	Space	Breaking	Spaces text by the width defined for the space character. When an object has its text wrapping setting set to "true", lines may be broken at a space. See clause D.3.7 "Line breaking" on page 524.
0xC2A0	0x00A0	Non-breaking Space	Non-breaking	Identical spacing characteristics to 0x20 but is not seen as word boundary for deciding a position to break a line of text. (0xC2A0 is the UTF-8 representation of 0x00A0)
0xE28087	0x2007	Figure Space	Non-breaking	Can be used in a string of numerals as an alternative to using comma to denote "thousands". This character is not treated as a word boundary when deciding a position to break a line of text.
NOTE: The character sequence 0x0D0A shall be rendered identically to a single 0x0D.				

D.4.2 Marker characters

The codes 0x1C to 0x1F are zero width, non-spacing, non-printing characters available for use by authors as markers in objects, i.e. when using string operations.

D.4.3 Non-printing characters

Certain characters (or character sequences) have no immediate visual representation.

These include:

- 0x1C to 0x1F marker characters (see clause D.4.2).
- Format control mark-up (see clause D.4.4).
- Other characters not recognized by the receiver.

When presenting text that includes these characters the character placement shall be as if the non-printing characters were eliminated from the text before rendering. In particular, the character spacing and inter character kerning shall be computed as if the non-printing characters were not present.

D.4.4 Format Control Mark-up

Within objects mark-up codes can be used to control the presentation of text. The sequence in table D.5 marks the start of some marked-up text. For each "start of mark-up" a corresponding "end of mark-up" is defined. The byte sequence for the "end of mark-up" is illustrated in Table D.6. The minimum number of supported mark-up instances, where each instance is a start and end mark-up pair, is 256.

Table D.5: General format for start of text mark-up

	bits	value	note
`start_of_markup`	8	0x1B	Escape
`markup_start_identifier`	8	0x40 to 0x5E	"@" to "^"
`parameters_length`	8	N	
`for( i=0; i<N; i++ ) {`			
`  parameter_byte`	8	0x00 to 0xFF	
`}`			

Table D.6: General format for end of text mark-up

	bits	value	note
`end_of_markup`	8	0x1B	Escape
`markup_end_identifier`	8	0x60 to 0x7E	"`" to "~"

Table D.7: Codes defined for use in marked-up text files

Min. Nesting	start mark-up	end mark-up	description
	0x1B 0x42 0x00	0x1B 0x62	Applies "bold" style to the text enclosed (note 1)
16	0x1B 0x43 0x04 0xrr 0xgg 0xbb 0xtt	0x1B 0x63	Applies colour to the text enclosed. 0xrr specifies the red intensity, 0xgg the green, 0xbb the blue and 0xtt the transparency (where 0x00 is fully opaque and 0xff fully transparent).
NOTE 1: Not supported in this version of the present document. NOTE 2: The required text encoding for this mark-up format is described in clause 11.2.11 "Text Encodings" on page 263.			

D.4.5 Future compatibility

Compatible extensions to the set of mark-up codes may be defined in future versions of the present document. For each the `markup_end_identifier` will be 32 (0x20) greater than the `markup_start_identifier`. MHP terminals shall ignore unrecognized mark-up and shall display any text enclosed within an unrecognized mark-up.

Annex E (normative): Character set

E.1 Basic Euro Latin character set

The MHP shall be able to *display* and *accept as input* at least the set of characters shown in table E.1.

The range of characters accepted as input may be limited by the capabilities of the available input devices. This clause does not imply that keyboards (real and virtual) for MHP terminals are required to support input of this full character set.

Table E.1: Extended Latin set

Code	ISO 10646-1 [18] Character name
0x0020	SPACE
0x0021	EXCLAMATION MARK
0x0022	QUOTATION MARK
0x0023	NUMBER SIGN
0x0024	DOLLAR SIGN
0x0025	PERCENT SIGN
0x0026	AMPERSAND
0x0027	APOSTROPHE
0x0028	LEFT PARENTHESIS
0x0029	RIGHT PARENTHESIS
0x002A	ASTERISK
0x002B	PLUS SIGN
0x002C	COMMA
0x002D	HYPHEN-MINUS
0x002E	FULL STOP
0x002F	SOLIDUS
0x0030	DIGIT ZERO
0x0031	DIGIT ONE
0x0032	DIGIT TWO
0x0033	DIGIT THREE
0x0034	DIGIT FOUR
0x0035	DIGIT FIVE
0x0036	DIGIT SIX
0x0037	DIGIT SEVEN
0x0038	DIGIT EIGHT
0x0039	DIGIT NINE
0x003A	COLON
0x003B	SEMICOLON
0x003C	LESS-THAN SIGN
0x003D	EQUALS SIGN
0x003E	GREATER-THAN SIGN
0x003F	QUESTION MARK
0x0040	COMMERCIAL AT
0x0041	LATIN CAPITAL LETTER A
0x0042	LATIN CAPITAL LETTER B
0x0043	LATIN CAPITAL LETTER C
0x0044	LATIN CAPITAL LETTER D
0x0045	LATIN CAPITAL LETTER E
0x0046	LATIN CAPITAL LETTER F
0x0047	LATIN CAPITAL LETTER G
0x0048	LATIN CAPITAL LETTER H
0x0049	LATIN CAPITAL LETTER I
0x004A	LATIN CAPITAL LETTER J
0x004B	LATIN CAPITAL LETTER K
0x004C	LATIN CAPITAL LETTER L
0x004D	LATIN CAPITAL LETTER M
0x004E	LATIN CAPITAL LETTER N
0x004F	LATIN CAPITAL LETTER O
0x0050	LATIN CAPITAL LETTER P
0x0051	LATIN CAPITAL LETTER Q
0x0052	LATIN CAPITAL LETTER R
0x0053	LATIN CAPITAL LETTER S
0x0054	LATIN CAPITAL LETTER T
0x0055	LATIN CAPITAL LETTER U
0x0056	LATIN CAPITAL LETTER V
0x0057	LATIN CAPITAL LETTER W
0x0058	LATIN CAPITAL LETTER X
0x0059	LATIN CAPITAL LETTER Y
0x005A	LATIN CAPITAL LETTER Z
0x005B	LEFT SQUARE BRACKET
0x005C	REVERSE SOLIDUS
0x005D	RIGHT SQUARE BRACKET
0x005E	CIRCUMFLEX ACCENT
0x005F	LOW LINE
0x0060	GRAVE ACCENT
0x0061	LATIN SMALL LETTER A
0x0062	LATIN SMALL LETTER B
0x0063	LATIN SMALL LETTER C
0x0064	LATIN SMALL LETTER D
0x0065	LATIN SMALL LETTER E
0x0066	LATIN SMALL LETTER F
0x0067	LATIN SMALL LETTER G
0x0068	LATIN SMALL LETTER H
0x0069	LATIN SMALL LETTER I
0x006A	LATIN SMALL LETTER J
0x006B	LATIN SMALL LETTER K
0x006C	LATIN SMALL LETTER L

Code	ISO 10646-1 [18] Character name
0x006D	LATIN SMALL LETTER M
0x006E	LATIN SMALL LETTER N
0x006F	LATIN SMALL LETTER O
0x0070	LATIN SMALL LETTER P
0x0071	LATIN SMALL LETTER Q
0x0072	LATIN SMALL LETTER R
0x0073	LATIN SMALL LETTER S
0x0074	LATIN SMALL LETTER T
0x0075	LATIN SMALL LETTER U
0x0076	LATIN SMALL LETTER V
0x0077	LATIN SMALL LETTER W
0x0078	LATIN SMALL LETTER X
0x0079	LATIN SMALL LETTER Y
0x007A	LATIN SMALL LETTER Z
0x007B	LEFT CURLY BRACKET
0x007C	VERTICAL LINE
0x007D	RIGHT CURLY BRACKET
0x007E	TILDE
0x00A0	NO-BREAK SPACE
0x00A1	INVERTED EXCLAMATION MARK
0x00A2	CENT SIGN
0x00A3	POUND SIGN
0x00A4	CURRENCY SIGN
0x00A5	YEN SIGN
0x00A8	DIAERESIS
0x00A9	COPYRIGHT SIGN
0x00AA	FEMININE ORDINAL INDICATOR
0x00AB	LEFT-POINTING DOUBLE ANGLE QUOTATION MARK
0x00AC	NOT SIGN
0x00AD	SOFT HYPHEN
0x00AE	REGISTERED SIGN
0x00B0	DEGREE SIGN
0x00B4	ACUTE ACCENT
0x00B6	PILCROW SIGN
0x00B7	MIDDLE DOT
0x00B8	CEDILLA
0x00BA	MASCULINE ORDINAL INDICATOR
0x00BB	RIGHT-POINTING DOUBLE ANGLE QUOTATION MARK
0x00BC	VULGAR FRACTION ONE QUARTER
0x00BD	VULGAR FRACTION ONE HALF
0x00BE	VULGAR FRACTION THREE QUARTERS
0x00BF	INVERTED QUESTION MARK
0x00C0	LATIN CAPITAL LETTER A WITH GRAVE
0x00C1	LATIN CAPITAL LETTER A WITH ACUTE
0x00C2	LATIN CAPITAL LETTER A WITH CIRCUMFLEX
0x00C3	LATIN CAPITAL LETTER A WITH TILDE
0x00C4	LATIN CAPITAL LETTER A WITH DIAERESIS
0x00C5	LATIN CAPITAL LETTER A WITH RING ABOVE
0x00C6	LATIN CAPITAL LETTER AE
0x00C7	LATIN CAPITAL LETTER C WITH CEDILLA
0x00C8	LATIN CAPITAL LETTER E WITH GRAVE
0x00C9	LATIN CAPITAL LETTER E WITH ACUTE
0x00CA	LATIN CAPITAL LETTER E WITH CIRCUMFLEX
0x00CB	LATIN CAPITAL LETTER E WITH DIAERESIS
0x00CC	LATIN CAPITAL LETTER I WITH GRAVE
0x00CD	LATIN CAPITAL LETTER I WITH ACUTE
0x00CE	LATIN CAPITAL LETTER I WITH CIRCUMFLEX
0x00CF	LATIN CAPITAL LETTER I WITH DIAERESIS
0x00D0	LATIN CAPITAL LETTER ETH
0x00D1	LATIN CAPITAL LETTER N WITH TILDE
0x00D2	LATIN CAPITAL LETTER O WITH GRAVE
0x00D3	LATIN CAPITAL LETTER O WITH ACUTE
0x00D4	LATIN CAPITAL LETTER O WITH CIRCUMFLEX
0x00D5	LATIN CAPITAL LETTER O WITH TILDE
0x00D6	LATIN CAPITAL LETTER O WITH DIAERESIS
0x00D7	MULTIPLICATION SIGN
0x00D8	LATIN CAPITAL LETTER O WITH STROKE
0x00D9	LATIN CAPITAL LETTER U WITH GRAVE
0x00DA	LATIN CAPITAL LETTER U WITH ACUTE
0x00DB	LATIN CAPITAL LETTER U WITH CIRCUMFLEX
0x00DC	LATIN CAPITAL LETTER U WITH DIAERESIS
0x00DD	LATIN CAPITAL LETTER Y WITH ACUTE
0x00DE	LATIN CAPITAL LETTER THORN
0x00DF	LATIN SMALL LETTER SHARP S
0x00E0	LATIN SMALL LETTER A WITH GRAVE
0x00E1	LATIN SMALL LETTER A WITH ACUTE
0x00E2	LATIN SMALL LETTER A WITH CIRCUMFLEX
0x00E3	LATIN SMALL LETTER A WITH TILDE
0x00E4	LATIN SMALL LETTER A WITH DIAERESIS

Code	ISO 10646-1 [18] Character name
0x00E5	LATIN SMALL LETTER A WITH RING ABOVE
0x00E6	LATIN SMALL LETTER AE
0x00E7	LATIN SMALL LETTER C WITH CEDILLA
0x00E8	LATIN SMALL LETTER E WITH GRAVE
0x00E9	LATIN SMALL LETTER E WITH ACUTE
0x00EA	LATIN SMALL LETTER E WITH CIRCUMFLEX
0x00EB	LATIN SMALL LETTER E WITH DIAERESIS
0x00EC	LATIN SMALL LETTER I WITH GRAVE
0x00ED	LATIN SMALL LETTER I WITH ACUTE
0x00EE	LATIN SMALL LETTER I WITH CIRCUMFLEX
0x00EF	LATIN SMALL LETTER I WITH DIAERESIS
0x00F0	LATIN SMALL LETTER ETH
0x00F1	LATIN SMALL LETTER N WITH TILDE
0x00F2	LATIN SMALL LETTER O WITH GRAVE
0x00F3	LATIN SMALL LETTER O WITH ACUTE
0x00F4	LATIN SMALL LETTER O WITH CIRCUMFLEX
0x00F5	LATIN SMALL LETTER O WITH TILDE
0x00F6	LATIN SMALL LETTER O WITH DIAERESIS
0x00F7	DIVISION SIGN
0x00F8	LATIN SMALL LETTER O WITH STROKE
0x00F9	LATIN SMALL LETTER U WITH GRAVE
0x00FA	LATIN SMALL LETTER U WITH ACUTE
0x00FB	LATIN SMALL LETTER U WITH CIRCUMFLEX
0x00FC	LATIN SMALL LETTER U WITH DIAERESIS
0x00FD	LATIN SMALL LETTER Y WITH ACUTE
0x00FE	LATIN SMALL LETTER THORN
0x00FF	LATIN SMALL LETTER Y WITH DIAERESIS
0x0100	LATIN CAPITAL LETTER A WITH MACRON
0x0101	LATIN SMALL LETTER A WITH MACRON
0x0102	LATIN CAPITAL LETTER A WITH BREVE
0x0103	LATIN SMALL LETTER A WITH BREVE
0x0104	LATIN CAPITAL LETTER A WITH OGONEK
0x0105	LATIN SMALL LETTER A WITH OGONEK
0x0106	LATIN CAPITAL LETTER C WITH ACUTE
0x0107	LATIN SMALL LETTER C WITH ACUTE
0x0108	LATIN CAPITAL LETTER C WITH CIRCUMFLEX

Code	ISO 10646-1 [18] Character name
0x0109	LATIN SMALL LETTER C WITH CIRCUMFLEX
0x010A	LATIN CAPITAL LETTER C WITH DOT ABOVE
0x010B	LATIN SMALL LETTER C WITH DOT ABOVE
0x010C	LATIN CAPITAL LETTER C WITH CARON
0x010D	LATIN SMALL LETTER C WITH CARON
0x010E	LATIN CAPITAL LETTER D WITH CARON
0x010F	LATIN SMALL LETTER D WITH CARON
0x0110	LATIN CAPITAL LETTER D WITH STROKE
0x0111	LATIN SMALL LETTER D WITH STROKE
0x0112	LATIN CAPITAL LETTER E WITH MACRON
0x0113	LATIN SMALL LETTER E WITH MACRON
0x0116	LATIN CAPITAL LETTER E WITH DOT ABOVE
0x0117	LATIN SMALL LETTER E WITH DOT ABOVE
0x0118	LATIN CAPITAL LETTER E WITH OGONEK
0x0119	LATIN SMALL LETTER E WITH OGONEK
0x011A	LATIN CAPITAL LETTER E WITH CARON
0x011B	LATIN SMALL LETTER E WITH CARON
0x011C	LATIN CAPITAL LETTER G WITH CIRCUMFLEX
0x011D	LATIN SMALL LETTER G WITH CIRCUMFLEX
0x011E	LATIN CAPITAL LETTER G WITH BREVE
0x011F	LATIN SMALL LETTER G WITH BREVE
0x0120	LATIN CAPITAL LETTER G WITH DOT ABOVE
0x0121	LATIN SMALL LETTER G WITH DOT ABOVE
0x0122	LATIN CAPITAL LETTER G WITH CEDILLA
0x0123	LATIN SMALL LETTER G WITH CEDILLA
0x0124	LATIN CAPITAL LETTER H WITH CIRCUMFLEX
0x0125	LATIN SMALL LETTER H WITH CIRCUMFLEX
0x0126	LATIN CAPITAL LETTER H WITH STROKE
0x0127	LATIN SMALL LETTER H WITH STROKE
0x0128	LATIN CAPITAL LETTER I WITH TILDE
0x0129	LATIN SMALL LETTER I WITH TILDE
0x012A	LATIN CAPITAL LETTER I WITH MACRON
0x012B	LATIN SMALL LETTER I WITH MACRON

Code	ISO 10646-1 [18] Character name
0x012E	LATIN CAPITAL LETTER I WITH OGONEK
0x012F	LATIN SMALL LETTER I WITH OGONEK
0x0130	LATIN CAPITAL LETTER I WITH DOT ABOVE
0x0131	LATIN SMALL LETTER DOTLESS I
0x0132	LATIN CAPITAL LIGATURE IJ
0x0133	LATIN SMALL LIGATURE IJ
0x0134	LATIN CAPITAL LETTER J WITH CIRCUMFLEX
0x0135	LATIN SMALL LETTER J WITH CIRCUMFLEX
0x0136	LATIN CAPITAL LETTER K WITH CEDILLA
0x0137	LATIN SMALL LETTER K WITH CEDILLA
0x0138	LATIN SMALL LETTER KRA
0x0139	LATIN CAPITAL LETTER L WITH ACUTE
0x013A	LATIN SMALL LETTER L WITH ACUTE
0x013B	LATIN CAPITAL LETTER L WITH CEDILLA
0x013C	LATIN SMALL LETTER L WITH CEDILLA
0x013D	LATIN CAPITAL LETTER L WITH CARON
0x013E	LATIN SMALL LETTER L WITH CARON
0x013F	LATIN CAPITAL LETTER L WITH MIDDLE DOT
0x0140	LATIN SMALL LETTER L WITH MIDDLE DOT
0x0141	LATIN CAPITAL LETTER L WITH STROKE
0x0142	LATIN SMALL LETTER L WITH STROKE
0x0143	LATIN CAPITAL LETTER N WITH ACUTE
0x0144	LATIN SMALL LETTER N WITH ACUTE
0x0145	LATIN CAPITAL LETTER N WITH CEDILLA
0x0146	LATIN SMALL LETTER N WITH CEDILLA
0x0147	LATIN CAPITAL LETTER N WITH CARON
0x0148	LATIN SMALL LETTER N WITH CARON
0x014A	LATIN CAPITAL LETTER ENG
0x014B	LATIN SMALL LETTER ENG
0x014C	LATIN CAPITAL LETTER O WITH MACRON
0x014D	LATIN SMALL LETTER O WITH MACRON
0x0152	LATIN CAPITAL LIGATURE OE
0x0153	LATIN SMALL LIGATURE OE
0x0154	LATIN CAPITAL LETTER R WITH ACUTE
0x0155	LATIN SMALL LETTER R WITH ACUTE
0x0156	LATIN CAPITAL LETTER R WITH CEDILLA
0x0157	LATIN SMALL LETTER R WITH CEDILLA
0x0158	LATIN CAPITAL LETTER R WITH CARON

Code	ISO 10646-1 [18] Character name
0x0159	LATIN SMALL LETTER R WITH CARON
0x015A	LATIN CAPITAL LETTER S WITH ACUTE
0x015B	LATIN SMALL LETTER S WITH ACUTE
0x015C	LATIN CAPITAL LETTER S WITH CIRCUMFLEX
0x015D	LATIN SMALL LETTER S WITH CIRCUMFLEX
0x015E	LATIN CAPITAL LETTER S WITH CEDILLA
0x015F	LATIN SMALL LETTER S WITH CEDILLA
0x0160	LATIN CAPITAL LETTER S WITH CARON
0x0161	LATIN SMALL LETTER S WITH CARON
0x0162	LATIN CAPITAL LETTER T WITH CEDILLA
0x0163	LATIN SMALL LETTER T WITH CEDILLA
0x0164	LATIN CAPITAL LETTER T WITH CARON
0x0165	LATIN SMALL LETTER T WITH CARON
0x0166	LATIN CAPITAL LETTER T WITH STROKE
0x0167	LATIN SMALL LETTER T WITH STROKE
0x0168	LATIN CAPITAL LETTER U WITH TILDE
0x0169	LATIN SMALL LETTER U WITH TILDE
0x016A	LATIN CAPITAL LETTER U WITH MACRON
0x016B	LATIN SMALL LETTER U WITH MACRON
0x016C	LATIN CAPITAL LETTER U WITH BREVE
0x016D	LATIN SMALL LETTER U WITH BREVE
0x016E	LATIN CAPITAL LETTER U WITH RING ABOVE
0x016F	LATIN SMALL LETTER U WITH RING ABOVE
0x0172	LATIN CAPITAL LETTER U WITH OGONEK
0x0173	LATIN SMALL LETTER U WITH OGONEK
0x0174	LATIN CAPITAL LETTER W WITH CIRCUMFLEX
0x0175	LATIN SMALL LETTER W WITH CIRCUMFLEX
0x0176	LATIN CAPITAL LETTER Y WITH CIRCUMFLEX
0x0177	LATIN SMALL LETTER Y WITH CIRCUMFLEX
0x0178	LATIN CAPITAL LETTER Y WITH DIAERESIS
0x0179	LATIN CAPITAL LETTER Z WITH ACUTE
0x017A	LATIN SMALL LETTER Z WITH ACUTE
0x017B	LATIN CAPITAL LETTER Z WITH DOT ABOVE
0x017C	LATIN SMALL LETTER Z WITH DOT ABOVE

Code	ISO 10646-1 [18] Character name
0x017D	LATIN CAPITAL LETTER Z WITH CARON
0x017E	LATIN SMALL LETTER Z WITH CARON
0x01CD	LATIN CAPITAL LETTER A WITH CARON
0x01CE	LATIN SMALL LETTER A WITH CARON
0x02C6	MODIFIER LETTER CIRCUMFLEX ACCENT
0x02C7	CARON (Mandarin Chinese third tone)
0x02C9	MODIFIER LETTER MACRON (Mandarin Chinese first tone)
0x02D8	BREVE
0x02D9	DOT ABOVE (Mandarin Chinese light tone)
0x02DA	RING ABOVE
0x02DB	OGONEK
0x02DC	SMALL TILDE
0x066B	ARABIC DECIMAL SEPARATOR
0x1E80	LATIN CAPITAL LETTER W WITH GRAVE
0x1E81	LATIN SMALL LETTER W WITH GRAVE
0x1E82	LATIN CAPITAL LETTER W WITH ACUTE
0x1E83	LATIN SMALL LETTER W WITH ACUTE
0x1E84	LATIN CAPITAL LETTER W WITH DIAERESIS
0x1E85	LATIN SMALL LETTER W WITH DIAERESIS
0x1EF2	LATIN CAPITAL LETTER Y WITH GRAVE
0x1EF3	LATIN SMALL LETTER Y WITH GRAVE
0x2007	FIGURE SPACE
0x2013	EN DASH
0x2014	EM DASH
0x2018	LEFT SINGLE QUOTATION MARK
0x2019	RIGHT SINGLE QUOTATION MARK
0x201A	SINGLE LOW-9 QUOTATION MARK
0x201C	LEFT DOUBLE QUOTATION MARK
0x201D	RIGHT DOUBLE QUOTATION MARK
0x201E	DOUBLE LOW-9 QUOTATION MARK
0x2022	BULLET
0x2026	HORIZONTAL ELLIPSIS
0x2030	PER MILLE SIGN
0x2039	SINGLE LEFT-POINTING ANGLE QUOTATION MARK
0x203A	SINGLE RIGHT-POINTING ANGLE QUOTATION MARK
0x2044	FRACTION SLASH
0x20AC	EURO SIGN
0x2122	TRADE MARK SIGN
0x2190	LEFTWARDS ARROW
0x2191	UPWARDS ARROW
0x2192	RIGHTWARDS ARROW
0x2193	DOWNWARDS ARROW
0x2212	MINUS SIGN
0x2214	DOT PLUS
0x2215	DIVISION SLASH
0x221E	INFINITY
0x266B	BEAMED EIGHTH NOTES
0x2713	CHECK MARK
0x2717	BALLOT X

Annex F (informative): Authoring and Implementation Guidelines

F.1 Authoring Guidelines

- Authoring guidelines are needed to specify those methods, classes and interfaces which are intended for use by implementations of JMF players. These methods, classes and interfaces are not intended for use by applications except for this purpose and that should be made clear.
- Authoring guidelines are needed to make it clear that it is optional for JMF controls to have an associated java.awt component. This is in the JMF documentation but the phrasing implies this an exceptional case. In many MHP receivers, the presence of such a component would be the exceptional case.To be completed.

F.2 Implementation Guidelines

To be completed.

F.3 Authoring guidelines for DVB-J

To be completed.

F.4 Authoring guidelines for DVB HTML

F.4.1 CSS2 Authoring guidelines

The selection of the CSS2 subset in the present document has been influenced by the requirements of the conformance clauses as defined by the W3C. As such, some style properties and selectors have been selected in order to respect this requirement, although they might not be fully adapted to the TV environment and its constraints. The objective of this section is to provide content authors with some guidelines on the potential impacts the use of some selectors or properties might have. Some of those guidelines are due to CPU or other limitations that may with generations of receivers at the time of the writing. This might evolve with the arrival of new generations, however content authors should be aware of the potential existence of different generations of receivers in the field.

F.4.1.1 Selectors

Content authors are advised that the use of contextual selectors - descendent, child, adjacent sibling, :first-child - as well as the attribute and the attribute value selector might cause the pattern matching process to be slow when used through the DOM APIs. For better matching efficiency, the type, id and class selectors should be favoured

Content authors are advised that the use of the :first-letter and :first-line pseudo-elements might cause the rendering to be slow. See also guidelines for content generation and the :before and :after selectors.

F.4.1.2 Properties

F.4.1.2.1 Generalities

On a general basis, use of the "auto" value for properties should be avoided and explicit values should be preferred wherever possible.

F.4.1.2.2 Visual Formatting Model

F.4.1.2.2.1 "display"

Use of the "table-header-group", "table-row-group", "table-footer-group", "table-column" and "table-column-group" values of this property might cause the rendering to be slow. These values are meant to make elements behave like the table elements. Their functionality should be well understood before using them.

F.4.1.2.2.2 "float", "clear"

Use of those properties might slow down the positioning operation. Also, for better content predictability and interoperability, absolute positioning should be favoured (see below).

F.4.1.2.2.3 "position"

Use of the "fixed" value of this property might cause the associated rendering to be slow, especially in the case where boxes with different stack levels and with some level of translucency are used through the "z-index" property. On a general basis, for better content predictability and interoperability, absolute positioning should be favoured. Also, Content authors should not make any assumptions on the way the fixed positioning functionality interacts with scrolling.

F.4.1.2.2.4 Generated Content, automatic numbering, and lists

On a general level, content generation provides convenient functionality to the content author. However, this is at the cost of increased complexity in the receiver implementation. Content authors are then advised that the use of the associated selectors (:before and :after) and properties ("content", "counter-increment", "counter-reset", "quotes") might slow down the overall rendering.

F.4.1.2.2.5 "marker-offset", "display" (value "marker") :

Use of the list properties such as "list-style-type", "list-style-image", "list-style-position", and "list-style" should be favoured to markers because of the induced complexity of the latter, its relationships with content generation and consequently its potential slowness in the rendering.

F.4.1.2.3 Colours and Background

F.4.1.2.3.1 "background-attachment"

Use of the "fixed" value of this property might cause the associated rendering to be slow. Content authors should not make any assumptions on the way the fixed positioning functionality interacts with scrolling.

Moreover, content authors should not make assumption on the presence of this functionality in a receiver since it is optional in CSS2.

F.4.1.2.4 Visual Effects

F.4.1.2.4.1 "overflow"

Use of the "scroll" or "auto" values of this property might not cause the presence of scrolling mechanisms as used in the desktop environment. Due to ergonomic reasons, implementations might choose other mechanisms.

F.4.1.2.5 Fonts

F.4.1.2.5.1 "font"

Content authors should not make any assumption on the expected results when using the "caption", "icon", "menu", "message-box", "small-caption", "status-bar" values of the "font" property, which have no associated semantics in a DVB-MHP environment.

F.4.1.2.6 Text

F.4.1.2.6.1 "text-align"

Use of the "justify" value of this property might slow down the rendering because of the induced complexity. Depending on the algorithm used by the receiver, use of this value might also affect interoperability. Content authors should be aware that conformant receivers might interpret this value as being "left" or "right" depending on the directionality of the language.

Use of a string value for this property in a table cell might also slow down the rendering and in general might be unpredictable, for example when the content flows on more than one line.

F.4.1.2.6.2 "text-shadow"

Use of the optional blur radius after the shadow offset might slow down the rendering because of the induced complexity and may not be visible on a low resolution screen. Content authors should be advised that interoperability might be affected since the algorithm for computing the blur effect has not been specified.

F.4.1.2.7 User Interface

F.4.1.2.7.1 User preferences for colours

Content authors should not make any assumption on the expected results when using the system colours which have no associated semantics in a DVB-MHP environment. Those colours are: ActiveBorder, ActiveCaption, AppWorkspace, Background, ButtonFace, ButtonHighlight, ButtonShadow, ButtonText, CaptionText, GrayText, Highlight, HighlightText, InactiveBorder, InactiveCaption, InactiveCaptionText, InfoBackground, InfoText, Menu, MenuText, Scrollbar, ThreeDDarkShadow, ThreeDFace, ThreeDHighlight, ThreeDLightShadow, ThreeDShadow, Window, WindowFrame, WindowText.

Annex G (normative): Minimum Platform Capabilities

G.1 Graphics

In the area of graphics capability the following requirements are made on MHP terminals:

G.1.1 Device capabilities

G.1.1.1 General

- The number of DVB-J applications concurrently owning instances of `HScene` is not limited except by underlying platform resources like the total memory of the MHP terminal. The MHP terminal is required to support either the "Platforms Supporting a Restricted Multi-Window System" or the "Platforms Supporting a Full Multi-Window System" implementation scenarios as defined in `org.havi.ui.HSceneFactory`. The implementation scenario "Platforms Supporting a Single Window System" is not a valid choice for MHP.
- The MHP terminal is not required to provide a mechanism for the end-user to change user input focus between `HScenes`. Hence MHP applications wishing to receive user input focus must explicitly request it.
- The MHP terminal shall implement at least one `HGraphicsDevice` which shall be full screen.
- The MHP terminal shall implement at least one `HBackgroundDevice`. These are always full screen.
- The MHP terminal shall implement at least one `HVideoDevice` which is always capable of being configured to be full screen.
- The MHP terminal shall implement at least one `HScreen` which shall support at least one video, graphics and background device as defined immediately above.

G.1.1.2 Standard definition

The following tables define HScreenConfigurations and sets of coherent HScreenConfigurations for MHP terminals not supporting high definition video.

MHP terminals capable of 4:3 output and 16:9 output (such as set top boxes but also IDTVs capable of a "reduced scan") shall, regardless of the aspect ratio of the attached display (to the extent this is known), support all mandatory configurations and sets of coherent screen configurations in the appropriate table. MHP terminals capable of outputting a signal in only one aspect ratio shall support all mandatory configurations and sets of coherent configurations for that screen aspect ratio.

Table G.1: Sets of coherent configurations for standard definition - 625-line markets

Set	Screen Aspect Ratio	HGraphics Configuration		HVideo Configuration		HBackground Configuration		Notes
		Resolution	Pixel aspect ratio	Resolution	Pixel aspect ratio	Resolution	Pixel aspect ratio	
1,2	4:3	720x576	56/45	720x576	16/15	720x576	16/15	Default for 4:3 output
3,4	4:3	720x576	16/15	720x576	16/15	720x576	16/15	
5,6	*4:3*	*768x576*	*1/1*	720x576	16/15	720x576	16/15	
7,8	16:9	720x576	56/45	720x576	64/45	720x576	64/45	Default for 16:9 output
9,10	16:9	720x576	64/45	720x576	64/45	720x576	64/45	
11,12	*16:9*	*1024x576*	*1/1*	720x576	64/45	720x576	64/45	

Table G.2: Sets of coherent configurations for standard definition - 525-line markets

Set	Screen Aspect Ratio	HGraphics Configuration		HVideo Configuration		HBackground Configuration		Notes
		Resolution	Pixel aspect ratio	Resolution	Pixel aspect ratio	Resolution	Pixel aspect ratio	
1,2	4:3	720x480	47/45	720x480	8/9	720x480	8/9	Default for 4:3 output
3,4	4:3	720x480	8/9	720x480	8/9	720x480	8/9	
5,6	*4:3*	*640x480*	*1/1*	720x480	8/9	720x480	8/9	
7,8	16:9	720x480	47/45	720x480	32/27	720x480	32/27	Default for 16:9 output
9,10	16:9	720x480	32/27	720x480	32/27	720x480	32/27	
11,12	*16:9*	*854x480*	*1/1*	720x480	32/27	720x480	32/27	

The following additional requirements shall apply concerning both the above tables;

- HScreenConfigurations and sets of coherent screen configurations shown in *italics* are always optional.
- Each row shall correspond to two sets of coherent configurations since for each possible combination of a HGraphicsConfiguration and a HVideoConfiguration, 2 HBackgroundConfigurations shall be supported - one a HStillImageBackgroundConfiguration (supporting the display of MPEG stills) and one just a HBackgroundConfiguration only supporting a single colour.
- All configurations in the table shall exactly cover the full area from (0,0) to (1,1).

NOTE: For video, whether the video picture covers the entire HVideoDevice depends on factors including scaling, positioning and decoder format conversion.

- Where an MHP application has the HGraphicsDevice reserved, the receiver's picture shape and/or wide screen signalling shall be set to the output aspect ratio of the HGraphicsDevice. Where the HGraphicsDevice is not reserved by an MHP application, the picture shape and/or wide screen signalling shall be set according to the configuration of the HVideoDevice and the decoder format conversion being applied to the video.
- Each required HVideoConfiguration shall have its pixels aligned (as defined by HScreenConfigTemplate.VIDEO_GRAPHICS_PIXEL_ALIGNED) with all required HGraphicsConfigurations and vice-versa.
- HGraphicsConfigurations whose pixel aspect ratio is 56/45 are HEmulatedGraphicsConfigurations corresponding to the pixel aspect ratio of a logical 14:9 screen as defined in clause 13.3.7 "14:9 Aspect Ratio Support" on page 384.

NOTE: Although default configurations are shown, application developers should note that another application may already have changed the graphics configuration from the default before they start running or may change it while they are running.

G.1.1.3 High definition

MHP terminals supporting HD shall support at least 2 HGraphicsDevices as follows;

- The one in front shall have 4 possible HGraphicsConfigurations:
  - full screen 1 280 x 720
  - full screen 960 x 540
  - full screen standard definition (16:9)
  - full screen standard definition (14:9 - HEmulatedGraphicsConfiguration).
- The one behind shall have 3 possible HGraphicsConfigurations:
  - full screen 1 280 x 720
  - full screen standard definition (16:9)
  - full screen standard definition (14:9 - HEmulatedGraphicsConfiguration).

MHP terminals shall support the simultaneous display of full screen 1 280 x 720 and full screen standard definition graphics. The present document does not define how this is supported. Some possibilities include actual hardware graphics planes, hardware assisted composition ("blitting") and rendered into a single actual hardware graphics plane (e.g. by applying a transformation in the graphics library). Where a single real hardware graphics plane is used for both these resolutions, it shall have a resolution of at least 1 280 x 720. In this case, it is an allowed implementation option that applications in the rear HGraphicsDevice are clipped by all applications in front of them, both those in the same HGraphicsDevice area and those in the front HGraphicsDevice.

The resolution of 960 x 540 shall always be supported with an actual hardware graphics plane whose resolution is at least 960 x 540. The present document permits (but does not require) that the front HGraphicsDevice can only be configured to 960 x 540 when the rear HGraphicsDevice is disabled as defined by HScreenConfigTemplate.DISABLED. Applications which want to use 960 x 540 should be careful to ask for that resolution using HScreen.getCoherentConfigurations without putting requirements on the configuration of the rear graphics plane.

In the absence of MHP application control, the default shall be full screen 1 280 x 720 graphics in front of full screen SD graphics.

NOTE: Unbound applications running on MHP terminals supporting HD should ensure that a resolution of 1 280 x 720 is always available except when it has been arranged that no applications require it. Conversely service bound MHP applications wishing to obtain a resolution of 960 x 540 on MHP terminals supporting unbound applications may need to co-ordinate this with the owner of the unbound applications.

When HD video is being decoded, the resolution of the HVideoDevice is not specified by the present document. Some possible resolutions include the following;

- The resolution of the video being decoded. Typically used if the HD display does the conversion between the transmitted video resolution and the display resolution.
- The resolution of the HD display - assuming the MHP terminal has this information. Typically used for (old) displays which only support one resolution on their input.
- Some other (neutral) resolution.

In any case, it is expected that there is a single HVideoConfiguration for HD video decoding Hence it is meaningless for MHP applications to reserve or set the HVideoConfiguration when HD video is being decoded.

When HD video is being decoded, clause G.1.6 "MPEG I frame and Video drips" on page 545 of the present document defines that support for MPEG I-frames (and hence HStillImageBackgroundConfigurations) is optional. Hence HBackgroundDevices shall support at least the following HBackgroundConfigurations;

- An HStillImageBackgroundConfiguration which is required to be available except when HD video is being decoded (in which case it is optional).
- A full screen HBackgroundConfiguration which is not an HStillImageBackgroundConfiguration and which is valid at all times.

The following tables define mandatory and optional HScreenConfigurations and sets of coherent screen configurations for high definition markets. Optional HScreenConfigurations and sets of coherent screen configurations are shown in *italics*.

Table G.3: Sets of coherent configurations for high definition

Set Number	Video Being Decoded	Front HGraphics Configuration	Rear HGraphics Configuration	HVideo Configuration	HBackground Configuration	Notes
1,2	SD	1280x720	16:9 SD	16:9 SD	16:9 SD, one configuration capable of showing a still and one not.	
3,4	SD		14:9 SD			default for SD
5,6	SD	16:9 SD	1280x720			
7,8	SD	14:9 SD				
9,10	SD	960x540	Not specified in present document			
11,12	*SD*	*1920x1080*				
13	HD	1280x720	14:9 SD	HD video	Not specified in present document	default for HD
14	HD	1280x720	16:9 SD	HD video		
15	HD	16:9 SD	1280x720	HD video		
16	HD	14:9 SD	1280x720	HD video		
17	HD	960x540	Not specified in present document	HD video		
18	*HD*	*1920x1080*		HD video		

The following additional requirements shall apply concerning the above table:

- "16:9 SD" shall mean either 720 x 576 with 64/45 pixel aspect ratio (for 625-line / 50Hz markets) or 720 x 480 with 32/27 pixel aspect ratio (for 525-line / 60Hz markets).
- "14:9 SD" shall mean either 720 x 576 with 47/45 pixel aspect ratio (for 625-line / 50Hz markets) or 720 x 480 with 47/45 pixel aspect ratio (for 525-line / 60Hz markets).
- Each of the rows shown as corresponding to two sets of coherent configurations means set where the HbackgroundConfiguration shall be a HStillImageBackgroundConfiguration (supporting the display of MPEG stills) and one set where it is just a HBackgroundConfiguration only supporting a single colour.
- "HD video" means the single HVideoConfiguration for HD video referred to earlier in this clause.
- HScreenConfigurations and sets of coherent screen configurations shown in *italics* are always optional.

G.1.2 Video presentation capabilities

- The following set of standard decoder format conversions shall be supported by all MHP terminals:

  DFC_PROCESSING_CCO

  DFC_PROCESSING_FULL

  DFC_PROCESSING_LB_16_9

  DFC_PROCESSING_PAN_SCAN

  The following modes are optional:

  DFC_PROCESSING_LB_14_9

  DFC_PROCESSING_LB_2_21_1_ON_16_9

  DFC_PROCESSING_LB_2_21_1_ON_4_3

- MHP terminals are required to support displaying MPEG video with horizontal scale factors of 2, 3/2, 1, 3/4, 1/2, 1/3, 1/4, and vertical scale factors of 2, 1, 1/2, 1/3, 1/4. At least half of the decoded image height must remain within the display raster. For horizontal scaling factors of full size and above, at least one quarter of the decoded image width must remain within the display raster. For horizontal scaling factors below full size, at least half the decoded image width must remain within the display raster. Use of the scale factor 0 for both vertical and

horizontal scaling shall result in the video being discarded and the video plane being transparent to the plane behind it, as defined by the MHP graphics reference model. These requirements also apply to HD video on MHP terminals supporting that feature.

NOTE: The present document does not specify behaviour when either but not both of the vertical or the horizontal scaling factors are zero.

- Support for component-based JMF players is only required in MHP terminals that:

  a) Support the simultaneous decoding of more than one broadcast video stream (as defined in clause 7.2.2 "Video" on page 71) on a single display (HScreen instance).

  b) Expose through the MHP-defined API, the ability to initiate and/or control such decoding.

  In these MHP terminals, all JMF players shall be able to be used as a component-based player when decoding video. In other MHP terminals, this support is optional.

G.1.3 Image processing capabilities

- All DVBGraphics objects shall support SRC and CLEAR and SRC_OVER.
  When SRC_OVER is used with DVBGraphics objects with a sample model of the type TYPE_BASE a perfect result is only guaranteed to be produced with alpha values of 0 and 1. Alpha values other than 0 and 1 can be approximated. DVBGraphics object with a type of TYPE_ADVANCED will produce a result as expected but those SRC_OVER operations are likely to be slow.
- DVBGraphics object created from a DVBBufferedImage with the type TYPE_ADVANCED shall perform SRC_OVER operations without approximations of the compositing rule.

G.1.3.1 Composition rules

MHP terminals are required to implement at least the SRC, SRC_OVER and CLEAR rules when composing graphics over video and graphics over graphics.

G.1.4 Alpha capabilities

In the composition of the graphics (AWT/HAVi components) with background and video planes (see figure 28), MHP terminals are required to implement at least 16 levels of alpha evenly spaced between 0 (completely transparent) and 255 (opaque).

Allowed approximations for the composition of graphics over other graphics are defined in clause 13.6.1.1.2 "Graphics over other graphics" on page 390.

G.1.5 Colour capabilities

The colour model is a "true colour" one. There shall be at least 4 bits per pixel for each of R. G and B.

G.1.6 MPEG I frame and Video drips

The minimum positioning and scaling capabilities defined above for MPEG video shall also apply to MPEG I frame and Video drips.

The MHP terminal shall support at least one `HStillImageBackgroundConfiguration`.

MHP terminals shall support simultaneously the display of already decoded MPEG I-frames and the decoding and display of video. It is implementation dependent as to whether the decoding of MPEG I-frames is supported simultaneously with the decoding of video.

The display of I-frames simultaneously with HD video is optional.

G.2 Audio

No audio mixing is required.

Audio played from memory may pre-empt any audio from the transport stream. This may disturb decoding of any broadcast video stream.

Audio from memory shall be output in preference to audio from stream if overall audio output has not been disabled by the user. On platforms capable of mixing audio from memory with audio from the stream it shall do this if there is a stream playing. Where audio from the stream is interrupted, decoding of it shall automatically resume when audio from memory ceases if the stream concerned is still playing. This only applies where the audio from memory and the stream are both under the control of the same MHP application. Where multiple applications are involved see clause 9.4 "Inter application resource management" on page 209.

G.3 Video

The MHP terminal is only required to support decoding of a single video stream at a given time. The number of implemented video decoders will affect the functionality of the video and background devices.

MHP terminals shall be able to present un-synchronised broadcast video and audio where explicitly requested by MHP applications. See clause 11.4.2.5.5.

G.4 Resident fonts and text rendering

G.4.1 The built-in font

At least the font Tiresias [80] shall be provided.

NOTE: Tiresias is the trade name of a product supplied by Bitstream and owned by the Royal National Institute of the Blind. This information is given for the convenience of users of the present document and does not constitute an endorsement by ETSI of the product named. Equivalent products may be used if they can be shown to lead to the same results.

The built-in font shall be supported with the weight ("PLAIN"). The default size shall be 26 points.

The built-in font shall be rendered from an outline representation with a continuous range of point sizes from 12 to 96.

NOTE: Application developers should be aware that implementations may cache glyphs for recently used sizes. Using many different sizes simultaneously may degrade performance.

Table G.4 gives example sizes for various use cases.

Table G.4: Example font sizes and use cases

Size (points)	TV lines (note) over "Cap-V"	Informative Name
36	24	Heading / Large subtitle
31	21	Subtitle
26	18	Body
24	16	Footnote
NOTE: The primary definition of the character size is the font size in points, the height of a capital letter "V" in TV lines is provided for information only.		

G.4.2 Presentation to DVB-J

The embedded font "Tiresias" shall have:

- The logical name "SansSerif" (for example returned by `java.awt.Toolkit.getFontList`).
- The family name "Tiresias" (for example returned by `java.awt.Font.getFamily`).
- The font face name "Tiresias PLAIN".

G.4.3 Text directions

The `DVBTextLayoutManager` is only required to support the following configuration of text direction:

- LINE_ORIENTATION_HORIZONTAL and START_CORNER_UPPER_LEFT.

G.5 Input events

Table G.5: Minimum set of input events

Input event
VK_0 to VK_9
VK_UP
VK_DOWN
VK_LEFT
VK_RIGHT
VK_ENTER
VK_TELETEXT
VK_COLORED_KEY_0
VK_COLORED_KEY_1
VK_COLORED_KEY_2
VK_COLORED_KEY_3

This table defines the minimum set of input events which shall be available to the set of running MHP applications if they are interested in receiving them. For DVB-J applications, this is described in more detail in clause 11.4.1.4.

NOTE 1: They are not guaranteed to be always available to any one MHP application because another application running at the same time may have one of these events exclusively reserved. The application with focus (if any) always receives all of these events unless another application within the same service has requested and been granted exclusive access to one or more events. The process for event distribution for DVB-J applications is described in more detail in annex J "(normative): DVB-J event API" on page 556.

NOTE 2: The user input device for an MHP terminal may support more events than this however this is implementation dependent. If more events than this are supported, it is equally implementation dependent whether the additional events are sent to MHP applications or sent to the MHP navigator. Events which are always sent to the MHP navigator may not be visible at all to MHP applications. For example, an MHP receiver using a conventional remote control will probably have program up/program down keys which are only ever sent to the navigator and cause service selection when received there.

NOTE 3: The specification for `java.awt.event.keyEvent`, `org.havi.ui.event.HRcEvent` and `org.dvb.event.UserEvent` do not define which VK_ codes have "valid" Unicode characters. Hence DVB-J applications cannot rely on the return value of the `getKeyChar` method for KEY_PRESSED or KEY_RELEASED events. Applications which want to use Unicode characters should use KEY_TYPED events instead.

MHP terminals intending to provide a remote control key (or equivalent) labelled “back” (or equivalent) shall use VK_ F9 as its code. MHP applications decoding MHEG-5 Broadcast Profile [66] content shall use this key as the MHEG-5 “cancel key function”. This specification does not require support for this key in all MHP terminals.

The `HRcCapabilities.getRepresentation(int)` method shall return an `HEventRepresentation` instance for each input event in the above table. Each such `HEventRepresentation` instance shall return at least one of ER_TYPE_COLOR, ER_TYPE_STRING or ER_TYPE__SYMBOL from calls to its `getType()` method. Where ER_TYPE_SYMBOL is returned, the corresponding `java.awt.Image` instance shall have the size of 32 by 32. The representations supported shall match the user input device generating the input events listed above which is shipped with the MHP terminal.

NOTE: Application developers need to be aware that a small proportion of end-users will be using user input devices not shipped with the MHP terminal, e.g. replacements and/or programmable remote controls. There is no requirement for MHP terminals to detect this.

The following mapping from key codes to remote control labelling is recommended:

- VK_COLORED_KEY_0 Red
- VK_COLORED_KEY_1 Green
- VK_COLORED_KEY_2 Yellow
- VK_COLORED_KEY_3 Blue

Additionally, it is recommended that these keys be in the order red, green yellow then blue.

G.6 Memory

In order to be able to execute MHP conformance tests, the following minimum memory requirements are defined for MHP terminals. All of these are to be measured during normal usage and operational conditions of an MHP terminal. All are to be measured in the `initXlet` method of a DVB-J application which is both the only auto-start application signalled in a service and the only application running at that time.

- Enough memory to successfully load any arbitrary 262 144 (or less) Bytes of Java class files into the memory space of the Java virtual machine. Execution of code called as part of initializing fields in classes is excluded from consideration as part of "load"ing here. RAM usage by the bytecode verifier is included in consideration as part of "load"ing here.

Enough memory to do the above and individually each of the following:

- Enough memory to successfully create a Java byte array of lengths from 1 entry to 262 144 entries.
- Enough memory to successfully load and display any full screen (at standard definition graphics resolution) 8-bit PNG image (conforming to clause 15.1 "PNG - restrictions" on page 407) from a file which contains just the mandatory information and excludes any optional extension fields or chunks.
- Enough memory to successfully load from file and play from memory 5 seconds of audio at 128 kbit/s (where kbit/s is as used inTS 101 154 [9]). It shall be measured using files that do not include any optional extension fields.
- Enough memory to successfully allocate an array of `java.lang.Object` of length 16 384 and fill each element of this array with a distinct instance of `java.lang.Object`.

The memory requirements detailed in this clause are not exhaustive. For example, the specific requirement concerning an array of type byte in no way implies that MHP terminals are exempt from requirements found elsewhere in the MHP specification (including normatively referenced specifications) for supporting arrays of other types.

NOTE: Additional detail may be added to these requirements in order to properly enable the MHP conformance tests.

G.7 Other resources

Table G.6: Minimum requirements for other resources

Feature	Specification
gamma correction in the receiver	none
HAVi mattes	Platforms are not required to implement the functionality of mattes in HAVi. Non-implementation should be implemented as specified by HAVi.
Overlapping applications	MHP terminals are not required to support overlapping top level UI containers (e.g. HScenes where DVB-J applications are concerned).
AIT section filtering	The implementation is not required to dedicate more than one section filter to monitoring the AIT.
Key lengths for TLS	Receivers shall support certificate key lengths up to and including 2 048 bits for TLS (see clause 12.10 "Security on the return channel" on page 357).
Key lengths for Application Authentication	Receivers shall support certificate key lengths up to and including 2 048 bits for application authentication (see clause 12.2 "Authentication of applications" on page 316).
Internet clients	WWW and email clients required, usenet news client optional.
Non-CA Smart Card Reader	MHP terminals are not required to include this
Stored services	No requirement for persistent storage for stored services even if other forms of persistent storage are supported.
PSTN/ISDN modem (where present)	Where such a modem is present, the MHP terminal should provide a mechanism to configure a dialing prefix, e.g. '0', to be dialled in front of the number specified by the MHP application. Where such a prefix is supported, this shall be invisible to MHP applications, for example, it shall not need to be included in entries in the permission request file.

NOTE: The values in the table below are set for the purposes of conformance testing and should not be used by application or MHP terminal developers as being indicative of the capabilities of commercial products.

Table G.7: Minimum requirements for other resources for conformance purposes

Feature	Specification
Application accessible timers (note 2)	At least 4 timers for each ServiceContext which can be presenting MHP applications at the same time. (i.e. shared between the applications signalled as part of the same service). (note 1)
MPEG-2 transport stream network interface	Shall support at least one network interface enabling reception of an MPEG-2 transport stream and selection of that transport stream from among those available to be received. This shall support those broadcast channel protocols supported by the MHP terminal (see clause 6.2 "Broadcast Channel Protocols" on page 59) and the MHP APIs defined to interface to these protocols and to control these interfaces.
Bidirectional IP network interface	MHP terminals supporting the interactive broadcast profile shall support at least one network interface for bidirectional IP traffic. This shall support those interaction channel protocols supported by the MHP terminal (see clause 6.3 "Interaction Channel Protocols" on page 62) and the MHP APIs defined to interface to these protocols and to control these interfaces.
Conditional access	None required. The absence or optional presence of one shall be correctly reported through the Conditional access API. Local regulation may require more support than this minimum
Persistent storage	At least 131 072 bytes. This shall not include the requirements of clause 12.12 "Platform minima" on page 367 for persistent storage of CRLs and RCMMs.

Feature	Specification
Application accessible MPEG-2 section filters (note 2)	At least 2 shared among all applications signalled as part of the same service. (note 1).
Application accessible DVB-J threads (note 2)	At least 4 shared among all applications signalled as part of the same service. Threads created by the platform and used to call methods of the application are excluded from this number. (note 1).
Applications in a service	MHP terminals shall not impose any arbitrary limit on the number of applications which they can support at the same time.
Memory for stored services as defined in clause 9.6.2 "Stored services" on page 211	Either 0 or greater than or equal to 65 536 bytes. This memory shall be non-volatile. If greater than zero, there shall be a means to empty this memory, at least for the purposes of running conformance tests. (note 3).
NOTE 1: These requirements apply to one set of MHP applications signalled as part of the same service. If an MHP terminal supports simultaneous execution of more than one set of signalled applications then it shall make available at least these minimum resources for each set of signalled applications which can be executed simultaneously.	
NOTE 2: "Application accessible" means guaranteed to be accessible to MHP applications through the API defined in the present document for the feature concerned. This must be regardless of the extent of any usage of that feature or function as part of the MHP terminal implementation.	
NOTE 3: Implementors should choose an actual size based on the sizes of MHP applications found in their market and not based on this largely arbitrary number.	

Annex H (normative): Extensions

Private protocols and possibly APIs are not precluded and are outside of the scope of the MHP specification.

The addition of public or protected constructors, methods or fields to classes and interfaces in the `org.dvb` namespace is **not** allowed.

Restrictions on proprietary extensions to the `org.havi.ui` packages are found in section 7.2.2 ("Profile #1: DCMs and Application Modules") of HAVi [50].

Annex I (normative): DVB-J fundamental classes

Package
org.dvb.lang

Description

Provides those core platform related features not found in the java.lang package.

Class Summary	
Classes	
DVBClassLoader	This class loader is used to load classes and resources from a search path of URLs referring to locations where Java class files may be stored.

org.dvb.lang
DVBClassLoader

Declaration

```
public abstract class DVBClassLoader extends java.security.SecureClassLoader
```

```
java.lang.Object
  |
  +--java.lang.ClassLoader
        |
        +--java.security.SecureClassLoader
              |
              +--org.dvb.lang.DVBClassLoader
```

Description

This class loader is used to load classes and resources from a search path of URLs referring to locations where Java class files may be stored.

The classes that are loaded are by default only allowed to load code through the parent classloader, or from the URLs specified when the DVBClassLoader was created.

Constructors

DVBClassLoader(URL[])

```
public DVBClassLoader(java.net.URL[] urls)
```

Constructs a new DVBClassLoader for the given URLs. The URLs will be searched in the order specified for classes and resources.

If there is a security manager, this method first calls the security manager's `checkCreateClassLoader` method to ensure creation of a class loader is allowed.

Parameters:

`urls` - the URLs from which to load classes and resources

Throws:

`java.lang.SecurityException` - if a security manager exists and its `checkCreateClassLoader` method does not allow creation of a class loader.

See Also:

`java.lang.SecurityManager.checkCreateClassLoader()`

DVBClassLoader(URL[], ClassLoader)

```
public DVBClassLoader(java.net.URL[] urls, java.lang.ClassLoader parent)
```

Constructs a new DVBClassLoader for the given URLs. The URLs will be searched in the order specified for classes and resources.

If there is a security manager, this method first calls the security manager's `checkCreateClassLoader` method to ensure creation of a class loader is allowed.

Parameters:

`urls` - the URLs from which to load classes and resources

`parent` - the parent classloader for delegation

Throws:
`java.lang.SecurityException` - if a security manager exists and its `checkCreateClassLoader` method does not allow creation of a class loader.

See Also:
`java.lang.SecurityManager.checkCreateClassLoader()`

Methods

---

findClass(String)

```
protected java.lang.Class findClass(java.lang.String name)
            throws ClassNotFoundException
```

Finds and loads the class with the specified name from the URL search path. Any URLs are searched until the class is found.

Overrides:
`findClass` in class `ClassLoader`

Parameters:
`name` - the name of the class.

Returns:
the resulting class.

Throws:
`java.lang.ClassNotFoundException` - if the named class could not be found.

---

newInstance(URL[])

```
public static org.dvb.lang.DVBClassLoader newInstance(java.net.URL[] urls)
```

Creates a new instance of DVBClassLoader for the specified URLs. If a security manager is installed, the `loadClass` method of the DVBClassLoader returned by this method will invoke the `SecurityManager.checkPackageAccess` method before loading the class.

Parameters:
`urls` - the URLs to search for classes and resources.

Returns:
the resulting class loader

---

newInstance(URL[], ClassLoader)

```
public static org.dvb.lang.DVBClassLoader newInstance(java.net.URL[] urls,
            java.lang.ClassLoader parent)
```

Creates a new instance of DVBClassLoader for the specified URLs. If a security manager is installed, the `loadClass` method of the DVBClassLoader returned by this method will invoke the `SecurityManager.checkPackageAccess` method before loading the class.

Parameters:
`urls` - the URLs to search for classes and resources.

`parent` - the parent class loader for delegation.

Returns:
the resulting class loader

Annex J (normative): DVB-J event API

Applications can use the `org.dvb.event` API, to receive events without being focused and/or to have exclusive access to events.

J.1 Overview

This API provides a mechanism allowing MHP applications to influence the routing of events to either MHP applications or the navigator. This typically would be used in a mode where the receiver is primarily used for TV viewing, allowing some events to be received by the application, and allowing the navigator to receive those events that are not requested by any MHP application. This API enables MHP applications to choose between the following mechanisms for receiving events:

- through the standard `java.awt` mechanism,
- through the standard `java.awt` mechanism, but for some events to be exclusively accessed by the application,
- through a mechanism defined by this API,
- through the mechanism defined by this API, but for some events to be exclusively accessed by the application.

The last two solutions could be used by non-graphical applications in order to receive events that are coming from the user. It could also be used by an invisible application if it wants to be presented when a specific key is pressed.

If an application wants to have exclusive access to some events and to manage them through the java.awt then it must use this API so that it can be aware of the fact that it has lost or gained access to these events. One must notice that an application based on awt event mechanism will receive events only if it is focused.

If an application has acquired exclusive access to receive an event through either of these mechanisms, it will not receive this same event through the other mechanism. An application can obtain exclusive access to an event through only one of the two mechanisms at a time.

The diagram below shows how the MHP terminal decides on the processing of an event (defined by a set of keychar/keycode, event id and modifiers). This includes deciding on the mechanisms by which the event will be dispatched and the appropriate Java class to encapsulate the event for each of these mechanisms.

.:

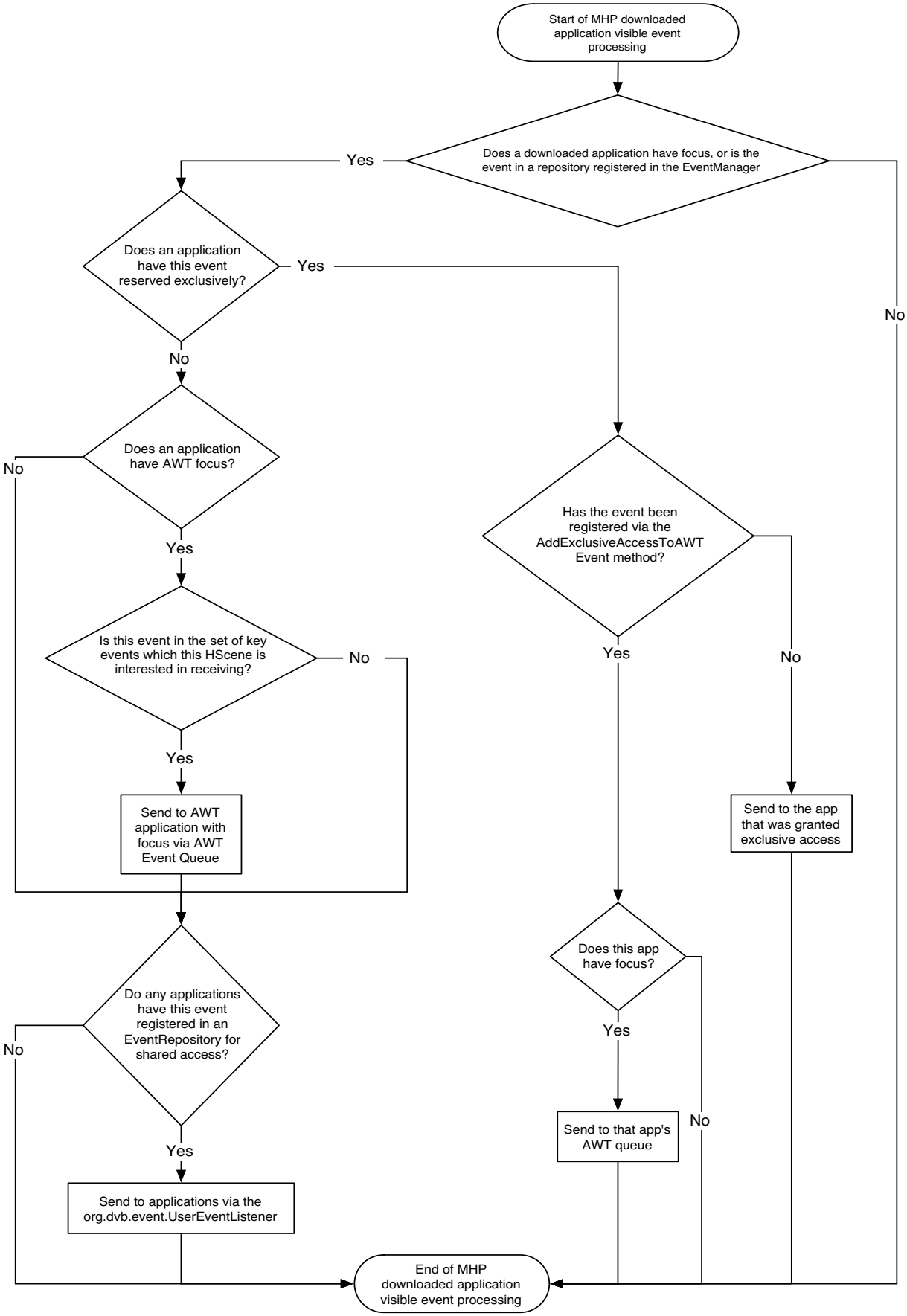


Figure J.1: The MHP downloaded application visible event distribution mechanism

NOTE: In this diagram, the terms "AWT queue" and "AWT Event Queue" are intended to apply to both events delivered directly through `java.awt` and to events delivered in HAVi event classes. Events delivered in HAVi event classes include `HFocusEvents` with a keycode as the `transfer-id` as well as `HKeyEvents`. Hence if a keycode is exclusively reserved by a `UserEventListener`, or by another application through `EventManager.addExclusiveAccessToAWTEvent()`, this does block `HFocusEvents` being generated if that keycode would be the transfer-id of the `HFocusEvent`

J.2 The resource management

An application asking for exclusive access to some events will use the resource framework defined in DAVIC 1.4.1p9 [3] so that it can be aware of the fact that it has lost access to the user events it asked for (see the example below).

J.3 The Event Repository

The UserEventRepository is the class that is used by the application to define the user events it intends to use. For the moment user events are just key events but it is a place-holder for new families of events (voice command for example). If an application asks for an exclusive access to events by means of a repository, this exclusive access will be lost at the time when one of the event is grabbed by another application. User events that can be accessed by an application are defined in the UserEvent class.

J.3.1 Example

exclusive access to events for a non-focused application

```
þimport org.davic.resources.ResourceClient.* ;
   import org.dvb.event.* ;
   class Example implements UserEventListener, ResourceStatusListener, ResourceClient {
      private int myStatus ;
      public Example () {
         EventManager em ;
         UserEventRepository repository ;
         em = EventManager.getInstance () ;
         repository = new UserEventRepository ("R1") ;
         repository.addKey (UserEvent.VK_ENTER) ;
         em.addUserListener ((UserEventListener)this, (ResourceClient)this, repository) ;
         em.addResourceStatusEventListener (this) ;
      }
      /**
   þ  * methods defined by the UserEventListener interface.
   þ  */
      public void UserEventReceived (UserEvent e) {
      }
      /**
   þ  * Methods defined by the ResourceClient interface.
   þ  */
      /**
   þ  * In the case a cooperative application asks for an user event
   þ  * exclusively used by me.
   þ  */
      public boolean requestRelease(ResourceProxy proxy, Object requestData) {
         String name ;
         // let's retrieve the name of the repository, that I have created, and
         // which contains the user event that the other application asks for.
         name = (RepositoryDescriptor)proxy.getName () ;
```

```
        if ((name.compareTo ("R1") == 0) & (myStatus == …)) {
           // Ok I release this event.
           return true ;
        } else {
           // No I need this event, sorry !
           return false ;
        }
     }
     public void release (ResourceProxy proxy) {
        …
     }
     public void notifyRelease (ResourceProxy proxy) {
        …
     }
     public void statusChanged (ResourceStatusEvent event) {
        …
     }
  }
```

J.4 Unicode

References to "Unicode" in the following API description shall be interpreted as references to ISO 10646-1 [18].

J.5 Virtual keyboards

On platforms where key events are generated from a sequence of other (intermediate) key events, the intermediate key events shall not be visible to MHP applications by any mechanism. Examples of these intermediate key events include;

- For a virtual keyboard, the sequence of keys used to navigate around that keyboard (e.g. `VK_UP`, `VK_LEFT`, `VK_ENTER`)
- For multi-key press entry (as used in some mobile phones), the keys pressed before the final value is resolved.

Package org.dvb.event

Description

Provides access to user input events before they are processed through the event mechanism of the java.awt package.

The algorithm used for generating UserEvents by the MHP terminal when reporting user input to MHP applications shall be the same as that used for java.awt.event.KeyEvent. For example, pressing the Shift key will cause a KEY_PRESSED event with a VK_SHIFT keyCode, while pressing the 'a' key will result in a VK_A keyCode. After the 'a' key is released, a KEY_RELEASED event will be fired with VK_A, followed by a KEY_TYPED event with a keyChar value of 'A'.

Class Summary	
Interfaces	
UserEventListener	The listener interface for receiving user inputs.
Classes	
EventManager	The event manager allows an application to receive events coming from the user.
OverallRepository	This class defines a repository which initially contains all the user events which can be delivered to an application.
RepositoryDescriptor	An instance of this class will be sent to clients of the DVB event API to notify them (through the interface org.davic.resources.ResourceClient) when they are about to lose, or have lost, access to an event source.
UserEvent	Represents a user event.
UserEventAvail-ableEvent	This event is sent to the resource status event listeners when user input events which had been exclusively reserved by an application are no longer exclusively reserved.
UserEventRepository	The application will use this class to define the events that it wants to receive.
UserEventUnavail-ableEvent	This event is sent to the resource status event listeners when user input events are exclusively reserved by an application.

org.dvb.event
EventManager

Declaration

```
public class EventManager implements org.davic.resources.ResourceServer
```

```
java.lang.Object
  |
  +--org.dvb.event.EventManager
```

All Implemented Interfaces:

```
org.davic.resources.ResourceServer
```

Description

The event manager allows an application to receive events coming from the user. These events can be sent exclusively to an application or can be shared between applications. The Event Manager allows also the application to ask for exclusive access to some events, these events being received either from the standard java.awt event mechanism or by the mechanism defined in this package. The EventManager is either a singleton for each MHP application or a singleton for the MHP terminal.

The right to receive events is considered as the same resource regardless of whether it is being handled exclusively or shared. An application successfully obtaining exclusive access to an event results in all other applications losing access to that event, whether the access of those applications was shared or exclusive.

Exclusive reservations shall be exclusive to a ResourceClient. If an application has successfully reserved exclusive access to an event with one ResourceClient and then attempts to reserve exclusive access with a different ResourceClient then this shall be handled as if the reservations were made by different applications.

Constructors

EventManager()

```
protected EventManager()
```

Constructor for instances of this class. This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

addExclusiveAccessToAWTEvent(ResourceClient, UserEventRepository)

```
public boolean addExclusiveAccessToAWTEvent(org.davic.resources.ResourceClient client,
            org.dvb.event.UserEventRepository userEvents)
```

An application should use this method to express its intend to have exclusive access to some events, but for these events to be received through the java.awt mechanism. The events the application wishes to receive are defined by the means of the UserEventRepository class. This repository is resolved at the time when this method call is made and adding or removing events from

the repository after this method call does not affect the subscription to those events. An exclusive event will be sent to the application if this latest is focused.

The effect of multiple calls to this method by the same application with different instances of UserEventRepository but the same ResourceClient shall be cumulative. If multiple calls to this method succeed in acquiring the events in the specified repositories then the semantics of each successful method call shall be obeyed as specified.

NOTE: This method is intended for applications that wish to ensure particular input events are exclusively handled by a particular UI component - for example, ensuring that number keys go to a PIN number entry widget and nowhere else. Reservations made by this method are not automatically cancelled when the component or application loses focus. Hence if the reservation is not released, no other application will receive the reserved events - those events will be silently discarded. This is due to the absence of any requirement for the platform to provide end users with a visual indication of which application has focus. Without such an indication, if events were not silently discarded, the PIN code events could be received by the wrong application. Applications which have reserved input events using this method should monitor for loss of focus to a different application and change the appearence of the Component - e.g. to indicate that PIN entry is no longer happening. Once the appearance has changed, the application should release the exclusive access so that the previously reserved input events become available to other applications.

Parameters:

`client` - resource client.

`userEvents` - the user events the application wants to be inform of.

Returns:

true if the events defined in the repository have been acquired, false otherwise.

Throws:

`java.lang.IllegalArgumentException` - if the client argument is set to null.

---

addResourceStatusEventListener(ResourceStatusListener)

```
public void addResourceStatusEventListener(org.davic.resources.ResourceStatusListener
            listener)
```

Adds the specified resource status listener so that an application can be aware of any changes regarding exclusive access to some events.

Specified By:

`addResourceStatusEventListener` in interface `ResourceServer`

Parameters:

`listener` - the resource status listener.

---

addUserEventListener(UserEventListener, ResourceClient, UserEventRepository)

```
public boolean addUserEventListener(org.dvb.event.UserEventListener listener,
            org.davic.resources.ResourceClient client,
            org.dvb.event.UserEventRepository userEvents)
```

Adds the specified listener to receive events coming from the user in an exclusive manner. The events the application wishes to receive are defined by the means of the UserEventRepository class. This repository is resolved at the time when this method call is made and adding or removing events from the repository after this method call does not affect the subscription to those events. The ResourceClient parameter indicates that the application wants to have an exclusive access to the user event defined in the repository.

The effect of multiple calls to this method by the same application with different instances of UserEventRepository but the same ResourceClient shall be cumulative. If multiple calls to this

method succeed in acquiring the events in the specified repositories then the semantics of each successful method call shall be obeyed as specified. Note that this can result in applications receiving the same event through more than one event listener where successful reservations with different Listeners use the same ResourceClient.

Parameters:

`listener` - the listener to receive the user events.

`client` - resource client.

`userEvents` - a class which contains the user events it wants to be informed of.

Returns:

true if the events defined in the repository have been acquired, false otherwise.

Throws:

`java.lang.IllegalArgumentException` - if the client argument is set to null.

---

addUserEventListener(UserEventListener, UserEventRepository)

```
public void addUserEventListener(org.dvb.event.UserEventListener listener,
            org.dvb.event.UserEventRepository userEvents)
```

Adds the specified listener to receive events coming from the user. The events the application wishes to receive are defined by the means of the UserEventRepository class. This repository is resolved at the time when this method call is made and adding or removing events from the repository after this method call does not affect the subscription to those events.

The effect of multiple calls to this method by the same application with different instances of UserEventRepository shall be cumulative. If multiple calls to this method succeed in acquiring the events in the specified repositories then the semantics of each successful method call shall be obeyed as specified. Note that this can result in applications receiving the same event through more than one event listener.

Parameters:

`listener` - the listener to receive the user events.

`userEvents` - a class which contains the user events it wants to be informed of.

---

getInstance()

```
public static org.dvb.event.EventManager getInstance()
```

This method returns the sole instance of the EventManager class. The EventManager class is a singleton.

Returns:

the instance of the EventManager.

---

removeExclusiveAccessToAWTEvent(ResourceClient)

```
public void removeExclusiveAccessToAWTEvent(org.davic.resources.ResourceClient client)
```

The application should use this method to release its exclusive access to user events defined by the means of the addExclusiveAccessToAWTEvent method.

Parameters:

`client` - the client that is no longer interested in events previously registered.

---

removeResourceStatusEventListener(ResourceStatusListener)

```
public void removeResourceStatusEventListener(org.davic.resources.ResourceStatusListener
            listener)
```

Removes the specified resource status listener.

Specified By:

`removeResourceStatusEventListener` in interface `ResourceServer`

Parameters:

`listener` - the listener to remove.

---

removeUserEventListener(UserEventListener)

```
public void removeUserEventListener(org.dvb.event.UserEventListener listener)
```

Removes the specified listener so that it will no longer receives user events. If it is appropriate (i.e the application has asked for an exclusive access), the exclusive access is lost.

Parameters:

`listener` - the user event listener.

org.dvb.event
OverallRepository

Declaration

```
public class OverallRepository extends UserEventRepository

java.lang.Object
  |
  +--org.dvb.event.RepositoryDescriptor
        |
        +--org.dvb.event.UserEventRepository
              |
              +--org.dvb.event.OverallRepository
```

All Implemented Interfaces:

`org.davic.resources.ResourceProxy`

Description

This class defines a repository which initially contains all the user events which can be delivered to an application. This includes all keycodes for which KEY_PRESSED and KEY_RELEASED events can be generated and all keychars for which KEY_TYPED events can be generated. Note that the set of keycodes and keychars which can be generated is dependent on the input devices of the MHP terminal. For example, this pre-defined repository could be used by an application, which requires a pin code from the user, in order to prevent another applications from receiving events.

See Also:

`UserEvent`, `org.havi.ui.event.HKeyCapabilities`

Constructors

OverallRepository()

```
public OverallRepository()
```

The constructor for the repository. The name of the constructed instance (as returned by getName()) is implementation dependent.

OverallRepository(String)

```
public OverallRepository(java.lang.String name)
```

The constructor for the repository with a name.

Parameters:

`name` - the name to use for the repository

org.dvb.event
RepositoryDescriptor

Declaration

```
public class RepositoryDescriptor implements org.davic.resources.ResourceProxy

java.lang.Object
  |
  +--org.dvb.event.RepositoryDescriptor
```

All Implemented Interfaces:

`org.davic.resources.ResourceProxy`

Direct Known Subclasses:

`UserEventRepository`

Description

An instance of this class will be sent to clients of the DVB event API to notify them (through the interface org.davic.resources.ResourceClient) when they are about to lose, or have lost, access to an event source. This object can be used by the application to get the name of the repository from which it will no longer be able to receive events. All instances of RepositoryDescriptor are also instances of UserEventRepository. This class is preserved for backwards compatibility with existing applications.

Methods

---

getClient()

```
public org.davic.resources.ResourceClient getClient()
```

Return the object which asked to be notified about withdrawal of the event source. This is the object passed as the `ResoourceClient` to whichever of the various 'add' methods on EventManager was used by the application to express interest in this repository.

Specified By:

`getClient` in interface `ResourceProxy`

Returns:

the object which asked to be notified about withdrawal of the event source. If the `UserEventRepository` has not yet been added to an `EventManager` then null shall be returned. Once the `UserEventRepository` has been added, the last used `ResourceClient` shall be returned even if the `UserEventRepository` has been since removed.

---

getName()

```
public java.lang.String getName()
```

Returns the name of the repository to which the lost, or about to be lost, user event belongs.

Returns:

String the name of the repository.

org.dvb.event
UserEvent

Declaration

```
public class UserEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.event.UserEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Represents a user event. A user event is defined by a family, a type and either a code or a character. Unless stated otherwise, all constants used in the specification of this class are defined in `java.awt.event.KeyEvent` and its parent classes.

Fields

UEF_KEY_EVENT

```
public static final int UEF_KEY_EVENT
```

the family for events that are coming from the remote control or from the keyboard.

Constructors

UserEvent(Object, int, char, long)

```
public UserEvent(java.lang.Object source, int family, char keyChar, long when)
```

Constructor for a new UserEvent object representing a key being typed. This is the combination of a key being pressed and then being released. The type of UserEvents created with this constructor shall be KEY_TYPED. Key combinations which do not result in characters, such as keys like the red key on a remote control, shall not generate KEY_TYPED events. `KEY_TYPED` events shall have no modifiers and hence shall not report any modifiers as being down.

Parameters:

`source` - the `EventManager` which is the source of the event

`family` - the event family.

`keyChar` - the character typed

`when` - a long integer that specifies the time the event occurred

Since:

MHP 1.0.1

UserEvent(Object, int, int, int, int, long)

```
public UserEvent(java.lang.Object source, int family, int type, int code, int modifiers,
            long when)
```

Constructor for a new UserEvent object representing a key being pressed.

Parameters:

`source` - the `EventManager` which is the source of the event

`family` - the event family.

`type` - the event type. Either one of KEY_PRESSED or KEY_RELEASED.

`code` - the event code. One of the constants whose name begins in “VK_” defined in java.awt.event.KeyEvent or org.havi.ui.event.HRcEvent.

`modifiers` - the modifiers active when the key was pressed. These have the same semantics as modifiers in `java.awt.event.KeyEvent`.

`when` - a long integer that specifies the time the event occurred

Methods

getCode()

```
public int getCode()
```

Returns the event code. For KEY_TYPED events, the code is VK_UNDEFINED.

Returns:

an int representing the event code.

getFamily()

```
public int getFamily()
```

Returns the event family. Could be UEF_KEY_EVENT.

Returns:

an int representing the event family.

getKeyChar()

```
public char getKeyChar()
```

Returns the character associated with the key in this event. If no valid Unicode character exists for this key event, keyChar is CHAR_UNDEFINED.

Returns:

a character

Since:

MHP 1.0.1

getModifiers()

```
public int getModifiers()
```

Returns the modifiers flag for this event. This method shall return 0 for UserEvents constructed using a constructor which does not include an input parameter specifying the modifiers.

Returns:
the modifiers flag for this event

Since:
MHP 1.0.1

---

getType()

```
public int getType()
```

Returns the event type. Could be KEY_PRESSED, KEY_RELEASED or KEY_TYPED.

Returns:
an int representing the event type.

---

getWhen()

```
public long getWhen()
```

Returns the timestamp of when this event occurred.

Returns:
a long

Since:
MHP 1.0.2

---

isAltDown()

```
public boolean isAltDown()
```

Returns whether or not the Alt modifier is down on this event. This method shall return false for UserEvents constructed using a constructor which does not include an input parameter specifying the modifiers.

Returns:
whether the Alt modifier is down on this event

Since:
MHP 1.0.1

---

isControlDown()

```
public boolean isControlDown()
```

Returns whether or not the Control modifier is down on this event. This method shall return false for UserEvents constructed using a constructor which does not include an input parameter specifying the modifiers.

Returns:
whether the Control modifier is down on this event

Since:
MHP 1.0.1

---

isMetaDown()

```
public boolean isMetaDown()
```

Returns whether or not the Meta modifier is down on this event. This method shall return false for UserEvents constructed using a constructor which does not include an input parameter specifying the modifiers.

Returns:
whether the Meta modifier is down on this event

Since:
MHP 1.0.1

---

isShiftDown()

```
public boolean isShiftDown()
```

Returns whether or not the Shift modifier is down on this event. This method shall return false for UserEvents constructed using a constructor which does not include an input parameter specifying the modifiers.

Returns:
whether the Shift modifier is down on this event

Since:
MHP 1.0.1

org.dvb.event
UserEventAvailableEvent

Declaration

```
public class UserEventAvailableEvent extends org.davic.resources.ResourceStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.davic.resources.ResourceStatusEvent
              |
              +--org.dvb.event.UserEventAvailableEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent to the resource status event listeners when user input events which had been exclusively reserved by an application are no longer exclusively reserved. Where one change in user input event reservation results in instances of this event being sent to several applications, the following shall apply.

- Each application shall receive its own instance of the UserEventRepository object which forms the source to this event. Any changes made to that repository by any one application shall not impact the instance seen by any other application.
- Any application receiving an instance of this event is allowed to attempt to exclusively reserve some of the newly available user events. In this situation, the normal resource management policy of the platform as described elsewhere in the present document shall be obeyed.
- Any applications which have registered for shared access to any of these user events shall start receiving those events following receipt of this event.

Since:

MHP 1.0.2

Constructors

UserEventAvailableEvent(Object)

```
public UserEventAvailableEvent(java.lang.Object source)
```

Constructor for the event.

Parameters:

source - a UserEventRepository which contains the events which stopped being exclusively reserved.

Since:

MHP 1.0.2

Methods

getSource()

```
public java.lang.Object getSource()
```

Returns a `UserEventRepository` which contains the events which were formerly exclusively reserved as passed into the constructor of the instance.

Overrides:

`getSource` in class `ResourceStatusEvent`

Returns:

a `UserEventRepository`

Since:

MHP 1.0.2

org.dvb.event
UserEventListener

Declaration

```
public interface UserEventListener extends java.util.EventListener
```

All Superinterfaces:

```
java.util.EventListener
```

Description

The listener interface for receiving user inputs.

Methods

---

userEventReceived(UserEvent)

```
public void userEventReceived(org.dvb.event.UserEvent e)
```

Called by the platform when a user input is received.

Parameters:

`e` - the user input event which was received

org.dvb.event
UserEventRepository

Declaration

```
public class UserEventRepository extends RepositoryDescriptor

java.lang.Object
  |
  +--org.dvb.event.RepositoryDescriptor
        |
        +--org.dvb.event.UserEventRepository
```

All Implemented Interfaces:

`org.davic.resources.ResourceProxy`

Direct Known Subclasses:

`OverallRepository`

Description

The application will use this class to define the events that it wants to receive. Events that are able to be put in the repository are defined in the UserEvent class.

Where a repository includes a `KEY_PRESSED` type event without the `KEY_RELEASED` type event for the same key code or vice versa then exclusive reservations shall be made for both event types but only the one requested shall be received by the listener. Where a repository includes a `KEY_TYPED` event without the corresponding `KEY_PRESSED` and `KEY_RELEASED` events (excluding `KEY_PRESSED` or `KEY_RELEASED` events for modifiers), when an exclusive reservation is requested, it shall also be made for those corresponding `KEY_PRESSED` and `KEY_RELEASED` events but only the requested event shall be received by the listener.

Repositories do not keep a count of the number of times a particular user event is added or removed. Repeatedly adding an event to a repository has no effect. Removing an event removes it regardless of the number of times it has been added. For example, org.dvb.event.UserEventRepository.addUserEvent(UserEvent event) does nothing in case that the event is already in the repository. For events based on a keycode, events are considered to be already in the repository if an event with the same triplet of family, type and code is already in the repository. For events based on a keychar, events are considered to be already in the repository if an event with the same family and keychar is already in the repository.

If an application loses exclusive access to a repository, it shall lose access to all events defined in that repository. Repositories are resolved when they are passed into the methods of EventManager. Adding or removing events from the repository after those method calls does not affect the subscription to those events.

Unless stated otherwise, all constants used in the specification of this class are defined in `java.awt.event.KeyEvent` and its parent classes and not in this class.

See Also:

`UserEvent`

Constructors

UserEventRepository(String)

```
public UserEventRepository(java.lang.String name)
```

The method to construct a new UserEventRepository.

Parameters:
`name` - the name of the repository.

Methods

---

addAllArrowKeys()

`public void addAllArrowKeys()`

Adds the key codes for the arrow keys (VK_LEFT, VK_RIGHT, VK_UP, VK_DOWN). Any key codes already in the repository will not be added again. After calling this method, the keycodes shall be present for both the `KEY_PRESSED` and `KEY_RELEASED` modes.

---

addAllColourKeys()

`public void addAllColourKeys()`

Adds the key codes for the colour keys (VK_COLORED_KEY_0, VK_COLORED_KEY_1, VK_COLORED_KEY_2, VK_COLORED_KEY_3). Any key codes already in the repository will not be added again. After calling this method, the keycodes shall be present for both the `KEY_PRESSED` and `KEY_RELEASED` modes.

---

addAllNumericKeys()

`public void addAllNumericKeys()`

Adds the key codes for the numeric keys (VK_0, VK_1, VK_2, VK_3, VK_4, VK_5, VK_6, VK_7, VK_8, VK_9). Any key codes already in the repository will not be added again. After calling this method, the keycodes shall be present for both the `KEY_PRESSED` and `KEY_RELEASED` modes.

---

addKey(int)

`public void addKey(int keycode)`

Adds the specified keycode to the repository. Keycodes added in this way shall be listed in the list of user events returned by the `getUserEvent` method. If a key is already in the repository, this method has no effect. After calling this method, the keycode shall be present for both the `KEY_PRESSED` and `KEY_RELEASED` modes.

Parameters:
`keycode` - the key code.

---

addUserEvent(UserEvent)

`public void addUserEvent(org.dvb.event.UserEvent event)`

Adds the given user event to the repository. The values of the modifiers (if any) in the `UserEvent` shall be ignored by the MHP terminal. The value of the source used to construct the specified `UserEvent` shall be ignored by the MHP terminal when the `UserEventRepository` is used to specify events which an application wants to receive.

Parameters:
`event` - the user event to be added in the repository.

getName()

```
public java.lang.String getName()
```

Returns the name of the current repository as passed to the constructor.

Overrides:
getName in class RepositoryDescriptor

Returns:
a String with the name of the repository.

getUserEvent()

```
public org.dvb.event.UserEvent[] getUserEvent()
```

Returns the list of the user events that are in the repository.

Returns:
an array which contains the user events that are in the repository.

removeAllArrowKeys()

```
public void removeAllArrowKeys()
```

Removes the key codes for the arrow keys (VK_LEFT, VK_RIGHT, VK_UP, VK_DOWN). Key codes from this set which are not present in the repository will be ignored. After calling this method, the keycodes shall not be present for both the KEY_PRESSED and KEY_RELEASED modes.

removeAllColourKeys()

```
public void removeAllColourKeys()
```

Removes the key codes for the colour keys (VK_COLORED_KEY_0, VK_COLORED_KEY_1, VK_COLORED_KEY_2, VK_COLORED_KEY_3). Key codes from this set which are not present in the repository will be ignored. After calling this method, the keycodes shall not be present for both the KEY_PRESSED and KEY_RELEASED modes.

removeAllNumericKeys()

```
public void removeAllNumericKeys()
```

Remove the key codes for the numeric keys (VK_0, VK_1, VK_2, VK_3, VK_4, VK_5, VK_6, VK_7, VK_8, VK_9). Key codes from this set which are not present in the repository will be ignored. After calling this method, the keycodes shall not be present for both the KEY_PRESSED and KEY_RELEASED modes.

removeKey(int)

```
public void removeKey(int keycode)
```

The method to remove a key from the repository. Removing a key which is not in the repository has no effect. After calling this method, the keycode shall not be present for both the KEY_PRESSED and KEY_RELEASED modes.

Parameters:
keycode - the key code.

removeUserEvent(UserEvent)

```
public void removeUserEvent(org.dvb.event.UserEvent event)
```

Remove a user event from the repository. Removing a user event which is not in the repository shall have no effect.

Parameters:

`event` - the event to be removed from the repository.

org.dvb.event
UserEventUnavailableEvent

Declaration

```
public class UserEventUnavailableEvent extends org.davic.resources.ResourceStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.davic.resources.ResourceStatusEvent
              |
              +--org.dvb.event.UserEventUnavailableEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

This event is sent to the resource status event listeners when user input events are exclusively reserved by an application.

Each application shall receive its own instance of the `UserEventRepository` object which forms the source to this event. Any changes made to that repository by any one application shall not impact the instance seen by any other application.

Any applications which have registered for shared access to any of these user events shall stop receiving those user events following receipt of this event. If such user events become available again, a `UserEventAvailableEvent` shall be generated by the platform before any more of those user events are received by applications.

Since:

MHP 1.0.2

Constructors

UserEventUnavailableEvent(Object)

`public UserEventUnavailableEvent(java.lang.Object source)`

Constructor for the event.

Parameters:

`source` - a `UserEventRepository` which contains the events which were exclusively reserved.

Since:

MHP 1.0.2

Methods

getSource()

```
public java.lang.Object getSource()
```

Returns a `UserEventRepository` which contains the events which were exclusively reserved as passed into the constructor of the instance.

Overrides:

`getSource` in class `ResourceStatusEvent`

Returns:

a `UserEventRepository`

Since:

MHP 1.0.2

Annex K (normative): DVB-J persistent storage API

Package
org.dvb.io.persistent

Description

Provides extensions to the java.io package for access to files held in persistent storage.

Class Summary	
Classes	
FileAccessPermissions	This class encapsulates file access permissions, world, Organisation and owner.
FileAttributes	This class encapsulates the attributes of a file stored in persistent storage.

org.dvb.io.persistent
FileAccessPermissions

Declaration

```
public class FileAccessPermissions

java.lang.Object
  |
  +--org.dvb.io.persistent.FileAccessPermissions
```

Description

This class encapsulates file access permissions, world, Organisation and owner. World means all applications authorised to access persistent storage. Owner means the application which created the file. Organisation is defined as applications with the same organisation id as defined elsewhere in the present document.

Constructors

FileAccessPermissions(boolean, boolean, boolean, boolean, boolean, boolean)

```
public FileAccessPermissions(boolean readWorldAccessRight, boolean writeWorldAccessRight,
            boolean readOrganisationAccessRight, boolean writeOrganisationAccessRight,
            boolean readApplicationAccessRight, boolean writeApplicationAccessRight)
```

This constructor encodes all the file access permissions as a set of booleans.

Parameters:

`readWorldAccessRight` - read access for all applications

`writeWorldAccessRight` - write access for all applications

`readOrganisationAccessRight` - read access for organisation

`writeOrganisationAccessRight` - write access for organisation

`readApplicationAccessRight` - read access for the owner

`writeApplicationAccessRight` - write access for the owner

Methods

---

hasReadApplicationAccessRight()

```
public boolean hasReadApplicationAccessRight()
```

Query whether this permission includes read access for the owning application

Returns:

true if the owning application can have read access, otherwise false.

---

hasReadOrganisationAccessRight()

```
public boolean hasReadOrganisationAccessRight()
```

Query whether this permission includes read access for the organisation

Returns:
true if applications in this organisation can have read access, otherwise false.

---

hasReadWorldAccessRight()

```
public boolean hasReadWorldAccessRight()
```

Query whether this permission includes read access for the world.

Returns:
true if all applications can have read access, otherwise false.

---

hasWriteApplicationAccessRight()

```
public boolean hasWriteApplicationAccessRight()
```

Query whether this permission includes write access for the owning application

Returns:
true if the owning application can have write access, otherwise false.

---

hasWriteOrganisationAccessRight()

```
public boolean hasWriteOrganisationAccessRight()
```

Query whether this permission includes write access for the organisation

Returns:
true if applications in this organisation can have read access, otherwise false.

---

hasWriteWorldAccessRight()

```
public boolean hasWriteWorldAccessRight()
```

Query whether this permission includes write access for the world.

Returns:
true if all applications can have write access, otherwise false.

---

setPermissions(boolean, boolean, boolean, boolean, boolean, boolean)

```
public void setPermissions(boolean ReadWorldAccessRight, boolean WriteWorldAccessRight,
            boolean ReadOrganisationAccessRight, boolean WriteOrganisationAccessRight,
            boolean ReadApplicationAccessRight, boolean WriteApplicationAccessRight)
```

This method allows to modify the permissions on this instance of the FileAccessPermission class.

Parameters:
`ReadWorldAccessRight` - read access for all applications

`WriteWorldAccessRight` - write access for all applications

`ReadOrganisationAccessRight` - read access for organisation

`WriteOrganisationAccessRight` - write access for organisation

`ReadApplicationAccessRight` - read access for the owner

`WriteApplicationAccessRight` - write access for the owner

org.dvb.io.persistent
FileAttributes

Declaration

```
public class FileAttributes

java.lang.Object
  |
  +--org.dvb.io.persistent.FileAttributes
```

Description

This class encapsulates the attributes of a file stored in persistent storage. The default attributes for a file are low priority, owner read / write only permissions and null expiration date.

Fields

PRIORITY_HIGH

```
public static final int PRIORITY_HIGH
```

Value for use as a file priority.

PRIORITY_LOW

```
public static final int PRIORITY_LOW
```

Value for use as a file priority.

PRIORITY_MEDIUM

```
public static final int PRIORITY_MEDIUM
```

Value for use as a file priority.

Constructors

FileAttributes(Date, FileAccessPermissions, int)

```
public FileAttributes(java.util.Date expiration_date,
            org.dvb.io.persistent.FileAccessPermissions p, int priority)
```

Constructor.

Parameters:

`expiration_date` - an expiration date or null

`p` - the access permissions to use

`priority` - the priority to use in persistent storage

Methods

getExpirationDate()

```
public java.util.Date getExpirationDate()
```

Returns the expiration date. It will return the value used by the platform, which need not be the same as the value set.

Returns:
the expiration date

getFileAttributes(File)

```
public static org.dvb.io.persistent.FileAttributes getFileAttributes(java.io.File f)
            throws IOException
```

Get the attributes of a file.

Parameters:
`f` - the file to use

Returns:
a copy of the attributes of a file

Throws:
`java.lang.SecurityException` - if the application is denied access to the file or to directories needed to reach the file by security policy

`java.io.IOException` - if access to the file fails due to an IO error or if the file reference is not to a valid location in persistent storage

getPermissions()

```
public org.dvb.io.persistent.FileAccessPermissions getPermissions()
```

Returns the file access permissions

Returns:
the file access permissions

getPriority()

```
public int getPriority()
```

Returns the priority to use in persistent storage

Returns:
the priority

setExpirationDate(Date)

```
public void setExpirationDate(java.util.Date d)
```

Sets the expiration date. This field is a hint to the platform to identify the date after which a file is no longer useful as percieved by the application. The platform may choose to use a different date than the one given as a parameter.

Parameters:
`d` - the expiration date

---

setFileAttributes(FileAttributes, File)

```
public static void setFileAttributes(org.dvb.io.persistent.FileAttributes p,
            java.io.File f)
            throws IOException
```

Associate a set of file attributes with a file.

Parameters:

`p` - the file attributes to use

`f` - the file to use

Throws:

`java.lang.SecurityException` - if the application is either denied access to the file or directories needed to reach the file by security policy or is not authorised to modify the attributes of the file.

`java.io.IOException` - if access to the file fails due to an IO error or if the file reference is not to a valid location in persistent storage

---

setPermissions(FileAccessPermissions)

```
public void setPermissions(org.dvb.io.persistent.FileAccessPermissions p)
```

Sets the file access permissions.

Parameters:

`p` - the file access permissions

---

setPriority(int)

```
public void setPriority(int priority)
```

Sets the priority to use in persistent storage

Parameters:

`priority` - the priority to set

Annex L (normative): User Settings and Preferences API

Package
org.dvb.user

Description

Provides access to settings and preferences configured by the end-user.

Class Summary	
Interfaces	
UserPreferenceChange-Listener	An application wishing to be informed of any change to a user preference implements this interface.
Classes	
Facility	A facility maps a preference's name to a single value or to an array of values.
GeneralPreference	This class defines a set of general preferences.
Preference	This abstract class defines the Preference object.
UserPreferenceChan-geEvent	This class defines the event sent to appropriate listeners when a user preference has been changed.
UserPreferenceManager	The UserPreferenceManager class gives access to the user preference settings.
UserPreferencePermis-sion	This class is for user preference and setting permissions.
Exceptions	
UnsupportedPreferen-ceException	Thrown when a non-supported preference is used.

org.dvb.user
Facility

Declaration

```
public class Facility

java.lang.Object
   |
   +--org.dvb.user.Facility
```

Description

A facility maps a preference's name to a single value or to an array of values. A facility enables an application to define the list of values supported for a specified preference. For example, if an application is available in English or French then it can create a Facility ("User Language", {"English", "French"}). When the application will retrieve the "User Language" from the general preference it will specify the associated facility in order to get a Preference which will contain a set a values compatible with those supported by the application.

Constructors

Facility(String, String)

```
public Facility(java.lang.String preference, java.lang.String value)
```

Creates a Facility with a single value. This facility can be used by an application to retrieve a preference compatible with its capabilities.

Parameters:

`preference` - a String representing the name of the preference.

`value` - a String representing the value of the preference.

Facility(String, String[])

```
public Facility(java.lang.String preference, java.lang.String[] values)
```

Creates a Facility with a set of values. This facility can be used by an application to retrieve a preference compatible with its capabilities.

Parameters:

`preference` - a String representing the name of the preference.

`values` - an array of String representing the set of values.

org.dvb.user
GeneralPreference

Declaration

```
public final class GeneralPreference extends Preference

java.lang.Object
  |
  +--org.dvb.user.Preference
        |
        +--org.dvb.user.GeneralPreference
```

Description

This class defines a set of general preferences. These preferences are read from the receiver and each application (downloaded or not) can access them through the `UserPreferenceManager.read` method. The standardized preferences are “User Language”, “Parental Rating”, “User Name”, “User Address”, “User @”, “Country Code”, “Default Font Size”, “Post Code”.

When constructed, objects of this class are empty and have no values defined. Values may be added using the add methods inherited from the Preference class or by calling `UserPreferenceManager.read`.

The encodings of these standardized preferences are as follows.

- User Language: 3 letter ISO 639 language codes;
- Parental Rating: string using the same encoding as returned by `javax.tv.service.guide.ContentRatingAdvisory.getDisplayText`;
- User Name: Name of the user. This shall be in an order that is appropriate for presentation directly to the user, e.g. in Western Europe, listing the first name first and the family name last is recommended as being culturally appropriate in many locales.
- User Address: postal address of the user, may contain multiple lines separated by carriage return characters (as defined in table D-4).
- User @: e-mail address of the user in the SMTP form as defined in RFC821;
- Country Code: two letter ISO 3166-1 country code;
- Default Font Size: preferred font size for normal body text expressed in points, decimal integer value encoded as a string (26 is the default; differing size indicates a preference of different font size than usual)
- “Post Code” : no standard encoding is defined since the formats of post codes (US zip codes, German Postleitzahl) are normally country specific. The format used should be the most natural one for the country identified by the “Country Code” preference.

The preference names are treated as case-insensitive. The preference names shall be considered equal at least when the method java.lang.String.equalsIgnoreCase() returns true for the strings when the locale “EN.UK” is used. Depending on the locale used in the implementation, implementations are allowed to consider equal also other upper and lower case character pairs in addition to those defined by the “EN.UK” locale.

The standardized preference names in the present document shall only use such letters where the upper and lower case characters are recognized by the “EN.UK” locale. Since the “Post Code” preference forms part of the “User Address” preference, successful calls to UserPreferenceManager.write(..) for a GeneralPreference(“Post Code”) shall modify the “User Address” preference. Hence UserPreferenceChangeEvents shall be generated for both “Post Code” and “User Address” in this specific situation. Successful calls to UserPreferenceManager.write(...) for a GeneralPreference(“User Address”) shall generate a UserPreferenceChangeEvent for “Post Code” if and only if the post code part of the address changes.

Constructors

GeneralPreference(String)

```
public GeneralPreference(java.lang.String name)
            throws IllegalArgumentException
```

Constructs a GeneralPreference object. A general preference maps a preference name to a list of strings.

Parameters:

`name` - the general preference name.

Throws:

`java.lang.IllegalArgumentException` - if the preference's name is not supported.

org.dvb.user
Preference

Declaration

```
public abstract class Preference

java.lang.Object
   |
   +--org.dvb.user.Preference
```

Direct Known Subclasses:

GeneralPreference

Description

This abstract class defines the Preference object. A Preference maps a name to a list of favourite values. The first element in the list is the favourite value for this preference.

The preference names are treated as case-insensitive. The preference names shall be considered equal at least when the method java.lang.String.equalsIgnoreCase() returns true for the strings when the locale "EN.UK" is used. Depending on the locale used in the implementation, implementations are allowed to consider equal also other upper and lower case character pairs in addition to those defined by the "EN.UK" locale.

The standardized preference names in the present document shall only use such letters where the upper and lower case characters are recognized by the "EN.UK" locale.

Constructors

Preference()

```
protected Preference()
```

This protected constructor is only present to enable sub-classes of this one to be defined by the platform. It is not intended to be used by inter-operable applications.

Preference(String, String)

```
public Preference(java.lang.String name, java.lang.String value)
```

Creates a new preference with the specified name and the specified value. This single value will be the favourite one for this preference.

Parameters:

`name` - a String object representing the name of the preference.

`value` - a String object representing the value of the preference.

Preference(String, String[])

```
public Preference(java.lang.String name, java.lang.String[] value)
```

Creates a new preference with the specified name and the specified value set. Each value in the value set must appear only once. The behaviour if a value is duplicated is implementation dependent.

Parameters:

`name` - a String object representing the name of the preference.

`value` - an array of String objects representing the set of values for this preference ordered from the most favourite to the least favourite.

Methods

---

add(int, String)

```
public void add(int position, java.lang.String value)
```

Adds a new value for this preference. The value is inserted at the specified position. If the value is already in the list then it is moved to the position specified. 1 If the position is greater than or equal to the length of the list, then the value is added to the end of this list. If the position is negative, then the value is added to the beginning of this list. 1

Parameters:

`position` - an int representing the position in the list counting from zero.

`value` - a String representing the new value to insert.

---

add(String)

```
public void add(java.lang.String value)
```

Adds a new value for this preference. The value is added to the end of the list. If the value is already in the list then it is moved to the end of the list.

Parameters:

`value` - a String object representing the new value.

---

add(String[])

```
public void add(java.lang.String[] values)
```

Adds several new values for this preferences. The values are added to the end of the list in the same order as they are found in the array passed to this method. Any values already in the list are moved to the position in the list which they would have if they were not already present.

Parameters:

`values` - an array of strings representing the values to add

Since:

MHP 1.0.1

---

getFavourites()

```
public java.lang.String[] getFavourites()
```

Returns the list of favourite values for this preference. Returns an empty array if no value sets are defined for this preference.

Returns:

an array of String representing the favourite values for this preference.

---

getMostFavourite()

```
public java.lang.String getMostFavourite()
```

Returns the most favourite value for this preference, that is, the first element of the list.

Returns:
a String representing the most favourite value for this preference. Returns null if no value is defined for this preference

---

getName()

```
public java.lang.String getName()
```

Returns the name of the preference.

Returns:
a String object representing the name of the preference.

---

getPosition(String)

```
public int getPosition(java.lang.String value)
```

Returns the position in the list of the specified value.

Parameters:
`value` - a String representing the value to look for.

Returns:
an integer representing the position of the value in the list counting from zero. If the value is not found then it returns -1.

---

hasValue()

```
public boolean hasValue()
```

Tests if this preference has at least one value set.

Returns:
true if this preference has at least one value set, false otherwise.

---

remove(String)

```
public void remove(java.lang.String value)
```

Removes the specified value from the list of favourites. If the value is not in the list then the method call has no effect.

Parameters:
`value` - a String representing the value to remove.

---

removeAll()

```
public void removeAll()
```

Removes all the values of a preference

Since:
MHP 1.0.1

---

setMostFavourite(String)

```
public void setMostFavourite(java.lang.String value)
```

Sets the most favourite value for this preference. If the value is already in the list, then it is moved to the head. If the value is not already in the list then it is added at the head.

Parameters:

`value` - the most favourite value

---

toString()

```
public java.lang.String toString()
```

Convert name and favourites to a String.

Overrides:

`toString` in class `Object`

Returns:

the preference name and favourites

org.dvb.user
UnsupportedPreferenceException

Declaration

```
public class UnsupportedPreferenceException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.user.UnsupportedPreferenceException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when a non-supported preference is used.

Constructors

UnsupportedPreferenceException()

```
public UnsupportedPreferenceException()
```

Constructs a UnsupportedPreferenceException with no detail message.

UnsupportedPreferenceException(String)

```
public UnsupportedPreferenceException(java.lang.String a)
```

Constructs a UnsupportedPreferenceException with a detail message.

Parameters:

a - the detail message

org.dvb.user
UserPreferenceChangeEvent

Declaration

```
public class UserPreferenceChangeEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.user.UserPreferenceChangeEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This class defines the event sent to appropriate listeners when a user preference has been changed.

Constructors

UserPreferenceChangeEvent(String)

```
public UserPreferenceChangeEvent(java.lang.String preferenceName)
```

Constructs a new event.

Parameters:

preferenceName - the name of the modified preference.

Methods

---

getName()

```
public java.lang.String getName()
```

Returns the name of the modified Preference

Returns:

the Preference name.

org.dvb.user
UserPreferenceChangeListener

Declaration
```
public interface UserPreferenceChangeListener extends java.util.EventListener
```

All Superinterfaces:
`java.util.EventListener`

Description
An application wishing to be informed of any change to a user preference implements this interface.

Methods

---

receiveUserPreferenceChangeEvent(UserPreferenceChangeEvent)

```
public void receiveUserPreferenceChangeEvent(org.dvb.user.UserPreferenceChangeEvent e)
```

This method is called when a user preference changes.

Parameters:
`e` - the event notifying this event.

org.dvb.user
UserPreferenceManager

Declaration

```
public class UserPreferenceManager

java.lang.Object
  |
  +--org.dvb.user.UserPreferenceManager
```

Description

The UserPreferenceManager class gives access to the user preference settings. This class provides a set of methods that allow an application to read or save user settings. It also provides a mechanism to notify applications when a preference has been modified. The value of a user setting, retrieved with the read method, is a copy of the value that is stored in the receiver. The write method, if authorized, overwrites the stored value.

NOTE: MHP implementations are not required to validate the values in Preference objects, even those which are saved using the write method. Applications with write permissions need to be very careful that the values written are valid. Applications reading permissions need to be aware of the possibility that a previous application has set an invalid value.

Methods

---

addUserPreferenceChangeListener(UserPreferenceChangeListener)

```
public void addUserPreferenceChangeListener(org.dvb.user.UserPreferenceChangeListener l)
```

Adds a listener for changes in user preferences as held in the MHP terminal. Specifically this includes changes made by MHP applications succeeding in calling the write() method on this class. If the implementation of the MHP terminal allows the end user to change preferences then these changes also includes changes made to preferences by this mechanism. It does not include changes made to a Preference instance within the scope of a single MHP application. *

Parameters:

`l` - the listener to add.

---

getInstance()

```
public static org.dvb.user.UserPreferenceManager getInstance()
```

Return an instance of the `UserPreferenceManager` for this application. Repeated calls to this method by the same application shall return the same instance.

Returns:

an instance of `UserPreferenceManager`

---

read(Preference)

```
public void read(org.dvb.user.Preference p)
```

Allows an application to read a specified user preference. When end-user preferences are read into a `Preference` object from the MHP terminal, the ordering of these values shall be as determined by the end-user, from most preferred to least preferred to the extent that this is known.

Parameters:
`p` - an object representing the preference to read.

Throws:
`java.lang.SecurityException` - if the calling application is denied access to this preference

---

read(Preference, Facility)

```
public void read(org.dvb.user.Preference p, org.dvb.user.Facility facility)
```

Allows an application to read a specified user preference taking into account the facility defined by the application. After this method returns, the values in the `Preference` object shall be the values of that user preference with any unsupported values from the `Facility` removed from that list. Note that the order of values returned here need not be the same as that returned by `read(Preference)`.

If the intersection between the two sets of values is empty then the preference will have no value. If there is a mis-match between the name of the preference used when constructing the facility and the name of the preference used in this method then the preference will have no value.

Parameters:
`p` - an object representing the preference to read.

`facility` - the preferred values of the application for the preference

Throws:
`java.lang.SecurityException` - if the calling application is denied access to this preference

---

removeUserPreferenceChangeListener(UserPreferenceChangeListener)

```
public void removeUserPreferenceChangeListener(org.dvb.user.UserPreferenceChangeListener l)
```

Removes a listener for changes in user preferences.

Parameters:
`l` - the listener to remove.

---

write(Preference)

```
public void write(org.dvb.user.Preference p)
            throws UnsupportedPreferenceException, IOException
```

Saves the specified user preference. If this method succeeds then it will change the value of this preference for all future MHP applications.

Parameters:
`p` - the preference to save.

Throws:
`UnsupportedPreferenceException` - if the preference provided is not a standardized preference as defined for use with `GeneralPreference`.

`java.lang.SecurityException` - if the application does not have permission to call this method

`java.io.IOException` - if saving the preference fails for other I/O reasons

org.dvb.user
UserPreferencePermission

Declaration

```
public class UserPreferencePermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.user.UserPreferencePermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for user preference and setting permissions. A UserPreferencePermission contains a name, but no actions list.

The permission name can either be "read" or "write". The "read" permission allows an application to read the user preferences and settings (using `UserPreferenceManager.read`) for which read access is not always granted. Access to the following settings/preferences is always granted: "User Language", "Parental Rating", "Default Font Size" and "Country Code"

The "write" permission allows an application to modify user preferences and settings (using `UserPreferenceManager.write`).

Constructors

UserPreferencePermission(String)

`public UserPreferencePermission(java.lang.String name)`

Creates a new UserPreferencePermission with the specified name. The name is the symbolic name of the UserPreferencePermission.

Parameters:

`name` - the name of the UserPreferencePermission

UserPreferencePermission(String, String)

`public UserPreferencePermission(java.lang.String name, java.lang.String actions)`

Creates a new UserPreferencePermission object with the specified name. The name is the symbolic name of the UserPreferencePermission, and the actions String is unused and should be null. This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:

`name` - the name of the UserPreferencePermission

`actions` - should be null.

Annex M (normative): SI Access API

M.1 Unicode

References to "Unicode" in the following API description shall be interpreted as references to ISO 10646-1 [18].

Package
org.dvb.si

Description

Provides access to DVB service information.

General Design

Many of the methods in this package use a common design template. Asynchronous method calls to retrieve data from the network all return an instance of the `SIRequest` class. Applications may use this to inquire about or terminate the retrieval operation. When the retrieval operation completes, an instance of a subclass of `SIRetrievalEvent` will be sent to the `SIRetrievalListener` which the application passed in as a parameter to the original method call to retrieve data from the network. When constructing these events, the platform shall provide as the request parameter to the event constructor, the same instance of the `SIRequest` class as was returned by the original method call which started the retrieval operation. This `SIRequest` instance shall be returned by the `getSource` method on such events.

Class Summary

Interfaces

DescriptorTag	This interface defines constants corresponding to the most common descriptor tags.
PMTElementaryStream	This interface represents an elementary stream of a service.
PMTService	This interface represents a particular service carried by a transport stream.
PMTStreamType	This interface defines the constants corresponding to the different stream types
SIBouquet	This interface (together with the SITransportStreamBAT interface) represents a sub-table of the Bouquet Association Table (BAT) describing a particular bouquet.
SIEvent	This interface represents a particular event within a service.
SIInformation	This interface groups the common features of SIBouquet, SINetwork, SITransportStream, SIService, PMTService, SIEvent, SITime and PMTElementaryStream.
SIIterator	Objects implementing SIIterator interface allow to browse through a set of SI objects.
SIMonitoringListener	This interface shall be implemented by using application classes in order to listen to changes in monitored SI objects.
SIMonitoringType	This interface defines the constants corresponding to the SI information type values in SIMonitoringEvent.
SINetwork	This interface (together with the SITransportStreamNIT interface) represents a sub-table of the Network Information Table (NIT) describing a particular network.
SIRetrievalListener	This interface shall be implemented by application classes in order to receive events about completion of SI requests.
SIRunningStatus	This interface defines the constants corresponding to the running status values for services and events.
SIService	This interface represents a particular service carried by a transport stream.

Class Summary	
SIServiceType	This interface defines constants corresponding to the different service types.
SITime	This interface represents the Time and Date Table (TDT) and the (optional) Time Offset Table (TOT).
SITransportStream	This interface is the base interface for representing information about transport streams.
SITransportStreamBAT	This interface represents information about transport streams that has been retrieved from a BAT table.
SITransportStreamDescription	This interface represents the Transport Stream Description Table (TSDT).
SITransportStreamNIT	This interface represents information about transport streams that has been retrieved from a NIT table.
TextualServiceIdentifierQuery	An interface that can be implemented by objects representing DVB services.
Classes	
Descriptor	This class represents a descriptor within a sub-table.
SIDatabase	This class represents the root of the SI information hierarchy.
SILackOfResourcesEvent	This event is sent in response to a SI retrieval request when the resources needed for retrieving the data are not available, e.g. due to the necessary resources being all taken up by the calling application or other applications.
SIMonitoringEvent	Objects of this class are sent to listener objects of the using application to notify that a change in the monitored information has happened.
SINotInCacheEvent	This event is sent in response to a SI retrieval request when the request was made with the FROM_CACHE_ONLY mode and the requested data is not present in the cache.
SIObjectNotInTableEvent	This event is sent in response to a SI retrieval request when the SI table where the information about the requested object should be located has been retrieved but the requested object is not present in it.
SIRequest	Object instances of this class represent SI retrieval requests made by the application.
SIRequestCancelledEvent	This event is sent in response to a SI retrieval request when the request is cancelled with the SIRequest.cancelRequest method call.
SIRetrievalEvent	This class is the base class for events about completion of a SI retrieval request.
SISuccessfulRetrieveEvent	This event is sent in response to a SI retrieval request when the retrieve request was successfully completed.
SITableNotFoundEvent	This event is sent in response to a SI retrieval request when the SI table that should contain the requested information could not be retrieved.
SITableUpdatedEvent	This event is sent in response to a SI descriptor retrieval request when the table carrying the information about the object has been updated and the set of descriptors consistent with the old object can not be retrieved.
SIUtil	This class contains SI related utility functions.
Exceptions	
SIException	This class is the root of the SI exceptions hierarchy.
SIIllegalArgumentException	This exception is thrown when one or more of the arguments passed to a method are invalid (e.g. numeric identifiers out of range, etc.)

Class Summary	
SIInvalidPeriodException	This exception is thrown when a specified period is invalid (for example, start time is after the end time)

org.dvb.si
Descriptor

Declaration

```
public class Descriptor

java.lang.Object
  |
  +--org.dvb.si.Descriptor
```

Description

This class represents a descriptor within a sub-table.

A descriptor consist of three fields: a tag, a contentLength and the content.

The tag uniquely identifies the descriptor type. The content length indicates the number of bytes in the content. The content consists of an array of bytes of length content length. The data represented by the content is descriptor type dependent.

See Also:

DescriptorTag

Constructors

Descriptor()

```
protected Descriptor()
```

This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

getByteAt(int)

```
public byte getByteAt(int index)
            throws IndexOutOfBoundsException
```

Get a particular byte within the descriptor content

Parameters:

`index` - index to the descriptor content. Value 0 corresponds to the first byte after the length field.

Returns:

The required byte

Throws:

`java.lang.IndexOutOfBoundsException` - if index < 0 or index >= ContentLength

---

getContent()

```
public byte[] getContent()
```

Get a copy of the content of this descriptor (everything after the length field).

Returns:
a copy of the content of the descriptor

---

getContentLength()

```
public short getContentLength()
```

This method returns the length of the descriptor content as coded in the length field of this descriptor.

Returns:
The length of the descriptor content.

---

getTag()

```
public short getTag()
```

Get the descriptor tag. The value returned shall be the actual value used and is not limited to the values defined in `DescriptorTag`.

Returns:
The descriptor tag (the most common values are defined in the DescriptorTag interface)

See Also:
`DescriptorTag`

org.dvb.si
DescriptorTag

Declaration
```
public interface DescriptorTag
```

Description
This interface defines constants corresponding to the most common descriptor tags.

See Also:
Descriptor

Fields

BOUQUET_NAME

```
public static final short BOUQUET_NAME
```

Constant value for the descriptor tag as specified in EN 300 468

CA_IDENTIFIER

```
public static final short CA_IDENTIFIER
```

Constant value for the descriptor tag as specified in EN 300 468

CABLE_DELIVERY_SYSTEM

```
public static final short CABLE_DELIVERY_SYSTEM
```

Constant value for the descriptor tag as specified in EN 300 468

COMPONENT

```
public static final short COMPONENT
```

Constant value for the descriptor tag as specified in EN 300 468

CONTENT

```
public static final short CONTENT
```

Constant value for the descriptor tag as specified in EN 300 468

COUNTRY_AVAILABILITY

```
public static final short COUNTRY_AVAILABILITY
```

Constant value for the descriptor tag as specified in EN 300 468

DATA_BROADCAST

```
public static final short DATA_BROADCAST
```

Constant value for the descriptor tag as specified in EN 300 468

EXTENDED_EVENT

```
public static final short EXTENDED_EVENT
```

Constant value for the descriptor tag as specified in EN 300 468

FREQUENCY_LIST

```
public static final short FREQUENCY_LIST
```

Constant value for the descriptor tag as specified in EN 300 468

LINKAGE

```
public static final short LINKAGE
```

Constant value for the descriptor tag as specified in EN 300 468

LOCAL_TIME_OFFSET

```
public static final short LOCAL_TIME_OFFSET
```

Constant value for the descriptor tag as specified in EN 300 468

MOSAIC

```
public static final short MOSAIC
```

Constant value for the descriptor tag as specified in EN 300 468

MULTILINGUAL_BOUQUET_NAME

```
public static final short MULTILINGUAL_BOUQUET_NAME
```

Constant value for the descriptor tag as specified in EN 300 468

MULTILINGUAL_COMPONENT

```
public static final short MULTILINGUAL_COMPONENT
```

Constant value for the descriptor tag as specified in EN 300 468

MULTILINGUAL_NETWORK_NAME

```
public static final short MULTILINGUAL_NETWORK_NAME
```

Constant value for the descriptor tag as specified in EN 300 468

MULTILINGUAL_SERVICE_NAME

```
public static final short MULTILINGUAL_SERVICE_NAME
```

Constant value for the descriptor tag as specified in EN 300 468

NETWORK_NAME

```
public static final short NETWORK_NAME
```

Constant value for the descriptor tag as specified in EN 300 468

NVOD_REFERENCE

```
public static final short NVOD_REFERENCE
```

Constant value for the descriptor tag as specified in EN 300 468

PARENTAL_RATING

```
public static final short PARENTAL_RATING
```

Constant value for the descriptor tag as specified in EN 300 468

PARTIAL_TRANSPORT_STREAM

```
public static final short PARTIAL_TRANSPORT_STREAM
```

Constant value for the descriptor tag as specified in EN 300 468

PRIVATE_DATA_SPECIFIER

```
public static final short PRIVATE_DATA_SPECIFIER
```

Constant value for the descriptor tag as specified in EN 300 468

SATELLITE_DELIVERY_SYSTEM

```
public static final short SATELLITE_DELIVERY_SYSTEM
```

Constant value for the descriptor tag as specified in EN 300 468

SERVICE

```
public static final short SERVICE
```

Constant value for the descriptor tag as specified in EN 300 468

SERVICE_LIST

```
public static final short SERVICE_LIST
```

Constant value for the descriptor tag as specified in EN 300 468

SERVICE_MOVE

```
public static final short SERVICE_MOVE
```

Constant value for the descriptor tag as specified in EN 300 468

SHORT_EVENT

```
public static final short SHORT_EVENT
```

Constant value for the descriptor tag as specified in EN 300 468

SHORT_SMOOTHING_BUFFER

```
public static final short SHORT_SMOOTHING_BUFFER
```

Constant value for the descriptor tag as specified in EN 300 468

STREAM_IDENTIFIER

```
public static final short STREAM_IDENTIFIER
```

Constant value for the descriptor tag as specified in EN 300 468

STUFFING

```
public static final short STUFFING
```

Constant value for the descriptor tag as specified in EN 300 468

SUBTITLING

```
public static final short SUBTITLING
```

Constant value for the descriptor tag as specified in EN 300 468

TELEPHONE

```
public static final short TELEPHONE
```

Constant value for the descriptor tag as specified in EN 300 468

TELETEXT

```
public static final short TELETEXT
```

Constant value for the descriptor tag as specified in EN 300 468

TERRESTRIAL_DELIVERY_SYSTEM

```
public static final short TERRESTRIAL_DELIVERY_SYSTEM
```

Constant value for the descriptor tag as specified in EN 300 468

TIME_SHIFTED_EVENT

```
public static final short TIME_SHIFTED_EVENT
```

Constant value for the descriptor tag as specified in EN 300 468

TIME_SHIFTED_SERVICE

```
public static final short TIME_SHIFTED_SERVICE
```

Constant value for the descriptor tag as specified in EN 300 468

org.dvb.si
PMTElementaryStream

Declaration

```
public interface PMTElementaryStream extends SIInformation
```

All Superinterfaces:

SIInformation

Description

This interface represents an elementary stream of a service.

For each running service there is a PMT describing the elementary streams of the service. An object that implements this interface represents one such elementary stream. Each object that implements the PMTElementaryStream interface is identified by the combination of the identifiers original_network_id, transport_stream_id, service_id, component_tag (or elementary_PID).

See Also:

PMTService, PMTStreamType

Methods

---

getComponentTag()

```
public int getComponentTag()
```

Get the component tag identifier.

Returns:

The component tag. If the elementary stream does not have an associated component tag, this method returns -2.

---

getDvbLocator()

```
public org.davic.net.dvb.DvbLocator getDvbLocator()
```

Gets a DvbLocator that identifies this elementary stream

Returns:

The DvbLocator of this elementary stream

---

getElementaryPID()

```
public short getElementaryPID()
```

Get the elementary PID.

Returns:

The PID the data of elementary stream is sent on in the transport stream.

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Get the original network identification identifier.

Returns:
The original network identification.

---

getServiceID()

```
public int getServiceID()
```

Get the service identification identifier.

Returns:
The service identification.

---

getStreamType()

```
public byte getStreamType()
```

Get the stream type of this elementary stream. The value returned shall be the actual value from the descriptor loop and is not limited to the set of values defined in `PMTStreamType`.

Returns:
The stream type (some of the possible values are defined in the PMTStreamType interface).

See Also:
`PMTStreamType`

---

getTransportStreamID()

```
public int getTransportStreamID()
```

Get the transport stream identification identifier.

Returns:
The transport stream identification.

org.dvb.si
PMTService

Declaration
```
public interface PMTService extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface represents a particular service carried by a transport stream. The information is retrieved from the PMT table.

Each object that implements the PMTService interface is identified by the combination of the following identifiers: original_network_id, transport_stream_id, service_id.

Methods

---

getDvbLocator()

```
public org.davic.net.dvb.DvbLocator getDvbLocator()
```

Gets a DvbLocator that identifies this service

Returns:
The DvbLocator of this service

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Get the original network identification.

Returns:
The original network identification identifier.

---

getPcrPid()

```
public int getPcrPid()
```

Get the PCR pid.

Returns:
The PCR pid.

---

getServiceID()

```
public int getServiceID()
```

Get the service identification.

Returns:
The service identification identifier.

getTransportStreamID()

```
public int getTransportStreamID()
```

Get the transport stream identification.

Returns:
The transport stream identification identifier.

retrievePMTElementaryStreams(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrievePMTElementaryStreams(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] somePMTDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the elementary streams which compose this service from the Program Map Table (PMT).

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the PMTElementaryStream interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent. This method will retrieve PMTElementaryStreams from the same sub-table version as this PMTService instance. If this version of the sub-table is no longer available, an SITableUpdatedEvent is returned.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`somePMTDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If somePMTDescriptorTags is null, the application is not interested in descriptors. All non applicable tag values are ignored.

Returns:
An SIRequest object

Throws:
`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:
`SIRequest`, `SIRetrievalListener`, `PMTElementaryStream`

org.dvb.si
PMTStreamType

Declaration
public interface **PMTStreamType**

Description
This interface defines the constants corresponding to the different stream types

See Also:
PMTElementaryStream, PMTElementaryStream.getStreamType()

Fields

MPEG1_AUDIO

public static final byte **MPEG1_AUDIO**

Constant value for the stream type as specified in ISO/IEC 13818-1

MPEG1_VIDEO

public static final byte **MPEG1_VIDEO**

Constant value for the stream type as specified in ISO/IEC 13818-1

MPEG2_AUDIO

public static final byte **MPEG2_AUDIO**

Constant value for the stream type as specified in ISO/IEC 13818-1

MPEG2_VIDEO

public static final byte **MPEG2_VIDEO**

Constant value for the stream type as specified in ISO/IEC 13818-1

org.dvb.si
SIBouquet

Declaration
```
public interface SIBouquet extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface (together with the SITransportStreamBAT interface) represents a sub-table of the Bouquet Association Table (BAT) describing a particular bouquet.

Each object that implements the SIBouquet interface is identified by the identifier bouquet_id.

See Also:
SITransportStreamBAT

Methods

---

getBouquetID()

```
public int getBouquetID()
```

Get the identification.

Returns:
The bouquet identification of this bouquet.

---

getDescriptorTags()

```
public short[] getDescriptorTags()
```

This method defines extra semantics for the SIInformation.getDescriptorTags method. If the BAT sub-table on which this SIBouquet object is based consists of multiple sections, then this method returns the descriptor tags in the order they appear when concatenating the descriptor loops of the different sections.

Overrides:
getDescriptorTags in interface SIInformation

Returns:
The tags of the descriptors actually broadcast for the object (identified by their tags).

See Also:
SIInformation, SIInformation.getDescriptorTags()

---

getName()

```
public java.lang.String getName()
```

This method returns the name of this bouquet. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the

multilingual_bouquet_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_bouquet_name_descriptor and the name in the bouquet_name_descriptor. When this information is not available “” is returned. All control characters as defined in ETR 211 are ignored. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation

Returns:
The bouquet name of this bouquet.

---

getShortBouquetName()

```
public java.lang.String getShortBouquetName()
```

This method returns the short name (ETR 211) of this bouquet without emphasis marks. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_bouquet_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_bouquet_name_descriptor and the name in the bouquet_name_descriptor. If the descriptor is not present, “” is returned. If the string can be found but does not contain control codes for abbreviating it, the full string shall be returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The short bouquet name of this bouquet.

---

getSIServiceLocators()

```
public org.davic.net.dvb.DvbLocator[] getSIServiceLocators()
```

Get a list of DvbLocators identifying the services that belong to the bouquet.

Returns:
An array of DvbLocators identifying the services

See Also:
`org.davic.net.dvb.DvbLocator`, `SIService`

---

retrieveDescriptors(short, Object, SIRetrievalListener)

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener)
            throws SIIllegalArgumentException
```

This method defines extra semantics for the SIInformation.retrieveDescriptors method (first prototype). If the BAT sub-table on which this SIBouquet object is based consists of multiple sections, then this method returns the requested descriptors in the order they appear when concatenating the descriptor loops of the different sections.

Overrides:
`retrieveDescriptors` in interface `SIInformation`

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIInformation, SIInformation.retrieveDescriptors(short, Object, SIRetrievalListener)

---

retrieveDescriptors(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

This method defines extra semantics for the SIInformation.retrieveDescriptors method (second prototype). If the BAT sub-table on which this SIBouquet object is based consists of multiple sections, then this method returns the requested descriptors in the order they appear when concatenating the descriptor loops of the different sections. The tag values included in the someDescriptorsTags parameter are used for filtering the information that is returned. Only information related to descriptors whose tag value is included in the someDescriptorTags array is retrieved, unless the someDescriptorTags array contains -1 as its one and only item.

Overrides:
retrieveDescriptors in interface SIInformation

Parameters:
retrieveMode - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

appData - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - Descriptor tag values that are used for filtering descriptors from descriptors included in the SI table item corresponding to this object. If the array contains -1 as its one and only element, all descriptors related to this object are retrieved. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIInformation, SIInformation.retrieveDescriptors(short, Object, SIRetrievalListener, short[])

retrieveSIBouquetTransportStreams(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSIBouquetTransportStreams(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with transport streams belonging to the bouquet.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SITransportStreamBAT interface. This method will retrieve SIBouquetTransportStreams from the same sub-table version as this SIBouquet instance. If this version of the sub-table is no longer available, an SITableUpdatedEvent is returned.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the behaviour is implementation dependent. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SITransportStreamBAT`, `DescriptorTag`

org.dvb.si
SIDatabase

Declaration

```
public class SIDatabase

java.lang.Object
   |
   +--org.dvb.si.SIDatabase
```

Description

This class represents the root of the SI information hierarchy. There is one SIDatabase per network interface. In a system with a single network interface there is only one SIDatabase object.

When adding a listener to monitor for changes in an SI table (or data carried in an SI table), an event shall not be generated for the current version of that table (or data) found in the network at the time the listener is added. Events shall only be generated for changes following the detection of that current version.

Constructors

SIDatabase()

```
protected SIDatabase()
```

This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

addBouquetMonitoringListener(SIMonitoringListener, int)

```
public void addBouquetMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int bouquetId)
            throws SIIllegalArgumentException
```

Initiate monitoring of the bouquet information. When the bouquet information changes, an event will be delivered to the registered listener object.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream due to resources for the monitoring being scheduled between the monitoring activities of different tables. The present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change.

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream.

Parameters:

`listener` - listener object that will receive events when a change in the information is detected.

`bouquetId` - bouquet identifier of the bouquet whose information will be monitored.

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

---

addEventPresentFollowingMonitoringListener(SIMonitoringListener, int, int, int)

```
public void addEventPresentFollowingMonitoringListener(org.dvb.si.SIMonitoringListener
            listener, int originalNetworkId, int transportStreamId, int serviceId)
            throws SIIllegalArgumentException
```

Initiate monitoring of information in the EIT related to present and following events. When the information related to those events changes, an event will be delivered to the registered listener object.

The scope of the monitoring is determined by the original network identifier, transport stream identifier and service identifier. The listener will be notified about the change of the information in any present and following event within that scope.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream due to resources for the monitoring being scheduled between the monitoring activities of different tables. The present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change.

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream. When the referenced service is carried in the currently tuned transport stream, the terminal shall monitor this EITp/f actual and report the changes to any registered listener(s).

Parameters:

`listener` - listener object that will receive events when a change in the information is detected.

`originalNetworkId` - original network identifier specifying the scope of the monitoring.

`transportStreamId` - transport stream identifier specifying the scope of the monitoring.

`serviceId` - service identifier specifying the scope of the monitoring

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

---

addEventScheduleMonitoringListener(SIMonitoringListener, int, int, int, Date, Date)

```
public void addEventScheduleMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId, int serviceId,
            java.util.Date startTime, java.util.Date endTime)
            throws SIIllegalArgumentException, SIInvalidPeriodException
```

Initiate monitoring of information in the EIT related to scheduled events. When the information related to those events changes, an event will be delivered to the registered listener object.

The scope of the monitoring is determined by the original network identifier, transport stream identifier, service identifier, start time and end time of the schedule period. The listener will be notified about the change of the information in any scheduled event within that scope. The scope of the start time and end time shall be as specified for the parameters of the same name in SIService.retrieveScheduledSIEvents.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream due to resources for the monitoring being scheduled between the monitoring activities of different tables. The present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change.

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream.

Parameters:

`listener` - listener object that will receive events when a change in the information is detected.

`originalNetworkId` - original network identifier specifying the scope of the monitoring.

`transportStreamId` - transport stream identifier specifying the scope of the monitoring.

`serviceId` - service identifier specifying the scope of the monitoring

`startTime` - start time of the schedule period

`endTime` - end time of the schedule period

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

`SIInvalidPeriodException` - thrown if end time is before start time

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

---

addNetworkMonitoringListener(SIMonitoringListener, int)

```
public void addNetworkMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int networkId)
            throws SIIllegalArgumentException
```

Initiate monitoring of the network information. When the network information changes, an event will be delivered to the registered listener object.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream due to resources for the monitoring being scheduled between the monitoring activities of different tables. The present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change.

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream.

Parameters:

`listener` - listener object that will receive events when a change in the information is detected.

networkId - network identifier of the network whose information will be monitored.

Throws:

SIIllegalArgumentException - thrown if the identifiers are invalid (e.g. out of range)

See Also:

SIMonitoringListener, SIMonitoringEvent

---

addPMTServiceMonitoringListener(SIMonitoringListener, int, int, int)

```
public void addPMTServiceMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId, int serviceId)
            throws SIIllegalArgumentException
```

Initiate monitoring of information in the PMT related to a service. When the information related to a service changes, an event will be delivered to the registered listener object.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream due to resources for the monitoring being scheduled between the monitoring activities of different tables. Except as specified below, the present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change. When the referenced service is the currently selected service within a service context, the terminal shall monitor this PMT and report the changes to any registered listener(s).

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream.

Parameters:

listener - listener object that will receive events when a change in the information is detected.

originalNetworkId - original network identifier of the service

transportStreamId - transport stream identifier of the service

serviceId - service identifier specifying the service whose information will be monitored

Throws:

SIIllegalArgumentException - thrown if the identifiers are invalid (e.g. out of range)

See Also:

SIMonitoringListener, SIMonitoringEvent

---

addServiceMonitoringListener(SIMonitoringListener, int, int)

```
public void addServiceMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId)
            throws SIIllegalArgumentException
```

Initiate monitoring of information in the SDT related to services. When the information related to services changes, an event will be delivered to the registered listener object.

The scope of the monitoring is determined by the original network identifier and transport stream identifier. The listener will be notified about the change of the information in any service within that scope.

How the monitoring is performed is implementation dependent and especially does not necessarily need to be continuous. The event will be delivered as soon as the implementation notices the change which might have some delay relative to when the change was actually made in the stream

due to resources for the monitoring being scheduled between the monitoring activities of different tables. The present document does not set any minimum requirements for monitoring of the SI tables. This is to be done at a best effort basis by the implementation and is entirely implementation dependent. The only requirement is that when an implementation detects a change, e.g. because a resident Navigator or an MHP application has retrieved some SI information from the stream, then these listeners are notified of the change.

The monitoring stops silently and permanently when the network interface with which this SIDatabase object is associated starts tuning to another transport stream.

Parameters:

`listener` - listener object that will receive events when a change in the information is detected.

`originalNetworkId` - original network identifier specifying the scope of the monitoring.

`transportStreamId` - transport stream identifier specifying the scope of the monitoring.

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

---

getSIDatabase()

```
public static org.dvb.si.SIDatabase[] getSIDatabase()
```

Return an array of SIDatabase objects (one object per network interface). In a system with one network interface, the length of this array will be one. The network interface of each SIDatabase is used as data source for all new data accessed by this SIDatabase or SIInformation instances obtained from it.

This is the first method to be called to access the DVB-SI API. The returned SIDatabase objects provide the access point to the DVB-SI information.

Returns:

An array of SIDatabase objects, one per network interface.

---

removeBouquetMonitoringListener(SIMonitoringListener, int)

```
public void removeBouquetMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int bouquetId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for bouquet information monitoring. If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameters, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

`listener` - listener object that has previously been registered

`bouquetId` - bouquet identifier of the bouquet whose information has been requested to be monitored

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

removeEventPresentFollowingMonitoringListener(SIMonitoringListener, int, int, int)

```
public void removeEventPresentFollowingMonitoringListener(org.dvb.si.SIMonitoringListener
            listener, int originalNetworkId, int transportStreamId, int serviceId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for monitoring information related to present and following events If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameters, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

`listener` - listener object that has previously been registered

`originalNetworkId` - original network identifier specifying the scope of the monitoring.

`transportStreamId` - transport stream identifier specifying the scope of the monitoring.

`serviceId` - service identifier specifying the scope of the monitoring

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

removeEventScheduleMonitoringListener(SIMonitoringListener, int, int, int)

```
public void removeEventScheduleMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId, int serviceId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for monitoring information related to scheduled events for all periods If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameters, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

`listener` - listener object that has previously been registered

`originalNetworkId` - original network identifier specifying the scope of the monitoring.

`transportStreamId` - transport stream identifier specifying the scope of the monitoring.

`serviceId` - service identifier specifying the scope of the monitoring

Throws:

`SIIllegalArgumentException` - thrown if the identifiers are invalid (e.g. out of range)

See Also:

`SIMonitoringListener`, `SIMonitoringEvent`

removeNetworkMonitoringListener(SIMonitoringListener, int)

```
public void removeNetworkMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int networkId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for network information monitoring. If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameter, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

`listener` - listener object that has previously been registered

networkId - network identifier of the network which is no longer to be monitored by the listener

Throws:

SIIllegalArgumentException - thrown if the identifiers are invalid (e.g. out of range)

See Also:

SIMonitoringListener, SIMonitoringEvent

---

removePMTServiceMonitoringListener(SIMonitoringListener, int, int, int)

```
public void removePMTServiceMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId, int serviceId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for monitoring information in the PMT related to a service. If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameters, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

listener - listener object that has previously been registered

originalNetworkId - original network identifier of the service

transportStreamId - transport stream identifier of the service

serviceId - service identifier specifying the service whose information has been requested to be monitored

Throws:

SIIllegalArgumentException - thrown if the identifiers are invalid (e.g. out of range)

See Also:

SIMonitoringListener, SIMonitoringEvent

---

removeServiceMonitoringListener(SIMonitoringListener, int, int)

```
public void removeServiceMonitoringListener(org.dvb.si.SIMonitoringListener listener,
            int originalNetworkId, int transportStreamId)
            throws SIIllegalArgumentException
```

Removes the registration of an event listener for monitoring information related to services. If this method is called with a listener that is registered but not with the same identifiers of the SI objects as given in the parameters, the method shall fail silently and the listeners stays registered with those identifiers that it has been added.

Parameters:

listener - listener object that has previously been registered

originalNetworkId - original network identifier specifying the scope of the monitoring.

transportStreamId - transport stream identifier specifying the scope of the monitoring.

Throws:

SIIllegalArgumentException - thrown if the identifiers are invalid (e.g. out of range)

See Also:

SIMonitoringListener, SIMonitoringEvent

---

retrieveActualSINetwork(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveActualSINetwork(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
```

```
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the actual network. The actual network is the network carrying the transport stream currently selected by the network interface connected to this SIDatabase.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SINetwork interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent or SITableNotFoundEvent

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SINetwork`, `DescriptorTag`

---

retrieveActualSIServices(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveActualSIServices(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the actual services. The actual services are the services in the transport stream currently selected by the network interface connected to this SIDatabase.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SIService interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SIObjectNotInTableEvent` or `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SIService, DescriptorTag

---

retrieveActualSITransportStream(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveActualSITransportStream(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the actual transport stream. The actual transport stream is the transport stream currently selected by the network interface connected to this SIDatabase.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SITransportStreamNIT interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
retrieveMode - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

appData - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SITransportStream, DescriptorTag

---

retrievePMTElementaryStreams(short, Object, SIRetrievalListener, DvbLocator, short[])

```
public org.dvb.si.SIRequest retrievePMTElementaryStreams(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
```

```
org.davic.net.dvb.DvbLocator dvbLocator, short[] someDescriptorTags)
throws SIIllegalArgumentException
```

Retrieve PMT elementary stream information associated with components of a service. The required component(s) can be specified by its DVB locator.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the PMTElementaryStream interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SIObjectNotInTableEvent` or `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`dvbLocator` - DVB Locator identifying the component(s) of a service. The locator may be more specific than identifying one or more service components, but this method will only use the parts starting from the beginning up to the component tags.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid or if the locator is invalid and does not identify one or more service components

See Also:

`SIRequest`, `SIRetrievalListener`, `SIService`, `DescriptorTag`

---

retrievePMTElementaryStreams(short, Object, SIRetrievalListener, int, int, short[])

```
public org.dvb.si.SIRequest retrievePMTElementaryStreams(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            int serviceId, int componentTag, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve PMT elementary stream information associated with components of a service from the actual transport stream of this SIDatabase object. The elementary streams can be specified by their identification. When -1 is specified for `componentTag` then elementary streams shall be retrieved regardless of their component tag.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the PMTElementaryStream interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SIObjectNotInTableEvent` or `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`serviceId` - Identification of the elementary streams to be retrieved: service identifier

`componentTag` - Identification of the elementary streams to be retrieved: component tag (-1 means return elementary streams regardless of their component tag)

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid or the numeric identifiers are out of range

See Also:

`SIRequest`, `SIRetrievalListener`, `SIService`, `DescriptorTag`

---

retrievePMTService(short, Object, SIRetrievalListener, DvbLocator, short[])

```
public org.dvb.si.SIRequest retrievePMTService(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            org.davic.net.dvb.DvbLocator dvbLocator, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve PMT information associated with a service. The required service can be specified by its DVB locator.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the PMTService interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`dvbLocator` - DVB Locator identifying the service. The locator may be more specific than identifying a service, but this method will only use the parts starting from the beginning up to the service id.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid or the locator is invalid and does not identify a service

See Also:
SIRequest, SIRetrievalListener, SIService, DescriptorTag

---

retrievePMTServices(short, Object, SIRetrievalListener, int, short[])

```
public org.dvb.si.SIRequest retrievePMTServices(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            int serviceId, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve PMT information associated with services from the actual transport stream of this SIDatabase object. The required services can be specified by their identification. When -1 is specified as serviceId then services shall be retrieved regardless of their service id.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the PMTService interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent, SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
retrieveMode - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

appData - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

serviceId - Identification of the services to be retrieved: service identifier (-1 means return services regardless of their service id)

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid or the numeric identifiers are out of range

See Also:
SIRequest, SIRetrievalListener, SIService, DescriptorTag

retrieveSIBouquets(short, Object, SIRetrievalListener, int, short[])

```
public org.dvb.si.SIRequest retrieveSIBouquets(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            int bouquetId, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with bouquets. A bouquet can be specified by its identification. When bouquetId is set to -1, all bouquets signalled in the BAT of the currently received transport stream on that network interface are retrieved.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SIBouquet interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SIObjectNotInTableEvent` or `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`bouquetId` - Identifier of the bouquet to be retrieved or -1 for all bouquets signalled on the currently received transport stream.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid or the numeric identifiers are out of range

See Also:

`SIRequest`, `SIRetrievalListener`, `SIBouquet`, `DescriptorTag`

retrieveSINetworks(short, Object, SIRetrievalListener, int, short[])

```
public org.dvb.si.SIRequest retrieveSINetworks(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            int networkId, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with networks. A network can be specified by its identification. When networkId is set to -1, all networks signalled in NIT Actual and Other of the currently received TransportStream on that network interface shall be retrieved.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SINetwork interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`networkId` - Identification of the network to be retrieved or -1 for all networks currently signalled.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid or the numeric identifiers are out of range

See Also:

`SIRequest`, `SIRetrievalListener`, `SINetwork`, `DescriptorTag`

---

retrieveSIService(short, Object, SIRetrievalListener, DvbLocator, short[])

```
public org.dvb.si.SIRequest retrieveSIService(short retrieveMode, java.lang.Object appData,
            org.dvb.si.SIRetrievalListener listener,
            org.davic.net.dvb.DvbLocator dvbLocator, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with a service. The required service can be specified by its DVB locator.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SIService interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent“

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`dvbLocator` - DVB locator identifying the service.The locator may be more specific than identifying a service, but this method will only use the parts starting from the beginning up to the service id.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in

all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid or the locator is invalid and does not identify a service

See Also:
SIRequest, SIRetrievalListener, SIService, DescriptorTag

---

retrieveSIServices(short, Object, SIRetrievalListener, int, int, int, short[])

```
public org.dvb.si.SIRequest retrieveSIServices(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            int originalNetworkId, int transportStreamId, int serviceId,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with services. The required services can be specified by their identification. When -1 is specified for `transportStreamId` then services shall be retrieved regardless of their transport stream id. When -1 is specified for `serviceId` then services shall be retrieved regardless of their service id.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SIService interface. If no matching object was found, the appropriate one of the following events is sent: `SINotInCacheEvent`, `SIObjectNotInTableEvent` or `SITableNotFoundEvent`.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`originalNetworkId` - Identification of the services to be retrieved: original network identifier

`transportStreamId` - Identification of the services to be retrieved: transport stream identifier (-1 means return services regardless of their transport stream id)

`serviceId` - Identification of the services to be retrieved: service identifier (-1 means return services regardless of their service id)

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid or the numeric identifiers are out of range

See Also:
SIRequest, SIRetrievalListener, SIService, DescriptorTag

---

retrieveSITimeFromTDT(short, Object, SIRetrievalListener)

```
public org.dvb.si.SIRequest retrieveSITimeFromTDT(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener)
            throws SIIllegalArgumentException
```

Retrieve information associated with time from the Time and Date Table (TDT) from the actual transport stream.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SITime interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

Returns:
An SIRequest object

Throws:
`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SITime

---

retrieveSITimeFromTOT(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSITimeFromTOT(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with time from the Time Offset Table (TOT) from the actual transport stream. The time information will be accompanied with offset information

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SITime interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SITime

---

retrieveSITransportStreamDescription(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSITransportStreamDescription(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve the SITransportStreamDescription object representing the information of the TSDT table in the actual transport stream of this SIDatabase object.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SITransportStreamDescription interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
retrieveMode - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

appData - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SITransportStreamDescription, DescriptorTag

org.dvb.si
SIEvent

Declaration
```
public interface SIEvent extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface represents a particular event within a service.

Each object that implements the SIEvent interface is defined by the combination of the identifiers original_network_id, transport_stream_id, service_id, event_id.

Where methods return values from a short_event_descriptor, the following algorithm shall be used where more than one such descriptor is present. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those for which there is a short_event_descriptor then return the value from that descriptor. Otherwise return an implementation dependent selection between the values in the available short_event_descriptors.

See Also:
SIService

Methods

---

getContentNibbles()

```
public byte[] getContentNibbles()
```

This method returns the content nibbles related to the event. This information is extracted from the content_descriptor. If this descriptor is not present an empty array is returned (array with length 0). The return value is an array, each array element describes one content nibble. In each nibble the level 1 content nibbles occupy the four most significant bits of the returned bytes, level 2 content nibbles the four least significant bits.

Returns:
The content nibbles related to the event; level 1 content nibbles occupy the four most significant bits of the returned bytes, level 2 content nibbles the four least significant bits.

---

getDuration()

```
public long getDuration()
```

Get the duration of this event.

Returns:
The duration in seconds.

---

getDvbLocator()

```
public org.davic.net.dvb.DvbLocator getDvbLocator()
```

Gets a DvbLocator that identifies this event.

Returns:
The DvbLocator of this event

---

getEventID()

```
public int getEventID()
```

Get the event identification.

Returns:
The event identification.

---

getFreeCAMode()

```
public boolean getFreeCAMode()
```

Get the free_CA_mode value for this event, false indicates none of the component streams of this event are scrambled.

Returns:
The free_CA_mode value.

---

getLevel1ContentNibbles()

```
public byte[] getLevel1ContentNibbles()
```

This method returns the level 1 content nibbles of this event. This information is extracted from the content_descriptor. If this descriptor is not present an empty array is returned (array with length 0). The return value is an array, each array element describes one content nibble. In each nibble the data occupies the four least significant bits of the returned bytes with the four most significant bits set to 0.

Returns:
All level 1 content nibbles related to the event.

---

getName()

```
public java.lang.String getName()
```

This method returns the name of this event. The name is extracted from a short_event_descriptor. When this information is not available “” is returned. All control characters as defined in ETR 211 are ignored. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The event name of this event.

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Get the original network identification identifier.

Returns:
The original network identification.

getRunningStatus()

```
public byte getRunningStatus()
```

Get the running status of this event.

Returns:
The running status (the possible values are defined in the SIRunningStatus interface).

See Also:
SIRunningStatus

getServiceID()

```
public int getServiceID()
```

Get the service identification identifier.

Returns:
The service identification.

getShortDescription()

```
public java.lang.String getShortDescription()
```

This method returns the description of this event. The description is extracted from a short_event_descriptor. When this information is not available, "" is returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation

Returns:
The short description of this event.

getShortEventName()

```
public java.lang.String getShortEventName()
```

This method returns the short event name (ETR 211) of this event without emphasis marks. The name is extracted from a short_event_descriptor. If the descriptor is not present, "" is returned. If the string can be found but does not contain control codes for abbreviating it, the full string shall be returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The short event name of this event.

getStartTime()

```
public java.util.Date getStartTime()
```

Get the start time of this event in UTC time.

Returns:
The start time of this event.

getTransportStreamID()

```
public int getTransportStreamID()
```

Get the transport stream identification identifier.

Returns:
The transport stream identification.

retrieveSIService(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSIService(short retrieveMode, java.lang.Object appData,
            org.dvb.si.SIRetrievalListener listener, short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

This method retrieves the SIService object representing the service the event, represented by this SIEvent, is part of.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SIService interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SIService`, `DescriptorTag`

org.dvb.si
SIException

Declaration

```
public abstract class SIException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.si.SIException
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

SIIllegalArgumentException, SIInvalidPeriodException

Description

This class is the root of the SI exceptions hierarchy.

Constructors

SIException()

```
public SIException()
```

Default constructor for the exception

SIException(String)

```
public SIException(java.lang.String reason)
```

Constructor for the SI exception with a specified reason

Parameters:

reason - the reason why the exception was raised

org.dvb.si
SIIllegalArgumentException

Declaration

```
public class SIIllegalArgumentException extends SIException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.si.SIException
                    |
                    +--org.dvb.si.SIIllegalArgumentException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown when one or more of the arguments passed to a method are invalid (e.g. numeric identifiers out of range, etc.)

Constructors

SIIllegalArgumentException()

```
public SIIllegalArgumentException()
```

Default constructor for the exception

SIIllegalArgumentException(String)

```
public SIIllegalArgumentException(java.lang.String reason)
```

Constructor for the exception with a specified reason

Parameters:

reason - the reason why the exception was raised

org.dvb.si
SIInformation

Declaration
public interface **SIInformation**

All Known Subinterfaces:
PMTElementaryStream, PMTService, SIBouquet, SIEvent, SINetwork, SIService, SITime, SITransportStream, SITransportStreamBAT, SITransportStreamDescription, SITransportStreamNIT

Description
This interface groups the common features of SIBouquet, SINetwork, SITransportStream, SIService, PMTService, SIEvent, SITime and PMTElementaryStream.

Each SIInformation instance represents a sub-table (part). Any method accessing descriptors will retrieve descriptors from the same sub-table version as the SIInformation instance. When this version is no longer available, an SITableUpdatedEvent is returned.

See Also:
SIBouquet, SINetwork, SITransportStream, SIService, PMTService, SIEvent, SITime, PMTElementaryStream

Fields

FROM_CACHE_ONLY

public static final short **FROM_CACHE_ONLY**

Constant for retrieve mode parameter of the retrieve methods. When FROM_CACHE_ONLY mode is specified, the data will be retrieved only if it is in the cache. Otherwise, SINotInCacheEvent will be delivered to the listener. No stream access is done in this case.

FROM_CACHE_OR_STREAM

public static final short **FROM_CACHE_OR_STREAM**

Constant for retrieve mode parameter of the retrieve methods. When FROM_CACHE_OR_STREAM mode is specified, the data will be retrieved from cache if it is present in the cache, otherwise it will be retrieved from the stream.

FROM_STREAM_ONLY

public static final short **FROM_STREAM_ONLY**

Constant for retrieve mode parameter of the retrieve methods. When FROM_STREAM_ONLY mode is specified, the data will be retrieved directly from the stream and no cache access is tried first. This mode is meaningful only if the application knows that the information is not in the cache or that the information in the cache is no longer valid, but the implementation of the SI database may not be aware of the invalidity of the cached data. If the application has got the notification of the existence of an updated version through the listener mechanism in this API, the implementation of the SI

database is aware of the version change and the application should specify the FROM_CACHE_OR_STREAM mode to be able to retrieve the data faster if the updated version has already been loaded to the cache by the SI database implementation.

Methods

---

fromActual()

```
public boolean fromActual()
```

Return true when the information contained in the object that implements this interface was filtered from an 'actual' table or from a table with no 'actual/other' distinction.

Returns:
`true` if the information comes from an 'actual' table or from a table with no 'actual/other' distinction, otherwise returns `false`

---

getDataSource()

```
public org.davic.mpeg.TransportStream getDataSource()
```

Return the org.davic.mpeg.TransportStream object the information contained in the object that implements that interface was filtered from.

Returns:
The `org.davic.mpeg.TransportStream` object the information was filtered from.

See Also:
`org.davic.mpeg.TransportStream`

---

getDescriptorTags()

```
public short[] getDescriptorTags()
```

Get the tags of all descriptors that are part of this version of this object. The tags are returned in the same order as the descriptors are broadcast. This method returns also the tags of descriptors that were not hinted at and that are not necessarily present in the cache. If there are no descriptors associated with this SIInformation object, this method returns an empty array whose length is 0.

Returns:
The tags of the descriptors actually broadcast for the object (identified by their tags).

See Also:
`DescriptorTag`

---

getSIDatabase()

```
public org.dvb.si.SIDatabase getSIDatabase()
```

Return the root of the hierarchy the object that implements this interface belongs to.

Returns:
The root of the hierarchy.

---

getUpdateTime()

```
public java.util.Date getUpdateTime()
```

Return the time when the information contained in the object that implements this interface was last updated.

Returns:
The date of the last update.

---

retrieveDescriptors(short, Object, SIRetrievalListener)

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener)
            throws SIIllegalArgumentException
```

This method retrieves all descriptors in the order the descriptors are broadcast.

This method is asynchronous and the completion of the method will be signalled by an `SISuccessfulRetrieveEvent` being sent to listener. Any retrieved descriptors are found in the SIIterator returned by the `getResult` method of that event. If descriptors are found then this iterator will contain Descriptor objects. If there are no matching descriptors, this iterator will contain no objects.

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

Returns:
An SIRequest object

Throws:
`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:
`SIRequest`, `SIRetrievalListener`, `Descriptor`, `SIIterator`

---

retrieveDescriptors(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve a set of descriptors. This method retrieves all or a set of descriptors in the order the descriptors are broadcast.

The tag values included in the `someDescriptorTags` parameter are used for filtering the descriptors that are returned. Only those descriptors whose tag value is included in the `someDescriptorTags` array are retrieved, unless the `someDescriptorTags` array contains -1 as its one and only item in which case all descriptors related to this object are retrieved.

If the list of tags is a subset of the one hinted to the underlying implementation (in the request which created the object on which the method is called), this is likely to increase the efficiency of the (optional) caching mechanism

This method is asynchronous and the completion of the method will be signalled by an `SISuccessfulRetrieveEvent` being sent to listener. Any retrieved descriptors are found in the SIIterator returned by the `getResult` method of that event. If descriptors are found then this iterator

will contain Descriptor objects. If there are no matching descriptors, this iterator will contain no objects.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - Descriptor tag values of descriptors that are used for filtering descriptors from the descriptors included in the SI table item corresponding to this SIInformation object. If the array contains -1 as its one and only element, all descriptors related to this object are retrieved. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `Descriptor`, `SIIterator`, `DescriptorTag`

org.dvb.si
SIInvalidPeriodException

Declaration

```
public class SIInvalidPeriodException extends SIException

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.si.SIException
                    |
                    +--org.dvb.si.SIInvalidPeriodException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown when a specified period is invalid (for example, start time is after the end time)

Constructors

SIInvalidPeriodException()

public **SIInvalidPeriodException**()

Default constructor for the exception

SIInvalidPeriodException(String)

public **SIInvalidPeriodException**(java.lang.String reason)

Constructor for the exception with a specified reason

Parameters:

reason - the reason why the exception was raised

org.dvb.si
SIIterator

Declaration
```
public interface SIIterator extends java.util.Enumeration
```

All Superinterfaces:
```
java.util.Enumeration
```

Description
Objects implementing SIIterator interface allow to browse through a set of SI objects. In order to maintain consistency within the set of SI objects, this browsing does NOT initiate an actual access to the stream.

Methods

---

numberOfRemainingObjects()

```
public int numberOfRemainingObjects()
```

Get the number of remaining objects in the iterator.

Returns:
The number of remaining objects.

org.dvb.si
SILackOfResourcesEvent

Declaration

```
public class SILackOfResourcesEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SILackOfResourcesEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI retrieval request when the resources needed for retrieving the data are not available, e.g. due to the necessary resources being all taken up by the calling application or other applications.

See Also:

SIRetrievalListener

Constructors

SILackOfResourcesEvent(Object, SIRequest)

```
public SILackOfResourcesEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

org.dvb.si
SIMonitoringEvent

Declaration

```
public class SIMonitoringEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIMonitoringEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Objects of this class are sent to listener objects of the using application to notify that a change in the monitored information has happened.

See Also:

SIMonitoringType, SIMonitoringListener

Constructors

SIMonitoringEvent(SIDatabase, byte, int, int, int, int, int, Date, Date)

```
public SIMonitoringEvent(org.dvb.si.SIDatabase source, byte objectType, int networkId,
            int bouquetId, int originalNetworkId, int transportStreamId, int serviceId,
            java.util.Date startTime, java.util.Date endTime)
```

Constructor for the event object

Parameters:

source - the SIDatabase object which is the source of the event

objectType - type of the SIInformation object (constants in SIMonitoringType)

networkId - networkId

bouquetId - bouquetId

originalNetworkId - originalNetworkId

transportStreamId - transportStreamId

serviceId - serviceId

startTime - start time of event schedule period

endTime - end time of event schedule period

Methods

---

getBouquetID()

```
public int getBouquetID()
```

Returns the bouquetId of the bouquet. This method is only applicable if the SIInformation type returned with the getSIInformationType method is BOUQUET.

Returns:
the bouquetId or -2 if not applicable for this event

---

getEndTime()

```
public java.util.Date getEndTime()
```

Returns the end time of the schedule period whose event information has changed. This method is only applicable if the SIInformation type returned with the getSIInformationType method is SCHEDULED_EVENT.

Returns:
the end time or null if not applicable for this event

---

getNetworkID()

```
public int getNetworkID()
```

Returns the networkId of the network. This method is only applicable if the SIInformation type returned with the getSIInformationType method is NETWORK.

Returns:
the networkId or -2 if not applicable for this event

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Returns the originalNetworkId of the SIInformation objects This method is only applicable if the SIInformation type returned with the getSIInformationType method is SERVICE, PMT_SERVICE, PRESENT_FOLLOWING_EVENT or SCHEDULED_EVENT.

Returns:
the originalNetworkId or -2 if not applicable for this event

---

getServiceID()

```
public int getServiceID()
```

Returns the serviceId of the SIInformation objects This method is only applicable if the SIInformation type returned with the getSIInformationType method is PMT_SERVICE, PRESENT_FOLLOWING_EVENT or SCHEDULED_EVENT.

Returns:
the serviceId or -2 if not applicable for this event

---

getSIInformationType()

```
public byte getSIInformationType()
```

Get the SIInformation type of the information that has changed

Returns:
The SIInformation type (the possible values are defined in the SIMonitoringType interface).

See Also:
SIMonitoringType

---

getSource()

```
public java.lang.Object getSource()
```

Gets the SIDatabase instance that is sending the event.

Overrides:
getSource in class EventObject

Returns:
the SIDatabase instance that is the source of this event.

---

getStartTime()

```
public java.util.Date getStartTime()
```

Returns the start time of the schedule period whose event information has changed. This method is only applicable if the SIInformation type returned with the getSIInformationType method is SCHEDULED_EVENT.

Returns:
the start time or null if not applicable for this event

---

getTransportStreamID()

```
public int getTransportStreamID()
```

Returns the transportStreamId of the SIInformation objects This method is only applicable if the SIInformation type returned with the getSIInformationType method is SERVICE, PMT_SERVICE, PRESENT_FOLLOWING_EVENT or SCHEDULED_EVENT.

Returns:
the transportStreamId or -2 if not applicable for this event

org.dvb.si
SIMonitoringListener

Declaration
`public interface` **`SIMonitoringListener extends java.util.EventListener`**

All Superinterfaces:
`java.util.EventListener`

Description
This interface shall be implemented by using application classes in order to listen to changes in monitored SI objects.

See Also:
`SIMonitoringEvent`

Methods

---

postMonitoringEvent(SIMonitoringEvent)

`public void` **`postMonitoringEvent`**`(org.dvb.si.SIMonitoringEvent anEvent)`

This method is called back by the SI API implementation to notify the listener about an event.

Parameters:
`anEvent` - The notified event.

See Also:
`SIMonitoringEvent`

org.dvb.si
SIMonitoringType

Declaration
```
public interface SIMonitoringType
```

Description
This interface defines the constants corresponding to the SI information type values in SIMonitoringEvent.

See Also:
SIMonitoringListener, SIMonitoringEvent

Fields

BOUQUET

```
public static final byte BOUQUET
```

Constant for the type of SIInformation object: Bouquet

NETWORK

```
public static final byte NETWORK
```

Constant for the type of SIInformation object: Network

PMT_SERVICE

```
public static final byte PMT_SERVICE
```

Constant for the type of SIInformation object: PMTService

PRESENT_FOLLOWING_EVENT

```
public static final byte PRESENT_FOLLOWING_EVENT
```

Constant for the type of SIInformation object: Present or following event

SCHEDULED_EVENT

```
public static final byte SCHEDULED_EVENT
```

Constant for the type of SIInformation object: Scheduled event

SERVICE

```
public static final byte SERVICE
```

Constant for the type of SIInformation object: Service

org.dvb.si
SINetwork

Declaration
```
public interface SINetwork extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface (together with the SITransportStreamNIT interface) represents a sub-table of the Network Information Table (NIT) describing a particular network.

Each object that implements the SINetwork interface is identified by the identifier network_id.

See Also:
SITransportStream, SITransportStreamNIT

Methods

---

getDescriptorTags()

```
public short[] getDescriptorTags()
```

This method defines extra semantics for the SIInformation.getDescriptorTags method. If the NIT sub-table on which this SINetwork object is based consists of multiple sections, then this method returns the descriptor tags in the order they appear when concatenating the descriptor loops of the different sections.

Overrides:
getDescriptorTags in interface SIInformation

Returns:
The tags of the descriptors actually broadcast for the object (identified by their tags).

See Also:
SIInformation, SIInformation.getDescriptorTags()

---

getName()

```
public java.lang.String getName()
```

This method returns the name of this network. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_network_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_network_name_descriptor and the name in the network_name_descriptor. When this information is not available “” is returned. All control characters as defined in ETR 211 are ignored. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The network name of this network.

getNetworkID()

```
public int getNetworkID()
```

Get the identification of this network.

Returns:
The network identification identifier.

getShortNetworkName()

```
public java.lang.String getShortNetworkName()
```

This method returns the short name (ETR 211) of this network without emphasis marks. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_network_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_network_name_descriptor and the name in the network_name_descriptor. If the descriptor is not present, "" is returned. If the string can be found but does not contain control codes for abbreviating it, the full string shall be returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The short network name of this network.

retrieveDescriptors(short, Object, SIRetrievalListener)

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener)
            throws SIIllegalArgumentException
```

This method defines extra semantics for the SIInformation.retrieveDescriptors method (first prototype). If the NIT sub-table on which this SINetwork object is based consists of multiple sections, then this method returns the requested descriptors in the order they appear when concatenating the descriptor loops of the different sections.

Overrides:
`retrieveDescriptors` in interface `SIInformation`

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

Returns:
An SIRequest object

Throws:
`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:
`SIInformation`, `SIInformation.retrieveDescriptors(short, Object, SIRetrievalListener)`

retrieveDescriptors(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveDescriptors(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

This method defines extra semantics for the SIInformation.retrieveDescriptors method (second prototype). If the NIT sub-table on which this SINetwork object is based consists of multiple sections, then this method returns the requested descriptors in the order they appear when concatenating the descriptor loops of the different sections. The tag values included in the someDescriptorsTags parameter are used for filtering the information that is returned. Only information related to descriptors whose tag value is included in the someDescriptorTags array is retrieved, unless the someDescriptorTags array contains -1 as its one and only item.

Overrides:
`retrieveDescriptors` in interface `SIInformation`

Parameters:
`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - Descriptor tag values that are used for filtering descriptors from descriptors included in the SI table item corresponding to this object. If the array contains -1 as its one and only element, all descriptors related to this object are retrieved. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:
`SIInformation`, `SIInformation.retrieveDescriptors(short, Object, SIRetrievalListener, short[])`

retrieveSITransportStreams(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSITransportStreams(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with transport streams carried via the network.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SITransportStreamNIT interface. This method will retrieve SITransportStreams from the same sub-table version as this SINetwork instance. If this version of the sub-table is no longer available, an SITableUpdatedEvent is returned.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the behaviour is implementation dependent. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SITransportStreamNIT`, `DescriptorTag`

org.dvb.si
SINotInCacheEvent

Declaration

```
public class SINotInCacheEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SINotInCacheEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI retrieval request when the request was made with the FROM_CACHE_ONLY mode and the requested data is not present in the cache.

See Also:

SIRetrievalListener

Constructors

SINotInCacheEvent(Object, SIRequest)

```
public SINotInCacheEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

org.dvb.si
SIObjectNotInTableEvent

Declaration

```
public class SIObjectNotInTableEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SIObjectNotInTableEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI retrieval request when the SI table where the information about the requested object should be located has been retrieved but the requested object is not present in it. The reason may be that the object corresponding to the requested identifiers does not exist.

See Also:

SIRetrievalListener

Constructors

SIObjectNotInTableEvent(Object, SIRequest)

```
public SIObjectNotInTableEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

org.dvb.si
SIRequest

Declaration

```
public class SIRequest

java.lang.Object
   |
   +--org.dvb.si.SIRequest
```

Description

Object instances of this class represent SI retrieval requests made by the application. The application may cancel the request using this object.

Constructors

SIRequest()

```
protected SIRequest()
```

This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

cancelRequest()

```
public boolean cancelRequest()
```

Cancels the retrieval request.

Returns:

true if the request was cancelled and an SIRequestCancelledEvent will be delivered to the listener, false if the request has already completed (either successfully, with an error or due to a prior cancel method call)

---

isAvailableInCache()

```
public boolean isAvailableInCache()
```

Returns whether the information will be returned from cache or from the stream

Returns:

true if the information is available in the cache and will be returned from there otherwise false

org.dvb.si
SIRequestCancelledEvent

Declaration

```
public class SIRequestCancelledEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SIRequestCancelledEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

This event is sent in response to a SI retrieval request when the request is cancelled with the SIRequest.cancelRequest method call.

See Also:

`SIRequest`, `SIRetrievalListener`

Constructors

SIRequestCancelledEvent(Object, SIRequest)

```
public SIRequestCancelledEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

`appData` - the application data passed in the request method call

`request` - the SIRequest instance which is the source of the event

org.dvb.si
SIRetrievalEvent

Declaration

```
public abstract class SIRetrievalEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

SILackOfResourcesEvent, SINotInCacheEvent, SIObjectNotInTableEvent, SIRequestCancelledEvent, SISuccessfulRetrieveEvent, SITableNotFoundEvent, SITableUpdatedEvent

Description

This class is the base class for events about completion of a SI retrieval request. Exactly one event will be returned in response to an SI retrieval request.

See Also:

SIRetrievalListener

Constructors

SIRetrievalEvent(Object, SIRequest)

```
public SIRetrievalEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

Methods

---

getAppData()

```
public java.lang.Object getAppData()
```

Returns the application data that was passed to the retrieve method

Returns:

the application data

getSource()

```
public java.lang.Object getSource()
```

Returns the SIRequest object that is the source of this event

Overrides:

`getSource` in class `EventObject`

Returns:

the SIRequest object

org.dvb.si
SIRetrievalListener

Declaration
```
public interface SIRetrievalListener extends java.util.EventListener
```

All Superinterfaces:
`java.util.EventListener`

Description
This interface shall be implemented by application classes in order to receive events about completion of SI requests.

See Also:
`SIRetrievalEvent`

Methods

---

postRetrievalEvent(SIRetrievalEvent)

```
public void postRetrievalEvent(org.dvb.si.SIRetrievalEvent event)
```

This method is called by the SI API implementation to notify the listener about completion of an SI request.

Parameters:
`event` - The event object.

See Also:
`SIRetrievalEvent`

org.dvb.si
SIRunningStatus

Declaration
```
public interface SIRunningStatus
```

Description
This interface defines the constants corresponding to the running status values for services and events.

Fields

NOT_RUNNING

```
public static final byte NOT_RUNNING
```

Constant value for the running status as specified in EN 300 468

PAUSING

```
public static final byte PAUSING
```

Constant value for the running status as specified in EN 300 468

RUNNING

```
public static final byte RUNNING
```

Constant value for the running status as specified in EN 300 468

STARTS_IN_A_FEW_SECONDS

```
public static final byte STARTS_IN_A_FEW_SECONDS
```

Constant value for the running status as specified in EN 300 468

UNDEFINED

```
public static final byte UNDEFINED
```

Constant value for the running status as specified in EN 300 468

org.dvb.si
SIService

Declaration

```
public interface SIService extends SIInformation, TextualServiceIdentifierQuery
```

All Superinterfaces:

SIInformation, TextualServiceIdentifierQuery

Description

This interface represents a particular service carried by a transport stream. Information that can be obtained through the methods of this interface is retrieved from the SDT table.

Each object that implements the SIService interface is identified by the combination of the following identifiers: original_network_id, transport_stream_id, service_id.

Methods

---

getDvbLocator()

```
public org.davic.net.dvb.DvbLocator getDvbLocator()
```

Gets a DvbLocator that identifies this service.

Returns:
The DvbLocator of this service

---

getEITPresentFollowingFlag()

```
public boolean getEITPresentFollowingFlag()
```

Get the EIT_present_following_flag value, true indicates this service has present and/or following event information.

Returns:
The EIT_present_following_flag value.

---

getEITScheduleFlag()

```
public boolean getEITScheduleFlag()
```

Get the EIT_schedule_flag value, true indicates this services has scheduled event information.

Returns:
The EIT_schedule_flag value.

---

getFreeCAMode()

```
public boolean getFreeCAMode()
```

Retrieve the free_CA_mode value of this service, false indicates none of the components of this service are scrambled.

Returns:

The free_CA_mode value of this service.

---

getName()

```
public java.lang.String getName()
```

This method returns the name of the service represented by this service. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_service_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_service_name_descriptor and the name in the service_descriptor. If this descriptor is not present "" is returned. All control characters as defined in ETR 211 are ignored. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The name of this service.

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Get the original network identification.

Returns:
The original network identification identifier.

---

getProviderName()

```
public java.lang.String getProviderName()
```

This method returns the service provider name of this service If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_service_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_service_name_descriptor and the name in the service_descriptor. If this descriptor is not present "" is returned. All control characters as defined in ETR 211 are ignored. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The service provider name of this service.

---

getRunningStatus()

```
public byte getRunningStatus()
```

Retrieve the running status of this service.

Returns:
The running status (the possible values are defined in the SIRunningStatus interface)

See Also:
`SIRunningStatus`

---

getServiceID()

```
public int getServiceID()
```

Get the service identification.

Returns:

The service identification identifier.

---

getShortProviderName()

```
public java.lang.String getShortProviderName()
```

This method returns the short name (ETR 211) of the service provider of this service without emphasis marks. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_service_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_service_name_descriptor and the name in the service_descriptor. If the descriptor is not present, "" is returned. If the string can be found but does not contain control codes for abbreviating it, the full string shall be returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The short service provider name of this service.

---

getShortServiceName()

```
public java.lang.String getShortServiceName()
```

This method returns the short name (ETR 211) of this service without emphasis marks. If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` is one of those in the multilingual_service_name_descriptor, return the name in that language, otherwise return an implementation dependent selection between the names in the multilingual_service_name_descriptor and the name in the service_descriptor. If the descriptor is not present, "" is returned. If the string can be found but does not contain control codes for abbreviating it, the full string shall be returned. For each character the DVB-SI 8 bit character code is mapped to the appropriate Unicode representation.

Returns:
The short name of this service.

---

getSIServiceType()

```
public short getSIServiceType()
```

Get the service type. The service type is extracted from the service_descriptor.

Returns:
The service type. (Some of the possible values are defined in the SIServiceType interface.)

See Also:
`SIServiceType`

---

getTransportStreamID()

```
public int getTransportStreamID()
```

Get the transport stream identification.

Returns:
The transport stream identification identifier.

retrieveFollowingSIEvent(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveFollowingSIEvent(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the following event from the EIT-present/following.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SIEvent interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SIEvent`, `DescriptorTag`

retrievePMTService(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrievePMTService(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve the PMTService information associated with this service.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the PMTService interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, PMTService, DescriptorTag

---

retrievePresentSIEvent(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrievePresentSIEvent(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with the present event from the EIT-present/following.

The SIIterator that is returned with the event when the request completes successfully will contain an object that implements the SIEvent interface. If no matching object was found, the appropriate one of the following events is sent: SINotInCacheEvent SIObjectNotInTableEvent or SITableNotFoundEvent.

Parameters:
retrieveMode - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

appData - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

listener - SIRetrievalListener that will receive the event informing about the completion of the request.

someDescriptorTags - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:
An SIRequest object

Throws:
SIIllegalArgumentException - thrown if the retrieveMode is invalid

See Also:
SIRequest, SIRetrievalListener, SIEvent, DescriptorTag

---

retrieveScheduledSIEvents(short, Object, SIRetrievalListener, short[], Date, Date)

```
public org.dvb.si.SIRequest retrieveScheduledSIEvents(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
```

```
short[] someDescriptorTags, java.util.Date startTime, java.util.Date endTime)
throws SIIllegalArgumentException, SIInvalidPeriodException
```

Retrieve information associated with the scheduled events within the service for a requested period from the EIT-schedule. The events are presented in the order they are present in the EIT-schedule. A scheduled event is retrieved by this method if the time interval from the start time of the event (inclusive) (as returned by SIEvent.getStartTime) to the end time of the event (exclusive) (as defined by the sum of SIEvent.getStartTime and SIEvent.getDuration) intersects the time interval from startTime (inclusive) to endTime (exclusive) specified by the input parameters to this method.

The SIIterator that is returned with the event when the request completes successfully will contain one or more objects that implement the SIEvent interface.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

`startTime` - The beginning of the required period in UTC time.

`endTime` - The end of the required period in UTC time.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

`SIInvalidPeriodException` - When no valid period is indicated.

See Also:

`SIRequest`, `SIRetrievalListener`, `SIEvent`, `DescriptorTag`

org.dvb.si
SIServiceType

Declaration
```
public interface SIServiceType
```

Description
This interface defines constants corresponding to the different service types.

See Also:
SIService.getSIServiceType()

Fields

D_D2_MAC

```
public static final short D_D2_MAC
```

Constant value for the service type as specified in EN 300 468

DATA_BROADCAST

```
public static final short DATA_BROADCAST
```

Constant value for the service type as specified in EN 300 468

DIGITAL_RADIO_SOUND

```
public static final short DIGITAL_RADIO_SOUND
```

Constant value for the service type as specified in EN 300 468

DIGITAL_TELEVISION

```
public static final short DIGITAL_TELEVISION
```

Constant value for the service type as specified in EN 300 468

FM_RADIO

```
public static final short FM_RADIO
```

Constant value for the service type as specified in EN 300 468

MHP_APPLICATION

```
public static final short MHP_APPLICATION
```

Constant value for the service type as specified in EN 300 468

MOSAIC

```
public static final short MOSAIC
```

Constant value for the service type as specified in EN 300 468

NTSC

```
public static final short NTSC
```

Constant value for the service type as specified in EN 300 468

NVOD_REFERENCE

```
public static final short NVOD_REFERENCE
```

Constant value for the service type as specified in EN 300 468

NVOD_TIME_SHIFTED

```
public static final short NVOD_TIME_SHIFTED
```

Constant value for the service type as specified in EN 300 468

PAL

```
public static final short PAL
```

Constant value for the service type as specified in EN 300 468

SECAM

```
public static final short SECAM
```

Constant value for the service type as specified in EN 300 468

TELETEXT

```
public static final short TELETEXT
```

Constant value for the service type as specified in EN 300 468

UNKNOWN

```
public static final short UNKNOWN
```

Constant value for the service type as specified in EN 300 468

org.dvb.si
SISuccessfulRetrieveEvent

Declaration

```
public class SISuccessfulRetrieveEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SISuccessfulRetrieveEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI retrieval request when the retrieve request was successfully completed. The result of the request can be obtained from the getResult method.

See Also:

SIRetrievalListener

Constructors

SISuccessfulRetrieveEvent(Object, SIRequest, SIIterator)

```
public SISuccessfulRetrieveEvent(java.lang.Object appData, org.dvb.si.SIRequest request,
            org.dvb.si.SIIterator result)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

result - an SIIterator containing the retrieved objects

Methods

---

getResult()

```
public org.dvb.si.SIIterator getResult()
```

Returns the requested data in an SIIterator object.

Returns:

An SIIterator containing the requested objects

See Also:

SIObjectNotInTableEvent

org.dvb.si
SITableNotFoundEvent

Declaration

```
public class SITableNotFoundEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SITableNotFoundEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI retrieval request when the SI table that should contain the requested information could not be retrieved. The reason may be that the requested table is not broadcast in the transport stream currently associated with the SI database.

See Also:

SIRetrievalListener

Constructors

SITableNotFoundEvent(Object, SIRequest)

```
public SITableNotFoundEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

org.dvb.si
SITableUpdatedEvent

Declaration

```
public class SITableUpdatedEvent extends SIRetrievalEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.si.SIRetrievalEvent
              |
              +--org.dvb.si.SITableUpdatedEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent in response to a SI descriptor retrieval request when the table carrying the information about the object has been updated and the set of descriptors consistent with the old object can not be retrieved. The application should in this case first update the SIInformation object and then request the descriptors again.

See Also:

SIRetrievalListener

Constructors

SITableUpdatedEvent(Object, SIRequest)

```
public SITableUpdatedEvent(java.lang.Object appData, org.dvb.si.SIRequest request)
```

The constructor for the event

Parameters:

appData - the application data passed in the request method call

request - the SIRequest instance which is the source of the event

org.dvb.si
SITime

Declaration
```
public interface SITime extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface represents the Time and Date Table (TDT) and the (optional) Time Offset Table (TOT). When it represents a TDT table, the `retrieveDescriptors` and `getDescriptorTags` methods behave as documented in the case when there are no descriptors, because the TDT does not contain any descriptors.

See Also:
SIDatabase

Methods

---

getUTCTime()

```
public java.util.Date getUTCTime()
```

Get the UTC time as coded in the TDT or TOT table.

Returns:
The UTC as coded in the TDT or TOT table.

org.dvb.si
SITransportStream

Declaration
```
public interface SITransportStream extends SIInformation
```

All Superinterfaces:
SIInformation

All Known Subinterfaces:
SITransportStreamBAT, SITransportStreamNIT

Description
This interface is the base interface for representing information about transport streams.

Transport stream retrieval methods in the SIDatabase class and the SINetwork interface use the NIT table and will return objects that implement the SITransportStreamNIT interface.

Transport stream retrieval methods in the SIBouquet interface use the BAT table and will return objects that implement the SITransportStreamBAT interface.

Methods

---

getDvbLocator()

```
public org.davic.net.dvb.DvbLocator getDvbLocator()
```

Gets a DvbLocator that identifies this transport stream.

Returns:
The DvbLocator of this transport stream.

---

getOriginalNetworkID()

```
public int getOriginalNetworkID()
```

Get the original network identification.

Returns:
The original network identification identifier.

---

getTransportStreamID()

```
public int getTransportStreamID()
```

Get the transport stream identification.

Returns:
The transport stream identification identifier.

retrieveSIServices(short, Object, SIRetrievalListener, short[])

```
public org.dvb.si.SIRequest retrieveSIServices(short retrieveMode,
            java.lang.Object appData, org.dvb.si.SIRetrievalListener listener,
            short[] someDescriptorTags)
            throws SIIllegalArgumentException
```

Retrieve information associated with services carried via the transport stream. This method works in the same way for objects that implement the SITransportStreamNIT and SITransportStreamBAT interfaces.

The SIIterator that is returned with the event when the request completes successfully will contain objects that implement the SIService interface.

Parameters:

`retrieveMode` - Mode of retrieval indicating whether the data should be retrieved only from the cache (FROM_CACHE_ONLY), from the cache if available and if not from the stream (FROM_CACHE_OR_STREAM), or always from the stream (FROM_STREAM_ONLY).

`appData` - An object supplied by the application. This object will be delivered to the listener when the request completes. The application can use this objects for internal communication purposes. If the application does not need any application data, the parameter can be null.

`listener` - SIRetrievalListener that will receive the event informing about the completion of the request.

`someDescriptorTags` - A list of hints for descriptors (identified by their tags) the application is interested in. If the array contains -1 as its one and only element, the application is interested in all descriptors. If someDescriptorTags is null, the application is not interested in descriptors. All values that are out of the valid range for descriptor tags (i.e. 0...255) are ignored, except for the special meaning of -1 as the only element in the array.

Returns:

An SIRequest object

Throws:

`SIIllegalArgumentException` - thrown if the retrieveMode is invalid

See Also:

`SIRequest`, `SIRetrievalListener`, `SIService`, `DescriptorTag`

org.dvb.si
SITransportStreamBAT

Declaration

```
public interface SITransportStreamBAT extends SITransportStream
```

All Superinterfaces:

SIInformation, SITransportStream

Description

This interface represents information about transport streams that has been retrieved from a BAT table. All descriptor accessing methods return descriptors retrieved from a BAT table. Methods in SIBouquet for retrieving transport streams return objects that implement this interface.

Methods

---

getBouquetID()

```
public int getBouquetID()
```

Get the identification of the bouquet this transport stream is part of.

Returns:

The bouquet identification identifier.

org.dvb.si
SITransportStreamDescription

Declaration
```
public interface SITransportStreamDescription extends SIInformation
```

All Superinterfaces:
SIInformation

Description
This interface represents the Transport Stream Description Table (TSDT).

It defines no methods of its own other than those inherited from SIInformation.

See Also:
SIDatabase, SITransportStream

org.dvb.si
SITransportStreamNIT

Declaration

```
public interface SITransportStreamNIT extends SITransportStream
```

All Superinterfaces:

SIInformation, SITransportStream

Description

This interface represents information about transport streams that has been retrieved from a NIT table. All descriptor accessing methods return descriptors retrieved from a NIT table. Methods in SIDatabase and SINetwork for retrieving transport streams return objects that implement this interface.

Methods

---

getNetworkID()

```
public int getNetworkID()
```

Get the identification of the network this transport stream is part of.

Returns:

The network identification identifier.

org.dvb.si
SIUtil

Declaration

```
public class SIUtil

java.lang.Object
  |
  +--org.dvb.si.SIUtil
```

Description

This class contains SI related utility functions.

Methods

---

convertSIStringToJavaString(byte[], int, int, boolean)

```
public static java.lang.String convertSIStringToJavaString(byte[] dvbSIText, int offset,
            int length, boolean emphasizedPartOnly)
            throws SIIllegalArgumentException
```

This method converts a text string that is coded according to annex A of the DVB-SI specification (EN 300 468) to a Java String object.

The text that must be converted is contained in 'dvbSIText' from index 'offset' to index 'offset+length-1' (inclusive).

If the text that must be converted is not validly coded according to annex A of the DVB-SI specification, then the result is undefined.

Parameters:

`dvbSIText` - The byte array that contains the string that must be converted.

`offset` - The offset indicates the start of the DVB-SI text in dvbSIText.

`length` - Length of the DVB-SI text in bytes.

`emphasizedPartOnly` - If emphasizedPartOnly is true, then only the text that is marked as emphasized (using the character emphasis on [0x86] and character emphasis off [0x87] control codes) will be returned. Otherwise, the character emphasis codes will be ignored, and all of the converted text will be returned.

Returns:

The converted text.

Throws:

`SIIllegalArgumentException` - thrown if offset and/or offset+length-1 is not a valid index in dvbSIText.

org.dvb.si
TextualServiceIdentifierQuery

Declaration
```
public interface TextualServiceIdentifierQuery
```

All Known Subinterfaces:
SIService

Description
An interface that can be implemented by objects representing DVB services. Allows applications to obtain the textual service identifiers related to a service.

Since:
MHP1.0.1

Methods

---

getTextualServiceIdentifiers()

```
public java.lang.String[] getTextualServiceIdentifiers()
```

Returns the textual service identifiers related to this object.

Returns:
an array of String objects containing the textual service identifiers or null if none are present.

Since:
MHP1.0.1

Annex N (normative): Streamed Media API Extensions

Package org.dvb.media

Description

Provides DVB specific extensions to the Java Media Framework.

Class Summary	
Interfaces	
BackgroundVideoPresentationControl	A control to support the setting and querying of the video presentation for background players.
ComponentBasedPlayerControl	The presence of this Control on a Player indicates that the Player can be used as either a background Player or a component-based Player.
DVBMediaSelectControl	DVBMediaSelectControl extends `MediaSelectControl` allowing the selection of different kinds of content in a running `Player`.
SubtitleListener	Report that a subtitle event has happened.
SubtitlingEventControl	Allow applications to register and unregister their interest in events related to the availability and presentation of subtitles.
VideoFormatControl	This provides a means for applications to get information associated with the format and aspect ratio of the video being presented to the user.
VideoFormatListener	The listener used to receive video format events
VideoPresentationControl	A control to support setting and querying the video presentation.
Classes	
ActiveFormatDescriptionChangedEvent	Event signalling that the transmitted active format definition has changed
AspectRatioChangedEvent	Event signalling that the aspect ratio of the transmitted video has changed
CAStopEvent	This event is generated whenever access to a service is withdrawn by the CA system, e.g. at the end of a free preview period.
DFCChangedEvent	Event signalling that the decoder format conversion being used has changed
DripFeedDataSource	This class allows to create a source for a JMF player to be able to feed the decoder progressively with parts of a clip (e.g.
DripFeedPermission	This class represents a permission to access the drip feed mode.
NoComponentSelectedEvent	This event is generated whenever presentation of a stream stops because there are no selected components to present.
PresentationChangedEvent	This event is generated whenever the content being presented by a player changes for reasons outside the control of the application.
ServiceRemovedEvent	This event is generated whenever access to a service stops because the service concerned has been removed from the network.
StopByResourceLossEvent	This event is generated whenever presentation of a stream stops because the player has lost so many resources that it cannot continue.
SubtitleAvailableEvent	Report that subtitles are available to be presented having been unavailable.

Class Summary	
SubtitleNotAvail-ableEvent	Inform an application that a subtitle stream has vanished from the network.
SubtitleNotSelectedE-vent	Report that subtitles are not now selected.
SubtitleSelectedEvent	Report that subtitles are now selected.
VideoFormatEvent	The base class for all other events relating to changes in video format
VideoTransformation	VideoTransformation objects express video transformations, i.e.
Exceptions	
CAException	This exception is thrown when access to a media stream is denied by the CA system.

org.dvb.media
ActiveFormatDescriptionChangedEvent

Declaration

```
public class ActiveFormatDescriptionChangedEvent extends VideoFormatEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.VideoFormatEvent
              |
              +--org.dvb.media.ActiveFormatDescriptionChangedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event signalling that the transmitted active format definition has changed

Constructors

ActiveFormatDescriptionChangedEvent(Object, int)

`public ActiveFormatDescriptionChangedEvent(java.lang.Object source, int newFormat)`

Construct the event

Parameters:

`source` - the source of the event

`newFormat` - the new active format description

Methods

---

getNewFormat()

`public int getNewFormat()`

Get the new active format description

Returns:

the new active format description. The value of this is represented by one of the constants from `VideoFormatControl` and shall be the value passed into the constructor of the event.

org.dvb.media
AspectRatioChangedEvent

Declaration

```
public class AspectRatioChangedEvent extends VideoFormatEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.VideoFormatEvent
              |
              +--org.dvb.media.AspectRatioChangedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event signalling that the aspect ratio of the transmitted video has changed

Constructors

AspectRatioChangedEvent(Object, int)

`public AspectRatioChangedEvent(java.lang.Object source, int newRatio)`

Construct the event

Parameters:

`source` - the source of the event

`newRatio` - the new aspect ratio of the transmitted video

Methods

---

getNewRatio()

`public int getNewRatio()`

Get the new aspect ratio of the transmitted video

Returns:

the new aspect ratio of the video. The value of this is represented by one of the constants from the VideoFormatControl class and shall be the value passed into the constructor of the event.

org.dvb.media
BackgroundVideoPresentationControl

Declaration

```
public interface BackgroundVideoPresentationControl extends VideoPresentationControl
```

All Superinterfaces:

javax.media.Control, VideoPresentationControl

Description

A control to support the setting and querying of the video presentation for background players.

Methods

---

getClosestMatch(VideoTransformation)

```
public org.dvb.media.VideoTransformation getClosestMatch(org.dvb.media.VideoTransformation
            t)
```

This method takes a video transformation and returns the closest match of that video transformation that can be supported for the currently selected video. If the input video transformation can be supported, then the output video transformation will have the same parameters as the input video transformation. The definition of 'closest match' is implementation dependent.

Parameters:

t - the input video transformation

Returns:

the closest match to the input video transformation. If the input video transformation is supported, then the input video transformation will be returned (the same instance), otherwise a newly created instance will be returned.

---

getVideoTransformation()

```
public org.dvb.media.VideoTransformation getVideoTransformation()
```

Return the current video transformation

Returns:

the video transformation (clipping/scaling/positioning) that is currently used for displaying the video.

---

setVideoTransformation(VideoTransformation)

```
public boolean setVideoTransformation(org.dvb.media.VideoTransformation t)
```

Sets a new video transformation (clipping/scaling/positioning). If the new video transformation is not supported, then the video transformation will not be changed at all (no best effort attempt is made).

Parameters:

t - the new video transformation

Returns:

true if the video transformation is supported and has been set, false otherwise.

org.dvb.media
CAException

Declaration

```
public class CAException extends java.io.IOException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.media.CAException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown when access to a media stream is denied by the CA system. It will typically be thrown by calls to DataSource.start() when access to the stream accessed by the DataSource is denied.

Constructors

CAException()

```
public CAException()
```

Constructor without a reason

CAException(String)

```
public CAException(java.lang.String reason)
```

Constructor with a reason

Parameters:

reason - the reason why access to the stream failed

org.dvb.media
CAStopEvent

Declaration

```
public class CAStopEvent extends javax.media.StopEvent
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--javax.media.ControllerEvent
              |
              +--javax.media.TransitionEvent
                    |
                    +--javax.media.StopEvent
                          |
                          +--org.dvb.media.CAStopEvent
```

All Implemented Interfaces:

javax.media.MediaEvent, java.io.Serializable

Description

This event is generated whenever access to a service is withdrawn by the CA system, e.g. at the end of a free preview period. It is not generated when an attempt to construct a Player or DataSource fails due to CA restrictions, or when only some of the presented content is not available or alternate content is presented. Generation of this event informs the application that the Player is no longer presenting any content.

Constructors

CAStopEvent(Controller)

```
public CAStopEvent(javax.media.Controller source)
```

Construct an event.

Parameters:

source - the controller which was presenting the service

CAStopEvent(Controller, int, int, int, MediaLocator)

```
public CAStopEvent(javax.media.Controller source, int previous, int current, int target,
            javax.media.MediaLocator stream)
```

Construct an event.

Parameters:

source - the controller which was presenting the service

stream - the locator of the stream from which access has been withdrawn.

previous - the previous state of the controller

current - the current state of the controller

target - the target state of the controller

Methods

---

getStream()

```
public javax.media.MediaLocator getStream()
```

This method returns the stream from which access has been withdrawn.

Returns:
the locator for the stream concerned

org.dvb.media
ComponentBasedPlayerControl

Declaration

```
public interface ComponentBasedPlayerControl extends javax.media.Control
```

All Superinterfaces:

```
javax.media.Control
```

Description

The presence of this Control on a Player indicates that the Player can be used as either a background Player or a component-based Player. Players for broadcast streaming formats that do not provide this control will always return null from their getVisualComponent() method.

A Player that provides this control must continue to provide an instance of it (not necessarily the same instance) after any transitions from background to component-based modes and vice-versa.

Methods

---

releaseVisualComponent()

```
public boolean releaseVisualComponent()
            throws IllegalStateException
```

Transition the associated Player from a component-based Player to a background Player. Also releases the ownership of the visual component to allow other applications to acquire it.

The calling application must own the visual component - i.e. it must have obtained a non-null visual component through Player.getVisualComponent() on the Player associated with this control.

If the application has called paint() on that visual component, then this method transitions the Player from a component-based Player to a background Player, and releases the visual component. Otherwise, the Player is still a background Player so this method merely releases the visual component.

If this call transitions the Player from a component-based Player to a background Player, then the video is intially sized and positioned as close to the last location of the visual component as possible, given the limitations exposed after the transition by org.dvb.media.BackgroundVideoPresentationControl .getClosestMatch() or (equivalently) javax.tv.media.AWTVideoSizeControl.checkSize().

After the transition, applications shall re-acquire the list of JMF controls for the player. It is implementation dependent whether any previous JMF controls are re-used. Applications shall not use any previous JMF controls which are not in the new list of JMF controls.

The application should ensure that the visual component is removed from the AWT hierarchy before making this call. After this call, interoperable applications should not make any calls to the visual component aquired before this call. However, such calls will not affect the Player in any way. (For example, calling paint() on that visual component will not cause the Player to become a component-based player). The appearence of the visual component if it is displayed after this call is implementation-dependant.

Future calls to Player.getVisualComponent() will return a visual component that is different from the visual component returned before this call.

Returns:
true iff the Player has changed from component-based to background mode.

Throws:
`java.lang.IllegalStateException` - If the calling application does not own the visual component.

---

swapVideoComponent(Player)

```
public void swapVideoComponent(javax.media.Player other)
```

Swap the presentation of the video for this JMF player and another Player between a component and the background.

Parameters:
`other` - the other player to use in the swap

Throws:
`java.lang.IllegalArgumentException` - if both this player and the other player are background players or if both this player and the other player are component players or if the calling application does not have a reference to the java.awt.Component used in the swap or if either player is not presenting video

Since:
MHP 1.1.3

org.dvb.media
DFCChangedEvent

Declaration

```
public class DFCChangedEvent extends VideoFormatEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.VideoFormatEvent
              |
              +--org.dvb.media.DFCChangedEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Event signalling that the decoder format conversion being used has changed

Constructors

DFCChangedEvent(Object, int)

```
public DFCChangedEvent(java.lang.Object source, int newDFC)
```

Construct the event

Parameters:

source - the source of the event

newDFC - the new decoder format conversion being used

Methods

---

getNewDFC()

```
public int getNewDFC()
```

Get the new decoder format conversion

Returns:

the new decoder format conversion. The value of this is represented by one of the constants from the VideoFormatControl class and shall be the value passed into the constructor of the event.

org.dvb.media
DripFeedDataSource

Declaration

```
public class DripFeedDataSource extends javax.media.protocol.DataSource

java.lang.Object
  |
  +--javax.media.protocol.DataSource
        |
        +--org.dvb.media.DripFeedDataSource
```

All Implemented Interfaces:

`javax.media.protocol.Controls`, `javax.media.Duration`

Description

This class allows to create a source for a JMF player to be able to feed the decoder progressively with parts of a clip (e.g. I or P MPEG-2 frame) according to the drip-fed mode format defined in the MHP content format clause.

To start using the drip-feed mode, the application needs to instantiate a player representing a MPEG-2 video decoder and have its source be a DripFeedDataSource instance.

A DripFeedDataSource instance can be obtained by calling the default constructor of the class.

A player that will be bound to a MPEG-2 video decoder (when realized) can be created with a locator of the following text representation: “dripfeed://”.

After having the DripFeedDataSource connected to a Player representing a MPEG-2 video decoder, the following rules applies:
- If the feed method is called when the player is in the “prefetched” state the image will be stored so that when the player goes in the “started” state it will be automatically displayed.
- If the feed method is called when the player is in the “started” mode, the frame shall be displayed immediately. In particular it is not required to feed a second frame to the decoder to display the first frame.
- If the feed method is called when the player is in any other state (or if the DripFeedDataSource is not connected to a player), it will be ignored by the platform implementation.

Constructors

DripFeedDataSource()

```
public DripFeedDataSource()
```

Constructor. A call to the constructor will throw a security exception if the application is not granted the right to use the drip feed mode. The constructor shall automatically set the MediaLocator for this DataSource to the only allowed value: dripfeed://. There is no need for applications to later call setLocator.

Methods

connect()

```
public void connect()
            throws IOException
```

This method shall not be used and has no effect. This source is considered as always connected.

Overrides:
connect in class DataSource

Throws:
java.io.IOException - never thrown in this sub-class

disconnect()

```
public void disconnect()
```

This method shall not be used and has no effect. This source is considered as always connected.

Overrides:
disconnect in class DataSource

feed(byte[])

```
public void feed(byte[] clip_part)
```

This method allows an application to feed the decoder progressively with parts of a clip (e.g. I or P MPEG-2 frame) according to the drip-fed mode format defined in the MHP content format clause. The feed method shall not be called more often than every 500ms. If this rule is not respected, display is not guaranteed.

While in the prefetch state the drip feed data source is only required to correctly process a single invocation of this method where the data consists only of a single I frame. Possible additional invocations while in the prefetch state shall have implementation specific results.

Parameters:
clip_part - Chunk of bytes compliant with the drip-fed mode format defined in the MHP content format clause (i.e. one MPEG-2 frame with optional synctactic MPEG-2 elements).

getContentType()

```
public java.lang.String getContentType()
```

This method shall return the content type for mpeg-2 video “drips”

Overrides:
getContentType in class DataSource

Returns:
the content type for MPEG-2 video drips

getControl(String)

```
public java.lang.Object getControl(java.lang.String controlType)
```

Obtain the object that implements the specified Class or Interface. The full class or interface name must be used. If the control is not supported then null is returned.

Overrides:
getControl in class DataSource

Parameters:
controlType - the full class or interface name of the requested control

Returns:
the object that implements the control, or null.

---

getControls()

```
public java.lang.Object[] getControls()
```

Obtain the collection of objects that control this object. If no controls are supported, a zero length array is returned.

Overrides:
`getControls` in class `DataSource`

Returns:
the collection of object controls

---

getDuration()

```
public javax.media.Time getDuration()
```

This method shall not be used and has no effect.

Overrides:
`getDuration` in class `DataSource`

Returns:
DURATION_UNKNOWN.

---

start()

```
public void start()
            throws IOException
```

This method shall not be used and has no effect. This source is considered as always started.

Overrides:
`start` in class `DataSource`

Throws:
`java.io.IOException` - never thrown in this sub-class

---

stop()

```
public void stop()
            throws IOException
```

This method shall not be used and has no effect. This source is considered as always started.

Overrides:
`stop` in class `DataSource`

Throws:
`java.io.IOException` - never thrown in this sub-class

org.dvb.media
DripFeedPermission

Declaration

```
public class DripFeedPermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.media.DripFeedPermission
```

All Implemented Interfaces:

java.security.Guard, java.io.Serializable

Description

This class represents a permission to access the drip feed mode.

Constructors

DripFeedPermission(String)

```
public DripFeedPermission(java.lang.String name)
```

Create a new DripFeedPermission.

Parameters:

name - the name string is currently unused and should be empty

---

DripFeedPermission(String, String)

```
public DripFeedPermission(java.lang.String name, java.lang.String actions)
```

Create a new DripFeedPermission. This constructor is used by the policy class to instantiate new permission objects.

Parameters:

name - The name string is currently unused and should be empty

actions - The actions string is currently unused and should be null.

Methods

---

implies(Permission)

```
public boolean implies(java.security.Permission p)
```

Checks if the specified permission is “implied” by this object.

Since name and actions are not used, the only check needed is whether p is also a DripFeedPermission.

Overrides:
`implies` in class `BasicPermission`

Parameters:
`p` - the permission to check against.

Returns:
true if the passed permission is equal to or implied by this permission, false otherwise.

org.dvb.media
DVBMediaSelectControl

Declaration

```
public interface DVBMediaSelectControl extends javax.tv.media.MediaSelectControl
```

All Superinterfaces:

`javax.media.Control`, `javax.tv.media.MediaSelectControl`

Description

DVBMediaSelectControl extends `MediaSelectControl` allowing the selection of different kinds of content in a running `Player`. The extension is to allow the selection in a single operation of all the media service components in a service without needing knowledge about which media service components are present in that service.

Since:

MHP 1.0.2

See Also:

`javax.tv.media.MediaSelectControl`

Methods

---

add(Locator, StreamType)

```
public void add(javax.tv.locator.Locator component,
            javax.tv.service.navigation.StreamType type)
            throws InvalidLocatorException, InvalidServiceComponentException, Insufficient
            ResourcesException, SecurityException
```

Adds a service component (for example, subtitles) to the presentation over-riding the stream type signalled for the component. This is an asynchronous operation that is completed on receipt of a MediaSelectEvent. Components whose addition would require Player resynchronization are not permitted. If the specified service component is already part of the presentation, this method does nothing.

Parameters:

`component` - The locator representing an individual service component to add to the presentation.

`type` - The stream type of the component

Throws:

`javax.tv.locator.InvalidLocatorException` - If the specified locator does not reference a selectable service component.

`javax.tv.service.selection.InvalidServiceComponentException` - If the addition of the service component would require resynchronization of the Player, if the service component is not part of the Service to which the MediaSelectControl is restricted, or if the service component must be presented in conjunction with another service component that is not part of the current presentation.

`javax.tv.service.selection.InsufficientResourcesException` - - If the operation cannot be completed due to a lack of system resources.

`java.lang.SecurityException` - - If the caller does not have MediaSelectPermission(component) permission.

Since:
MHP 1.1.2

---

select(Locator[], StreamType[])

```
public void select(javax.tv.locator.Locator[] components,
            javax.tv.service.navigation.StreamType[] types)
            throws InvalidLocatorException, InvalidServiceComponentException, Insufficient
            ResourcesException, SecurityException
```

Selects one or more service components for presentation over-riding the stream type signalled for the component. If some content is currently playing, it is replaced in its entirety by the specified selection. This is an asynchronous operation that is completed on receipt of a MediaSelectEvent. Note that for certain selections that imply a different time base or otherwise change synchronization relationships, a RestartingEvent will be posted by the Player. If any of the components are successfully presented then a MediaSelectSucceededEvent is generated with the locator array containing only those components that were successfully presented. A MediaSelectFailedEvent is only generated if none of the components are successfully presented.

Parameters:
`components` - An array of locators representing a set of individual service components to present together.

`types` - The stream type corresponding to each locator

Throws:
`javax.tv.locator.InvalidLocatorException` - If a locator provided does not reference a selectable service component.

`javax.tv.service.selection.InvalidServiceComponentException` - If a specified service component is not part of the Service to which the MediaSelectControl is restricted, if a specified service component must be presented in conjunction with another service component not contained in components, if the specified set of service components cannot be presented as a coherent whole, or if the service components are not all available simultaneously.

`javax.tv.service.selection.InsufficientResourcesException` - If the operation cannot be completed due to a lack of system resources.

`java.lang.SecurityException` - If the caller does not have MediaSelectPermission(components[i]) permission for any valid i.

`java.lang.IllegalArgumentException` - if the two arrays are not the same size.

Since:
MHP 1.1.2

---

select(Locator, StreamType)

```
public void select(javax.tv.locator.Locator component,
            javax.tv.service.navigation.StreamType type)
            throws InvalidLocatorException, InvalidServiceComponentException, Insufficient
            ResourcesException, SecurityException
```

Selects a new service component for presentation over-riding the stream type signalled for the component. If some content is currently playing, it is replaced in its entirety by the specified selection. This is an asynchronous operation that is completed upon receipt of a MediaSelectEvent.

Note that for certain selections that imply a different time base or otherwise change synchronization relationships, a RestartingEvent will be posted by the Player.

Parameters:

`component` - A locator representing an individual service component to present.

`type` - The stream type of the component

Throws:

`javax.tv.locator.InvalidLocatorException` - If the locator does not reference a selectable service component.

`javax.tv.service.selection.InvalidServiceComponentException` - If the specified service component is not part of the Service to which the MediaSelectControl is restricted, or if it cannot be presented alone.

`javax.tv.service.selection.InsufficientResourcesException` - If the operation cannot be completed due to a lack of system resources.

`java.lang.SecurityException` - If the caller does not have MediaSelectPermission(component) permission.

Since:

MHP 1.1.2

---

selectServiceMediaComponents(Locator)

```
public void selectServiceMediaComponents(javax.tv.locator.Locator l)
            throws InvalidLocatorException, InvalidServiceComponentException, Insufficient
            ResourcesException
```

Selects for presentation the media service components from a service. If some content is currently playing, it is replaced in its entirety by the media service components from the specified service. This is an asynchronous operation that is completed upon receipt of a MediaSelectEvent. Note that for most selections that imply a different time base or otherwise change synchronization relationships, a RestartingEvent will be posted by the Player. The rules for deciding which media service components shall be presented are defined in the main body of the present document.

Parameters:

`l` - the locator for a service

Throws:

`javax.tv.locator.InvalidLocatorException` - If the locator provided does not reference a service.

`javax.tv.service.selection.InvalidServiceComponentException` - If the locator provided does not reference a service which contains at least one media service component

`javax.tv.service.selection.InsufficientResourcesException` - If the operation cannot be completed due to a lack of system resources.

org.dvb.media
NoComponentSelectedEvent

Declaration

```
public class NoComponentSelectedEvent extends javax.media.StopEvent
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--javax.media.ControllerEvent
              |
              +--javax.media.TransitionEvent
                    |
                    +--javax.media.StopEvent
                          |
                          +--org.dvb.media.NoComponentSelectedEvent
```

All Implemented Interfaces:

`javax.media.MediaEvent`, `java.io.Serializable`

Description

This event is generated whenever presentation of a stream stops because there are no selected components to present. One example of this would be use of the `javax.tv.media.MediaSelectControl.remove` method to remove all components of a service. Generation of this event informs the application that the Player is no longer presenting any content.

Since:

MHP 1.0.1

Constructors

NoComponentSelectedEvent(Controller, int, int, int, MediaLocator)

```
public NoComponentSelectedEvent(javax.media.Controller source, int previous, int current,
            int target, javax.media.MediaLocator stream)
```

Construct an event.

Parameters:

`source` - the controller which was presenting the service

`stream` - the locator of the stream whose presentation has stopped

`previous` - the previous state of the controller

`current` - the current state of the controller

`target` - the target state of the controller

Methods

---

getStream()

```
public javax.media.MediaLocator getStream()
```

This method returns the stream whose presentation has stopped

Returns:
the locator for the stream concerned

org.dvb.media
PresentationChangedEvent

Declaration

```
public class PresentationChangedEvent extends javax.media.ControllerEvent
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--javax.media.ControllerEvent
              |
              +--org.dvb.media.PresentationChangedEvent
```

All Implemented Interfaces:

javax.media.MediaEvent, java.io.Serializable

Description

This event is generated whenever the content being presented by a player changes for reasons outside the control of the application. The state of the player does not change - only the content being presented.

Fields

CA_FAILURE

```
public static final int CA_FAILURE
```

Presentation changed due an action by the CA subsystem. Alternate content is being played, not the content selected by the user (e.g. adverts in place of a scrambled service)

See Also:

getReason()

CA_RETURNED

```
public static final int CA_RETURNED
```

Presentation changed due to an action by the CA subsystem. Normal content is now being presented as requested by the user. This reason code is used when the CA subsystem commands the MHP terminal to switch back to the normal presentation after having previously selected an alternate content.

See Also:

getReason()

STREAM_UNAVAILABLE

```
public static final int STREAM_UNAVAILABLE
```

The stream being presented is no longer available in the transport stream.

See Also:

getReason()

Constructors

PresentationChangedEvent(Controller, MediaLocator, int)

```
public PresentationChangedEvent(javax.media.Controller source,
            javax.media.MediaLocator stream, int reason)
```

Constructor for the event

Parameters:

`source` - the controller whose presentation changed

`stream` - the stream now being presented.

`reason` - the reason for the change encoded as one of the constants in this class

Methods

---

getReason()

```
public int getReason()
```

This method returns the reason why access has been withdrawn.

Returns:

the reason for the change specified when the event was constructed

---

getStream()

```
public javax.media.MediaLocator getStream()
```

This method returns the locator for the stream now being presented.

Returns:

the locator for the stream now being presented

org.dvb.media
ServiceRemovedEvent

Declaration

```
public class ServiceRemovedEvent extends javax.media.StopEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--javax.media.ControllerEvent
              |
              +--javax.media.TransitionEvent
                    |
                    +--javax.media.StopEvent
                          |
                          +--org.dvb.media.ServiceRemovedEvent
```

All Implemented Interfaces:

javax.media.MediaEvent, java.io.Serializable

Description

This event is generated whenever access to a service stops because the service concerned has been removed from the network. Generation of this event informs the application that the Player is no longer presenting any content.

Since:

MHP 1.0.1

Constructors

ServiceRemovedEvent(Controller)

```
public ServiceRemovedEvent(javax.media.Controller source)
```

Construct an event.

Parameters:

source - the controller which was presenting the service

ServiceRemovedEvent(Controller, int, int, int, MediaLocator)

```
public ServiceRemovedEvent(javax.media.Controller source, int previous, int current,
            int target, javax.media.MediaLocator stream)
```

Construct an event.

Parameters:

source - the controller which was presenting the service

stream - the locator of the stream which was removed from the network

previous - the previous state of the controller

current - the current state of the controller

target - the target state of the controller

Methods

---

getStream()

```
public javax.media.MediaLocator getStream()
```

This method returns the stream which was removed from the network

Returns:
the stream concerned

org.dvb.media
StopByResourceLossEvent

Declaration

```
public class StopByResourceLossEvent extends javax.media.StopEvent
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--javax.media.ControllerEvent
              |
              +--javax.media.TransitionEvent
                    |
                    +--javax.media.StopEvent
                          |
                          +--org.dvb.media.StopByResourceLossEvent
```

All Implemented Interfaces:

javax.media.MediaEvent, java.io.Serializable

Description

This event is generated whenever presentation of a stream stops because the player has lost so many resources that it cannot continue. Generation of this event informs the application that the Player is no longer presenting any content.

Since:

MHP 1.0.1

Constructors

StopByResourceLossEvent(Controller, int, int, int, MediaLocator)

```
public StopByResourceLossEvent(javax.media.Controller source, int previous, int current,
            int target, javax.media.MediaLocator stream)
```

Construct an event.

Parameters:

`source` - the controller which was presenting the service

`stream` - the locator of the stream which was being presented

`previous` - the previous state of the controller

`current` - the current state of the controller

`target` - the target state of the controller

Methods

getStream()

```
public javax.media.MediaLocator getStream()
```

This method returns the stream which was being presented

Returns:
the locator for the stream concerned

org.dvb.media
SubtitleAvailableEvent

Declaration

```
public class SubtitleAvailableEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.SubtitleAvailableEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Report that subtitles are available to be presented having been unavailable. This event is not generated on service selection or other forms of 'zapping'. Its generation is restricted to changes in the composition of the subtitle aspects of the same broadcast stream.

Constructors

SubtitleAvailableEvent(Object)

```
public SubtitleAvailableEvent(java.lang.Object source)
```

Constructor.

Parameters:

source - the source of the event. The platform shall always pass in the JMF player presenting the subtitles.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Return the JMF player which is the source of the event.

Overrides:

getSource in class EventObject

Returns:

the source of the event. This shall be the JMF player passed in to the constructor of the event.

org.dvb.media
SubtitleListener

Declaration
```
public interface SubtitleListener extends java.util.EventListener
```

All Superinterfaces:
```
java.util.EventListener
```

Description
Report that a subtitle event has happened.

Methods

---

subtitleStatusChanged(EventObject)

```
public void subtitleStatusChanged(java.util.EventObject event)
```

Report a subtitle event has happened.

Parameters:
`event` - the event which happened

org.dvb.media
SubtitleNotAvailableEvent

Declaration

```
public class SubtitleNotAvailableEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.SubtitleNotAvailableEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Inform an application that a subtitle stream has vanished from the network. This event is not generated on service selection or other forms of 'zapping'. Its generation is restricted to changes in the composition of the subtitle aspects of the same broadcast stream.

Constructors

SubtitleNotAvailableEvent(Object)

```
public SubtitleNotAvailableEvent(java.lang.Object source)
```

Constructor.

Parameters:

source - the source of the event. The platform shall always pass in the JMF player presenting the subtitles.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Return the source of the event.

Overrides:

getSource in class EventObject

Returns:

the source of the event. This shall be the JMF player passed in to the constructor of the event.

org.dvb.media
SubtitleNotSelectedEvent

Declaration

```
public class SubtitleNotSelectedEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.SubtitleNotSelectedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Report that subtitles are not now selected. Even if subtitles are available in the network, they will not be presented. This event is generated when the combination of end user control of subtitles through the navigator and application control of subtitles through `SubtitlingLanguageControl.setSubtitling` changes whether subtitles are to be presented if they are available. It is not generated for changes in the underlying availability of subtitles even if those cause changes in whether subtitles are presented or not.

Constructors

SubtitleNotSelectedEvent(Object)

```
public SubtitleNotSelectedEvent(java.lang.Object source)
```

Constructor

Parameters:

`source` - the source of the event. The platform shall always pass in the JMF player presenting the subtitles.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Return the source of the event

Overrides:

`getSource` in class `EventObject`

Returns:

the source of the event. This shall be the JMF player passed in to the constructor of the event.

org.dvb.media
SubtitleSelectedEvent

Declaration

```
public class SubtitleSelectedEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.SubtitleSelectedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Report that subtitles are now selected. If subtitles are also available then they will be presented. This event is generated when the combination of end user control of subtitles through the navigator and application control of subtitles through `SubtitlingLanguageControl.setSubtitling` changes whether subtitles are to be presented if they are available. It is not generated for changes in the underlying availability of subtitles even if those cause changes in whether subtitles are presented or not.

Constructors

SubtitleSelectedEvent(Object)

```
public SubtitleSelectedEvent(java.lang.Object source)
```

Constructor

Parameters:

`source` - the source of the event. The platform shall always pass in the JMF player presenting the subtitles.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Return the source of the event

Overrides:

`getSource` in class `EventObject`

Returns:

the source of the event. This shall be the JMF player passed in to the constructor of the event.

org.dvb.media
SubtitlingEventControl

Declaration

```
public interface SubtitlingEventControl extends org.davic.media.SubtitlingLanguageControl
```

All Superinterfaces:

`javax.media.Control`, `org.davic.media.LanguageControl`, `org.davic.media.SubtitlingLanguageControl`

Description

Allow applications to register and unregister their interest in events related to the availability and presentation of subtitles.

Methods

---

addSubtitleListener(SubtitleListener)

```
public void addSubtitleListener(org.dvb.media.SubtitleListener l)
```

Add a listener for subtitle events

Parameters:

`l` - the listener to report the events to

---

removeSubtitleListener(SubtitleListener)

```
public void removeSubtitleListener(org.dvb.media.SubtitleListener l)
```

Remove a listener for subtitle events

Parameters:

`l` - the listener to remove

org.dvb.media
VideoFormatControl

Declaration
```
public interface VideoFormatControl extends javax.media.Control
```

All Superinterfaces:
```
javax.media.Control
```

Description
This provides a means for applications to get information associated with the format and aspect ratio of the video being presented to the user. This control will only be available for Players presenting MPEG-2 video streams.

It is important to note that due to different video and display formats (and user preferences), not all of the full video frame may be displayed. Similarly, it may not always be possible to map video and graphics with perfect accuracy.

Signalling for the active format description shall be supported as defined in Annex B of TS 101 154

Fields

AFD_14_9

```
public static final int AFD_14_9
```

Constant representing an MPEG active format description of 14:9 (centre)

AFD_14_9_TOP

```
public static final int AFD_14_9_TOP
```

Constant representing an MPEG active format description of 14:9 (top)

AFD_16_9

```
public static final int AFD_16_9
```

Constant representing an MPEG active format description of 16:9 (centre)

AFD_16_9_SP_14_9

```
public static final int AFD_16_9_SP_14_9
```

Constant representing an MPEG active format description of 16:9 (with shoot & protect 14:9 centre)

AFD_16_9_SP_4_3

```
public static final int AFD_16_9_SP_4_3
```

Constant representing an MPEG active format description of 16:9 (with shoot & protect 4:3 centre)

AFD_16_9_TOP

```
public static final int AFD_16_9_TOP
```

Constant representing an MPEG active format description of 16:9 (top)

AFD_4_3

```
public static final int AFD_4_3
```

Constant representing an MPEG active format description of 4:3 (centre)

AFD_4_3_SP_14_9

```
public static final int AFD_4_3_SP_14_9
```

Constant representing an MPEG active format description of 4:3 (with shoot & protect 14:9 centre)

AFD_GT_16_9

```
public static final int AFD_GT_16_9
```

Constant representing an MPEG active format description of greater than 16:9 (centre)

AFD_NOT_PRESENT

```
public static final int AFD_NOT_PRESENT
```

Constant showing an MPEG active format description is not present

AFD_SAME

```
public static final int AFD_SAME
```

Constant representing an MPEG active format description that is the same as the coded frame

ASPECT_RATIO_16_9

```
public static final int ASPECT_RATIO_16_9
```

Constant representing an aspect ratio of 16:9

ASPECT_RATIO_2_21_1

```
public static final int ASPECT_RATIO_2_21_1
```

Constant representing an aspect ratio of 2.21:1

ASPECT_RATIO_4_3

```
public static final int ASPECT_RATIO_4_3
```

Constant representing an aspect ratio of 4:3

ASPECT_RATIO_UNKNOWN

```
public static final int ASPECT_RATIO_UNKNOWN
```

Constant representing an unknown aspect ratio

DAR_16_9

```
public static final int DAR_16_9
```

Constant representing a display aspect ratio of 16:9

DAR_4_3

```
public static final int DAR_4_3
```

Constant representing a display aspect ratio of 4:3

DFC_PLATFORM

```
public static final int DFC_PLATFORM
```

Control over the decoder format conversions is returned to being managed by the platform. This is the same as the value used if no MHP application has set a video transformation. It is not required to correspond to a single decoder format conversion and may change over time as the video input format & signalling change. This constant can only be used to set the decoder format conversion. Reading the decoder format conversion shall always return the DFC used at the time concerned.

DFC_PROCESSING_16_9_ZOOM

```
public static final int DFC_PROCESSING_16_9_ZOOM
```

The central 16:9 letterbox area of the 4:3 720 x 576 input grid is expanded to fill the 16:9 output frame.

DFC_PROCESSING_CCO

```
public static final int DFC_PROCESSING_CCO
```

A 4:3 central part out of the 720 x 576 input 16:9 frame is transferred into a 720 x 576 4:3 output frame

---

DFC_PROCESSING_FULL

```
public static final int DFC_PROCESSING_FULL
```

The full 720 x 576 frame is transferred (this may be either 4:3 or 16:9; part of this may be black, e.g. in the “pillar box” cases)

DFC_PROCESSING_LB_14_9

```
public static final int DFC_PROCESSING_LB_14_9
```

The 720 x 576 input grid is transferred into a 14:9 LB in a 4:3 frame

---

DFC_PROCESSING_LB_16_9

```
public static final int DFC_PROCESSING_LB_16_9
```

The 720 x 576 input grid is transferred into a 16:9 letterbox in a 4:3 frame

DFC_PROCESSING_LB_2_21_1_ON_16_9

```
public static final int DFC_PROCESSING_LB_2_21_1_ON_16_9
```

The 720 x 576 input grid is transferred into a 2.21:1 letterbox in a 16:9 frame.

DFC_PROCESSING_LB_2_21_1_ON_4_3

```
public static final int DFC_PROCESSING_LB_2_21_1_ON_4_3
```

The 720 x 576 input grid is transferred into a 2.21:1 letterbox in a 4:3 frame.

DFC_PROCESSING_NONE

```
public static final int DFC_PROCESSING_NONE
```

Decoder format conversion is inactive

DFC_PROCESSING_PAN_SCAN

```
public static final int DFC_PROCESSING_PAN_SCAN
```

A 4:3 part out of the 720 x 576 input 16:9 or 2.21:1 frame is transferred into a 720 x 576 4:3 output frame. The horizontal position of this part is determined by pan&scan vectors from the MPEG video stream.

DFC_PROCESSING_UNKNOWN

```
public static final int DFC_PROCESSING_UNKNOWN
```

Constant representing an unknown format conversion being performed by the decoder

Methods

addVideoFormatListener(VideoFormatListener)

```
public void addVideoFormatListener(org.dvb.media.VideoFormatListener l)
```

Add a listener for VideoFormatChangedEvents

Parameters:

`l` - the listener to add

getActiveFormatDefinition()

```
public int getActiveFormatDefinition()
```

Return the value of the active_format field of the MPEG Active Format Description of the video if it is transmitted (one of the constants AFD_* above). If this field is not available then AFD_NOT_PRESENT is returned. The constant values for the constants representing the active format description should be identical to the values specified in ETR154, annex B.

Returns:

the value of the active_format field of the MPEG Active Format Description of the video if it is transmitted. If this field is not available, or the video is not MPEG, then AFD_NOT_PRESENT is returned.

getAspectRatio()

```
public int getAspectRatio()
```

Return the aspect ratio of the video as it is transmitted. If the aspect ratio is not known, ASPECT_RATIO_UNKNOWN is returned

Returns:
the aspect ratio of the video

getDecoderFormatConversion()

```
public int getDecoderFormatConversion()
```

Return a value representing what format conversion is being done by the decoder in the platform (one of the constants DFC_* above). A receiver may implement only a subset of the available options. This decoder format conversion may be active or not depending upon the mode of operation.

Returns:
the decoder format conversion being performed or DFC_PROCESSING_UNKNOWN if this is not known

getDisplayAspectRatio()

```
public int getDisplayAspectRatio()
```

Return the aspect ratio of the display device connected to this MHP decoder (one of the constants DAR_* above)

Returns:
the aspect ratio of the display device connected to the decoder

getVideoTransformation(int)

```
public org.dvb.media.VideoTransformation getVideoTransformation(int dfc)
```

This method returns a VideoTransformation object that corresponds with the specified Decoder Format Conversion when applied to the currently selected video. If the specified Decoder Format Conversion is not supported for the currently selected video, then this method returns null.

Parameters:
`dfc` - the Decoder Format Conversion (one of the DFC_* constants specified in this interface)

Returns:
the video transformation, or null if the specified Decoder Format Conversion is not supported for the currently selected video.

isPlatform()

```
public boolean isPlatform()
```

Test if control over the decoder format conversions is being managed by the platform as defined by DFC_PLATFORM.

Returns:
true if control over the decoder format conversions is being managed by the platform, false otherwise

See Also:
DFC_PLATFORM

---

removeVideoFormatListener(VideoFormatListener)

```
public void removeVideoFormatListener(org.dvb.media.VideoFormatListener l)
```

Remove a listener for VideoFormatChangedEvents

Parameters:

`l` - the listener to remove

org.dvb.media
VideoFormatEvent

Declaration

```
public abstract class VideoFormatEvent extends java.util.EventObject
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.media.VideoFormatEvent
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

ActiveFormatDescriptionChangedEvent, AspectRatioChangedEvent, DFCChangedEvent

Description

The base class for all other events relating to changes in video format

Constructors

VideoFormatEvent(Object)

```
public VideoFormatEvent(java.lang.Object source)
```

Constructor

Parameters:

source - the source of the event. The platform shall always pass in the JMF Player presenting the video whose format changed.

org.dvb.media
VideoFormatListener

Declaration

```
public interface VideoFormatListener extends java.util.EventListener
```

All Superinterfaces:

`java.util.EventListener`

Description

The listener used to receive video format events

Methods

---

receiveVideoFormatEvent(VideoFormatEvent)

```
public void receiveVideoFormatEvent(org.dvb.media.VideoFormatEvent anEvent)
```

receive a VideoFormatEvent

Parameters:

`anEvent` - the VideoFormatEvent that has been received

org.dvb.media
VideoPresentationControl

Declaration

```
public interface VideoPresentationControl extends javax.media.Control
```

All Superinterfaces:

javax.media.Control

All Known Subinterfaces:

BackgroundVideoPresentationControl

Description

A control to support setting and querying the video presentation.

Note: For a component-based player the scaling and positioning of the video is done by manipulating the corresponding AWT component. The VideoPresentationControl only allows for the setting of the clipping region.

Note: If the hardware supports the positioning of interlaced video on even lines only (when counting from 0), then a component-based player is allowed to position the top of the video one line below where it should be.

For a background player there is the BackgroundVideoPresentationControl that allows for the setting of the clipping region, the position and the scaling of the video in one atomic action.

Fields

POS_CAP_FULL

```
public static final byte POS_CAP_FULL
```

Constant representing that the video can be positioned anywhere on the screen, even if a part of the video is off screen as a result of that.

POS_CAP_FULL_EVEN_LINES

```
public static final byte POS_CAP_FULL_EVEN_LINES
```

n Constant representing that the video can be positioned anywhere on the screen, even if a part of the video is off screen as a result of that, with the restriction that the field order is respected. This implies that interlaced video can be positioned on even lines only (when counting from 0).

POS_CAP_FULL_EVEN_LINES_IF_ENTIRE_VIDEO_ON_SCREEN

```
public static final byte POS_CAP_FULL_EVEN_LINES_IF_ENTIRE_VIDEO_ON_SCREEN
```

Constant representing that the video can be positioned anywhere on screen as long as all the video is on screen, with the restriction that the field order is respected. This implies that interlaced video can be positioned on even lines only (when counting from 0).

POS_CAP_FULL_IF_ENTIRE_VIDEO_ON_SCREEN

```
public static final byte POS_CAP_FULL_IF_ENTIRE_VIDEO_ON_SCREEN
```

Constant representing that the video can be positioned anywhere on screen as long as all the video is on screen.

POS_CAP_OTHER

```
public static final byte POS_CAP_OTHER
```

Constant representing that the video positioning capability cannot be expressed by another POS_CAP_* constant.

Methods

---

getActiveVideoArea()

```
public org.havi.ui.HScreenRectangle getActiveVideoArea()
```

This method returns the size and location of the active video area. The active video area excludes any “bars” used for letterboxing or pillarboxing that the receiver knows about. Bars that are included in the broadcast stream and not signalled by active format descriptors are included in the active video area. The active video area may be larger/smaller than the screen, and may possibly be offset. The offsets will be negative if the origin of the active video area is above/left of the top, left corner of the screen. In case of pan&scan, the value returned may vary over time. This method only describes the relationship between the active video and the screen. It does not describe which portion of the screen is displaying the video.
Note: This method includes any video scaling.

Returns:
an HScreenRectangle representing the active video area in the normalized coordinate space.

---

getActiveVideoAreaOnScreen()

```
public org.havi.ui.HScreenRectangle getActiveVideoAreaOnScreen()
```

This method returns the size and location of the active video area on-screen. The active video area excludes any “bars” used for letterboxing or pillarboxing that the receiver knows about. Bars that are included in the broadcast stream and not signalled by active format descriptors are included in the active video area. The active video area on-screen may be smaller than the area of the screen, and may possibly be offset a positive amount. This method only describes the area on-screen where active video is being presented. It does not really describe which part of the video is being shown on-screen. This is especially true for pan&scan.
Note: This method includes any video scaling.

Returns:
an HScreenRectangle representing the active video area on-screen in the normalized coordinate space.

---

getClipRegion()

```
public java.awt.Rectangle getClipRegion()
```

This method returns the area of the decoded video that will be displayed. If clipping is not supported, the dimensions of the bounding box will be the same as the displayed video. Note that when the MHP terminal is in pan & scan mode, the return value of this method will be out of date almost as soon as the method has returned.

Returns:

area of the decoded video that will be displayed. The coordinate space used to express the region is that of the decoded video after possible ETR154 up-sampling.

---

getHorizontalScalingFactors()

```
public float[] getHorizontalScalingFactors()
```

This method gives information about the supported discrete horizontal scaling factors in case arbitrary horizontal scaling is not supported.

Returns:

an array with the supported discrete horizontal scaling factors (including the scaling factor 1), sorted in ascending order. null is returned when arbitrary horizontal scaling is supported.

---

getInputVideoSize()

```
public java.awt.Dimension getInputVideoSize()
```

This method returns the dimensions of the video before any scaling has taken place (but after ETR154 up-sampling). On 50Hz standard definition systems this method always returns 720 x 576.

Returns:

the size of the decoded video before any scaling has taken place (but after ETR154 up-sampling)

---

getPositioningCapability()

```
public byte getPositioningCapability()
```

This method gives information about how the video can be positioned on screen.

Returns:

the positioning capability for the currently selected video as one of the POS_CAP_* constants.

---

getTotalVideoArea()

```
public org.havi.ui.HScreenRectangle getTotalVideoArea()
```

This method returns a relative size and location of the total video area, including any "bars" used for letterboxing or pillarboxing that are included in the broadcast stream, but excluding any "bars" introduced as a result of video filtering. This may be larger or smaller than the size of the physical display device. This method only describes the relationship between the total video and the screen. It does not describe which portion of the screen is displaying the video.
Note: This method includes any video scaling.

Returns:

an HScreenRectangle representing the total video area in the normalized coordinate space.

---

getTotalVideoAreaOnScreen()

```
public org.havi.ui.HScreenRectangle getTotalVideoAreaOnScreen()
```

This method returns a relative size and location of the total video area on-screen, including any "bars" used for letterboxing or pillarboxing that are included in the broadcast stream, but excluding any "bars" introduced as a result of video filtering. This method only describes the area on-screen where total video is being presented. This does not really describe which part of the video is being shown on-screen. This is especially true for pan&scan.
Note: This method includes any video scaling.

Returns:

an HScreenRectangle representing the total video area on-screen in the normalized coordinate space.

---

getVerticalScalingFactors()

```
public float[] getVerticalScalingFactors()
```

This method gives information about the supported discrete vertical scaling factors in case arbitrary vertical scaling is not supported.

Returns:

an array with the supported discrete vertical scaling factors (including the scaling factor 1), sorted in ascending order. null is returned when arbitrary vertical scaling is supported.

---

getVideoSize()

```
public java.awt.Dimension getVideoSize()
```

This method returns the size of the decoded video as it is being presented to the user. It takes scaling and clipping into account.

Returns:

the size of the decoded video as it is being presented to the user

---

setClipRegion(Rectangle)

```
public java.awt.Rectangle setClipRegion(java.awt.Rectangle clipRect)
```

Set the region of the decoded video that will be displayed. If clipping is not supported, this method has no effect. If the bounding box extends beyond the decoded video, the results are implementation dependent. By default, the clipping region is set to the dimensions of the decoded video. This method returns the bounding box of the clipping region that was actually set. Implementations may approximate the requested rectangle if they have restrictions on video clipping.

If the player is a component-based player (as opposed to a background player), then the top left corner of the clip region will be aligned with the top left corner of the java.awt.Component returned by the method javax.media.Player.getVisualComponent(). Hence changing the position of the clip region within the video moves the video with respect to the coordinate space used by java.awt.

Parameters:

`clipRect` - the bounding box of the clipping region. The coordinate space used to express the region is that of the decoded video after possible ETR154 up-sampling.

Returns:

the set clipping region. If the requested clipping region is supported exactly, then the input parameter clipRect is returned, otherwise a newly created object will be returned.

---

supportsArbitraryHorizontalScaling()

```
public float[] supportsArbitraryHorizontalScaling()
```

This method gives information about whether arbitrary horizontal scaling is supported for the currently playing video. If arbitrary horizontal scaling is supported, then an array with two elements in returned. The first element returns the smallest allowed scaling factor (e.g. 0,5) and the second element returns the largest allowed scaling factor (e.g. 4). If arbitrary horizontal scaling is not supported, null is returned. In that case the method getHorizontalScalingFactors can be used to query which discrete scaling factors are supported.

Returns:

an array with the minimum and maximum allowed horizontal scaling factor, or null if arbitrary horizontal scaling is not supported.

---

supportsArbitraryVerticalScaling()

```
public float[] supportsArbitraryVerticalScaling()
```

This method gives information about whether arbitrary vertical scaling is supported for the currently playing video. If arbitrary vertical scaling is supported, then an array with two elements in returned. The first element returns the smallest allowed scaling factor (e.g. 0,5) and the second element returns the largest allowed scaling factor (e.g. 2). If arbitrary vertical scaling is not supported, null is returned. In that case the method getVerticalScalingFactors can be used to query which discrete scaling factors are supported.

Returns:

an array with the minimum and maximum allowed vertical scaling factor, or null if arbitrary vertical scaling is not supported.

---

supportsClipping()

```
public boolean supportsClipping()
```

Test if the decoder supports clipping

Returns:

true if and only if the decoder supports clipping.

org.dvb.media
VideoTransformation

Declaration

```
public class VideoTransformation

java.lang.Object
   |
   +--org.dvb.media.VideoTransformation
```

Description

VideoTransformation objects express video transformations, i.e. the clipping, the horizontal and vertical scaling and the position of the video. All transformations are to be applied after possible ETR154 up-sampling.

Note: Instances of VideoTransformation can represent pan and scan, but an application cannot create such instances itself. An application can get a VideoTransformation representing pan and scan, by calling the VideoFormatControl.getVideoTransformation() method with the pan and scan Decoder Format Conversion constant.

Constructors

VideoTransformation()

```
public VideoTransformation()
```

Creates a VideoTransformation object with default parameters. Clipping is disabled, both the horizontal and the vertical scaling factors are 1, and the video position is (0,0) in the normalised coordinate space.

VideoTransformation(Rectangle, float, float, HScreenPoint)

```
public VideoTransformation(java.awt.Rectangle clipRect, float horizontalScalingFactor,
            float verticalScalingFactor, org.havi.ui.HScreenPoint location)
```

Creates a VideoTransformation object with the supplied parameters.

Parameters:

`clipRect` - the bounding box of the clipping region. The coordinate space used to express the region is that of the decoded video after possible ETR154 up-sampling. A non-null ClipRect enables clipping. A null ClipRect disables it.

`horizontalScalingFactor` - the horizontal scaling factor.

`verticalScalingFactor` - the vertical scaling factor.

`location` - the location of the video on the screen in the normalised coordinate space.

Methods

---

getClipRegion()

```
public java.awt.Rectangle getClipRegion()
```

Gets the clipping region.

Returns:
the bounding box of the clipping region. The coordinate space used to express the region is that of the decoded video after possible ETR154 up-sampling. null is returned if this video transformation represents pan and scan or if clipping is disabled.

---

getScalingFactors()

```
public float[] getScalingFactors()
```

Gets the horizontal and vertical scaling factors.

Returns:
an array with two elements. The first element contains the horizontal scaling factor, the second element the vertical scaling factor.

---

getVideoPosition()

```
public org.havi.ui.HScreenPoint getVideoPosition()
```

Returns the video position.

Returns:
the location of the video on the screen in the normalised coordinate space.

---

isPanAndScan()

```
public boolean isPanAndScan()
```

Returns whether this video transformation represents pan and scan.

Returns:
true is this video transformation represents pan and scan, false otherwise.

---

setClipRegion(Rectangle)

```
public void setClipRegion(java.awt.Rectangle clipRect)
```

Sets the clipping region.

If this video transformation represents pan and scan, then it will no longer represent pan and scan when this method is called. A non-null ClipRect enables clipping. A null ClipRect disables it.

Parameters:
`clipRect` - the bounding box of the clipping region. The coordinate space used to express the region is that of the decoded video after possible ETR154 up-sampling.

---

setScalingFactors(float, float)

```
public void setScalingFactors(float horizontalScalingFactor, float verticalScalingFactor)
```

Sets the horizontal and vertical scaling factors.

Parameters:
`horizontalScalingFactor` - the horizontal scaling factor.

`verticalScalingFactor` - the vertical scaling factor.

setVideoPosition(HScreenPoint)

```
public void setVideoPosition(org.havi.ui.HScreenPoint location)
```

Sets the video position.

Parameters:

`location` - the location of the video on the screen in the normalised coordinate space.

Annex O (normative): Integration of the Java TV SI API and DVB SI

O.1 Introduction

This clause describes how the Java TV Service Information API as described in Java TV [51] can be mapped to the data structures of DVB Service Information as defined in EN 300 468 [4]. Secondly the present document describes how the Java TV API and the DVB SI API (as described in annex M "(normative): SI Access API" on page 602) can be integrated.

O.2 Mapping of the Java TV SI API to DVB SI

This clause describes for every relevant Java interface and method in the Java TV SI API how it is mapped to the DVB Service Information.

When adding a listener to monitor for changes in an SI table (or data carried in an SI table), an event shall not be generated for the current version of that table (or data) found in the network at the time the listener is added. Events shall only be generated for changes following the detection of that current version.

O.2.1 javax.tv.service.Service

MHP terminals normally maintain a stored list of "installed" services discovered through the process explained in clause Z.6 "How does the platform know which services are available?" on page 971. The Service interface shall represent the entries in this list and also those services which are discovered in the network but which are not yet stored in this list (see clause O.2.8.5 "getService" on page 741). Neither PSI-only services nor hidden services should be presented to the end-user by the navigator, either in a UI showing the list of available services or in response to the program up / program down keys on conventional remote controls.

Depending on the MHP terminal implementation, the objects implementing this interface may or may not implement the ServiceNumber interface as well. Furthermore, it is allowed that even within the same MHP terminal implementation, some objects implementing the Service interface implement the ServiceNumber while other objects implement only the Service interface.

Objects implementing this interfaces and representing DVB services shall also implement the `org.dvb.si.TextualServiceIdentifierQuery` interface.

The methods are mapped as follows:

O.2.1.1 getName

Returns the name of the service as stored in the MHP terminal. Depending on the MHP terminal implementation, the end user may have the possibility to edit these names according to his preferences. If the contents of this field are retrieved by the MHP terminal by default from DVB SI, it is recommended that the MHP terminal uses the abbreviated form of the service name from the Service descriptor (see 4.6.1 "Use of control codes in names" in TR 101 211 [i.2]).

O.2.1.2 getServiceType

Returns the ServiceType according to the mapping defined in clause O.2.3 "javax.tv.service.ServiceType" on page 739.

O.2.2 javax.tv.service.navigation.ServiceComponent

The ServiceComponent interface provides the information contained in the Component descriptors, Multilingual component descriptors or Data broadcast descriptors in the EIT.

O.2.2.1 getName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual component descriptor or data broadcast descriptor in the EIT, return the description in that language. Otherwise return an implementation dependent selection between the descriptions available in the EIT.

O.2.2.2 getAssociatedLanguage

Returns the ISO 639-2 [19] language code indicating the language of the component (i.e. not necessarily the selected language for the name returned by `getName()`) from the component descriptor, multilingual component descriptor or data broadcast descriptor.

O.2.2.3 getStreamType

Returns the stream type according to the mapping from the stream_content field and the component_type field of the Component descriptor or the Data broadcast descriptor to the Java TV stream types according to clause O.2.4 "javax.tv.service.navigation.StreamType" on page 739.

O.2.3 javax.tv.service.ServiceType

The DVB SI service types are defined in Table 61 of EN 300 468 [4]. These should be mapped to the Java TV service types as follows.

Table O.1: Mapping DVB to Java TV service types

DVB Service type code	DVB Service Type Description	Java TV Service Type
0x01	Digital television service	DIGITAL_TV
0x02	Digital radio sound service	DIGITAL_RADIO
0x03	Teletext service	DATA_BROADCAST
0x04	NVOD Reference service	NVOD_REFERENCE
0x05	NVOD time-shifted service	NVOD_TIME_SHIFTED
0x06	Mosaic service	DIGITAL_TV
0x07	PAL coded signal	ANALOG_TV
0x08	SECAM coded signal	ANALOG_TV
0x09	D/D2-MAC	ANALOG_TV
0x0A	FM Radio	ANALOG_RADIO
0x0B	NTSC coded signal	ANALOG_TV
0x0C	Data broadcast service	DATA_BROADCAST
0x10	MHP application service	DATA_APPLICATION
0x00, 0x0D to 0x0F, 0x11 to 0xFF		UNKNOWN

O.2.4 javax.tv.service.navigation.StreamType

The DVB SI stream_content and component_type values are defined in Table 15 of EN 300 468 [4]. These should be mapped to the Java TV Stream types as follows. If the component does not have an associated Component descriptor, but a Data broadcast descriptor, the stream type DATA shall be used.

Table O.2: Mapping DVB stream and component types to Java TV

DVB stream_content	DVB component_type	Java TV Stream type
0x01	0x00 to 0xff	VIDEO
0x02	0x00 to 0xff	AUDIO
0x03	0x01, 0x10 to 0x13, 0x20 to 0x23	SUBTITLES
0x03	0x02	DATA
0x03	0x00, 0x14 to 0x1F, 0x24 to 0xFF	UNKNOWN
0x04 to 0x0F	0x00 to 0xFF	UNKNOWN

O.2.5 javax.tv.service.SIElement

This interface is implemented by objects implementing the Network, Bouquet, TransportStream, ServiceDetails, ServiceComponent and ProgramEvent interfaces.

O.2.5.1 getServiceInformationType

This method shall return the DVB_SI ServiceInformationType.

O.2.6 javax.tv.service.SIManager

O.2.6.1 getSupportedDimensions

The parental rating descriptor defined in DVB SI standardizes one rating scheme that is based on age. To describe this DVB defined rating scheme, the getSupportedDimensions shall return an array that contains the string "DVB Age based rating".

O.2.6.2 getRatingDimension

When given the string "DVB Age based rating", this method shall return an object implementing the RatingDimension interface as described in clause O.2.10 "javax.tv.service.RatingDimension" on page 741.

O.2.6.3 retrieveSIElement

When passed a locator that points to a service, an object implementing the ServiceDetails interface shall be returned. Locators representing program events are not supported and shall fail with an `SIRequestFailureType(INSUFFICIENT_RESOURCES)`.

Other types of locators are supported as defined.

NOTE: program events can still be retrieved for specific times using the methods in `javax.tv.service.guide.ProgramSchedule`.

O.2.6.4 getTransports

The object returned by this method shall implement the Transport interface as described in clause O.2.12 "javax.tv.service.transport.Transport" on page 742.

O.2.6.5 filterServices

Filtering of Services shall be supported with ServiceFilters. The SIElementFilter is required to be supported as defined in clause O.2.7 "javax.tv.service.navigation.SIElementFilter" on page 740.

O.2.6.6 retrieveProgramEvent

This method shall fail with a `SIRequestFailureType(INSUFFICIENT_RESOURCES)`.

NOTE: program events can still be retrieved for specific times using the methods in `javax.tv.service.guide.ProgramSchedule`.

O.2.7 javax.tv.service.navigation.SIElementFilter

The SIElementFilter allows filtering of Services based on another SIElement. This filter type shall be supported for the Network and TransportStream objects. For other SIElement objects, the constructor may throw FilterNotSupportedException.

O.2.8 javax.tv.service.navigation.ServiceDetails

The ServiceDetails interface represents the information regarding the service as retrieved from the broadcast DVB SI. The object implementing this interface for DVB SI implements the CAIdentification interface according to the mapping defined in clause O.2.9 "javax.tv.service.navigation.CAIdentification" on page 741. These objects shall not implement the ServiceNumber interface.

O.2.8.1 getLongName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual service descriptor in the SDT, return the service name in that language. Otherwise return an implementation dependent selection between the descriptors available in the SDT.

O.2.8.2 getServiceType

Returns the ServiceType according to the mapping defined in clause O.2.3 "javax.tv.service.ServiceType" on page 739.

O.2.8.3 retrieveServiceDescription

Shall always result in a notifyFailure of the SIRequestor object being called with the DATA_UNAVAILABLE SIRequestFailureType, as DVB SI does not include a service description.

O.2.8.4 retrieveComponents

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual component descriptors or data broadcast descriptors in the EIT present/following table then the information for the ServiceComponents shall be retrieved from those descriptors. Otherwise the information for the ServiceComponents shall be returned from an implementation dependent selection between the descriptors available in the EIT present/following table.

O.2.8.5 getService

Calling this method for a `ServiceDetails` instance whose corresponding service is not in the "installed" services list (i.e. a new service found in the SDT which would not previously have been returned from `SIManager.FilterServices(null)`) shall return a Service instance and shall not return null. The implementation is responsible for creating this Service instance. It is implementation dependent whether this Service instance is also "installed" and hence whether or not it is returned by `FilterServices(null)`. This Service instance shall have no different behaviour from "installed" services apart from this.

O.2.9 javax.tv.service.navigation.CAIdentification

This interface shall be implemented by objects implementing the ServiceDetails, ProgramEvent or Bouquet interface.

O.2.9.1 getCASystemIds

Returns the array of integer values containing the CA_system_ids from the CA identifier descriptor. If the CA identifier descriptor is not present, returns an empty array.

O.2.9.2 isFree

When implemented in an object implementing the ServiceDetails or ProgramEvent interface, this method shall return true if and only if the free_CA_mode bit is set to "0" in the SDT or EIT entry, respectively.

When implemented in an object implementing the Bouquet interface, this method shall return true if and only if there is no CA identifier descriptor present in the BAT.

O.2.10 javax.tv.service.RatingDimension

The Parental rating descriptor defined in DVB SI standardizes one rating scheme that is based on age. This rating scheme contains 15 distinct age rating levels from 4 to 18 years.

An object that describes this DVB defined rating scheme shall implement the methods as follows.

O.2.10.1 getDimensionName

Returns the string "DVB Age based rating".

O.2.10.2 getNumberOfLevels

Returns 15.

O.2.10.3 getRatingLevelDescription

Returns an array of 2 strings of the form:

{"Over *n*", "Recommended minimum age: *n* years"}

where n is the input parameter + 4.

O.2.11 javax.tv.service.navigation.ServiceProviderInformation

This interface shall be implemented by objects implementing the ServiceDetails interface.

O.2.11.1 getProviderName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual service descriptor or service descriptor in the SDT, return the provider name from that descriptor. Otherwise return an implementation dependent selection from the descriptors available in the SDT.

O.2.12 javax.tv.service.transport.Transport

The object implementing the Transport interface shall also implement the interfaces NetworkCollection and BouquetCollection.

O.2.13 javax.tv.service.transport.Bouquet

The Bouquet interface is implemented by an object that represents a DVB SI Bouquet.

Objects implementing this interface shall also implement the CAIdentification interface. See clause O.2.9 "javax.tv.service.navigation.CAIdentification" on page 741.

O.2.13.1 getBouquetID

Returns the integer DVB SI Bouquet ID value.

O.2.13.2 getName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual bouquet name descriptor in the BAT, return the name in that language. Otherwise return an implementation dependent selection from the descriptors available in the BAT.

O.2.13.3 getLocator

Returns an implementation dependent javax.tv.locator.Locator object that does not have a standardized external representation and might not be a org.davic.net.dvb.DvbLocator.

O.2.14 javax.tv.service.transport.Network

The Network interface is implemented by an object that represents a DVB SI Network.

O.2.14.1 getNetworkID

Returns the integer DVB SI Network ID value.

O.2.14.2 getName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a multilingual network name descriptor in the NIT, return the name in that language. Otherwise return an implementation dependent selection from the descriptors available in the NIT.

O.2.14.3 getLocator

Returns an implementation dependent javax.tv.locator.Locator object that does not have a standardized external representation and might not be a org.davic.net.dvb.DvbLocator.

O.2.15 javax.tv.service.transport.TransportStream

The TransportStream interface is implemented by an object that represents a transport stream.

O.2.15.1 getTransportStreamID

Returns the integer DVB SI transport stream ID value.

O.2.15.2 getDescription

Transport streams do not have descriptions in DVB SI, so this method shall return an empty string.

O.2.16 javax.tv.service.guide.ProgramEvent

This interface is implemented by objects representing DVB SI Events.

Objects implementing this interface shall also implement the CAIdentification interface. See clause O.2.9 "javax.tv.service.navigation.CAIdentification" on page 741.

O.2.16.1 getDuration

Returns the duration value from the event entry in the body of the EIT.

O.2.16.2 getStartTime

Returns the start time value from the event entry in the body of the EIT.

O.2.16.3 getEndTime

Returns the end time value calculated from the start time and duration in the body of the EIT.

O.2.16.4 getName

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a short event descriptor in the EIT, return the name from that descriptor. Otherwise return an implementation dependent selection from the descriptors available in the EIT.

O.2.16.5 retrieveDescription

If the language returned by `javax.tv.service.SIManager.getPreferredLanguage` corresponds to the language of a short event descriptor in the EIT, return the description from that descriptor. Otherwise return an implementation dependent selection from the descriptors available in the EIT.

The description text in the `ProgramEventDescription` object is just passed through as a String containing the description as it was transmitted in the EIT table with just a character set mapping performed.

Codes 0x8a and 0xe08a defined in tables A.1 and A.2 of EN 300 468 [4] shall be mapped to the Java newline character, '\n'.

O.2.16.6 getRating

Returns the rating from the Parental rating descriptor according to the mapping defined in clause O.2.17 "javax.tv.service.guide.ContentRatingAdvisory" on page 743.

O.2.17 javax.tv.service.guide.ContentRatingAdvisory

O.2.17.1 getDimensionNames

Returns an array containing the string "DVB Age based rating" as one of the elements in the array.

O.2.17.2 getRatingLevel

When the parameter is "DVB Age based rating" and the parental rating descriptor contains a rating value between 0x01 and 0x0F for the current region, returns the integer rating value contained in the parental rating descriptor decremented by one (i.e. the value in the descriptor - 1). In other cases when the parameter is "DVB Age based rating" returns -1.

O.2.17.3 getRatingText

When the parameter is "DVB Age based rating" and the parental rating descriptor contains a rating value between 0x01 and 0x0F for the current region, returns a string of the form "Recommended minimum age: n years" where n is the rating value in the descriptor incremented by 3 (i.e. the value in the descriptor + 3). In other cases when the parameter is "DVB Age based rating" returns an empty string.

NOTE: Applications wishing to present this information in languages other than English should use the `getRatingLevel()` method and perform their own encoding of this for end-user presentation.

O.2.17.4 getDisplayText

When the parental rating descriptor contains a rating value between 0x01 and 0x0F for the current region, returns a string that contains the string "Over n", where n is the rating value in the descriptor incremented by 3 (i.e. the value in the descriptor + 3), as its substring.

NOTE: Applications wishing to present this information in languages other than English should use the `getRatingLevel()` method and perform their own encoding of this for end-user presentation.

O.2.17.5 retrieveProgramEvent(Locator, SIRequestor)

This method is not supported and shall fail with an `SIRequestFailureType(INSUFFICIENT_RESOURCES)`.

O.3 Integration of the Java TV SI API and the DVB SI API

In order for the protocol independent service information API to be useful, there needs to be an easy and convenient way for applications to use the DVB specific parts when they are needed. The information provided in the protocol independent API is quite minimal and does not cover all the aspects of the standardized DVB Service Information nor access to the private extensions carried in the standard protocol. If there is no integration between these APIs and the application programmer needs to use a completely different API to retrieve additional information on the object retrieved from the protocol independent API, the usefulness of the protocol independent API is very questionable. In this case, the application programmer will start using only the protocol dependent API, as it provides the complete information and is as easy to use as the other API.

To overcome these problems and make the protocol independent API somehow useful, it needs to be well integrated with the protocol dependent API, so that if an application uses first the protocol independent API for browsing the information, it can easily get additional, protocol dependent information on the objects of interest.

The Java language provides an easy way to achieve this integration: the same objects can implement both the protocol independent interface as well as the protocol dependent interface. This way the application programmer only needs to cast the object to the protocol dependent interface and can directly call methods from the protocol specific API.

Objects implementing the following interfaces of the DVB SI API should implement also the corresponding Java TV SI API interfaces. When retrieving SI objects through the Java TV APIs, they shall also implement the corresponding DVB SI API interfaces.

The interfaces of both APIs shall be implemented on the objects as follows:

Figure O.1

org.dvb.si.SINetwork	objects implement also	javax.tv.service.transport.Network
org.dvb.si.SIBouquet	objects implement also	javax.tv.service.transport.Bouquet
org.dvb.si.SITransportStreamNIT	objects implement also	javax.tv.service.transport.TransportStream
org.dvb.si.SIService	objects implement also	javax.tv.service.navigation.ServiceDetails
org.dvb.si.SIEvent	objects implement also	javax.tv.service.guide.ProgramEvent

Annex P (normative): Broadcast Transport Protocol Access

The Object Carousel represents the best suited protocol to carry a structure of objects. Thus, the Object Carousel "mimics" a remote server.

The structure of the objects carried in an Object Carousel is identical to the structure of UU-Objects located on a remote DSMCC-UU Server.

The aim of this API is to enable an application to access files encapsulated in an object carousel or accessible through a DSMCC interactive network.

NOTE: The protocol is abstracted from the application viewpoint, so, objects accessible through this API are either objects encapsulated in an Object Carousel, or Objects located in an interactive DSMCC network on a remote server.

To benefit from the fact that most of the functionalities are already covered by the java.io package, this API inherits from java.io and only defines the extra-functionalities pertaining to:

a) The nature of the network (broadcast or DSMCC remote server) and its latency (e.g. possibility to asynchronously load the objects).

b) The type of the objects that can be encapsulated in a carousel and that do not exist in a classical File structure. These are: ServiceGateway, Directory, File, Stream and StreamEvent.

c) Definition of ServiceGateway, which defines a new namespace corresponding to the new Domain, and enables the mounting of a new volume.

An application can optionally use only the classes of java.io. Alternatively/additionally applications can use additional classes and methods adapted to the specific nature and latency of the network (such as for example, the asynchronous loading of objects).

The following, briefly explains the functionalities offered by this API

The ServiceDomain class enables attaching to a ServiceDomain. Attachment to a serviceDomain corresponds to the mounting of a volume in the file hierarchy system and the loading of the Service Gateway.

When attached to a Service Domain the DSM-CC UU-File, UU-Stream, UU-Directory and UU-StreamEvent objects are accessible through this API.

The class DSMCCObject represents a UU-object. Due to the close relationship between resident files and downloaded files, this class inherits from the java.io.File class. The DSMCCObject class just defines the additional methods specific to DSMCC-UU that basically deal with asynchronous or synchronous loading of Objects.

For the UU-Files or UU-Directory Objects, their content is accessible as it would be for a classical file system, i.e. by using the `java.io package` (e.g. for listing the objects pointed to by a Directory object, you invoke the `list()` method of the `java.io.File` class, or to access the content of a UU-File, you can instantiate a `FileInputStream` to read the `File`, etc.).

Additionally, the DSMCCStream and DSMCCStreamEvent classes define functionalities specific to the respective types of Objects (Stream and StreamEvent), which basically consists in accessing the attributes of these Objects.

The DSMCCStream class provides access to the following attributes Duration, current NPT. In addition, an application can retrieve the list of Taps (modelized by the 'Locator' class), in order for a Player to be able to control and play that Stream.

The DSMCCStreamEvent class inherits from the DSMCCStream class, and provides access to the event list attributes of a StreamEvent Object. In addition, the application has the possibility to subscribe the events which are present in the eventList.

The AsynchronousLoadingEvent class and its subclasses represent events that are sent to a listener to notify it of the loading of an Object that had been activated by the application (asynchronous loading mode).

The StreamEvent class represents an abstraction of the real event that is generated, i.e. the streameventdescriptor, which enables the broadcaster to synchronize the application with the stream. This class enables the access to the content of an event, the content of the event being described by the StreamEventDescriptor, which is inserted in the stream in DSMCC sections at the transport level.

Finally, the StreamEventListener and AsynchronousLoadingEventListener are interfaces that must be implemented by the application, in order for it to receive the respective StreamEvents and AsynchronousLoadingEvents.

Package org.dvb.dsmcc

Description

Provides extended access to files carried in the broadcast stream. It includes some extensions to java.io which are generic to (possibly) long-latency file systems and some concepts which are specific to the DSMCC object carousel.

Class Summary

Interfaces

AsynchronousLoadingEventListener	Listener for applications which perform asynchronous loading, in order to be informed if the loading is done or if an error has occurred.
NPTListener	Objects that implement the `NPTListener` interface can receive `NPTStatusEvent` and `NPTRateChangedEvent` events.
ObjectChangeEventListener	The objects that implements the ObjectChangeEventListener interface can receive ObjectChangeEvent event.
StreamEventListener	Objects that implement the StreamEventListener interface can receive StreamEvent event.

Classes

AsynchronousLoadingEvent	This class described an Object event which is used to notify the loading of a DSMCC object.
DSMCCObject	A `DSMCCObject` extends the java.io.File class with a combination of features appropriate for any file system with a long access time and features specific to the DSMCC object carousel as one example of such a file system.
DSMCCStream	The DSMCCStream class is used to manage DSMCC Stream Objects.
DSMCCStreamEvent	The DSMCCStreamEvent class is used to manage DSMCC StreamEvent Objects.
InsufficientResourcesEvent	This event is generated if there are insufficient resources available to load a DSMCCObject. e.g. if there is not enough memory.
InvalidFormatEvent	This event is generated if the format of the data received is inconsistent.
InvalidPathnameEvent	The pathname does not exist or the ServiceDomain has been detached.
LoadingAbortedEvent	This event will be sent to the AsynchronousEventListener when an asynchronous loading operation is aborted.
MPEGDeliveryErrorEvent	An MPEGDeliveryErrorEvent indicates that an error (for instance, a time out or accessing the data would require tuning) has occurred while loading data from an MPEG Stream.
NotEntitledEvent	This event is sent when an attempt to asynchronously load an object has failed because the elementary stream carrying the object is scrambled and the user is not entitled to access the content of the object.
NPTDiscontinuityEvent	Sent when an MHP terminal detects a permanent value discontinuity in a broadcast timebase as defined in the main body of the present document.
NPTPresentEvent	Sent to listeners on a DSMCCStream object when a broadcast timeline newly appears for that DSMCC stream when it was not previously present.
NPTRate	Represents the rate at which an broadcast timeline progresses.

Class Summary	
NPTRateChangeEvent	Sent only when the rate of an broadcast timeline changes value.
NPTRemovedEvent	Sent to listeners on a DSMCCStream object when a broadcast timeline which was present for that DSMCC stream is removed.
NPTStatusEvent	Sent when an MHP terminal detects a change of status in the broadcast timeline of a stream.
ObjectChangeEvent	This class describes an object change event that is used to monitor the arrival of a new version of a DSMCCObject.
ServerDeliveryErrorEvent	The local machine can not communicate with the server.
ServiceDomain	A ServiceDomain represents a group of DSMCC objects.
ServiceXFRErrorEvent	The object requested is available in an alternate ServiceDomain.
ServiceXFRReference	A ServiceXFRReference object is used when a DSMCC Object can not be loaded in the current ServiceDomain but is available in an alternate ServiceDomain.
StreamEvent	This class describes a Stream event which is used to synchronize an application with an MPEG Stream.
SuccessEvent	This event indicates that the asynchronous loading was successful.
Exceptions	
DSMCCException	The DSMCCException is the root class of all DSMCC related exceptions
IllegalObjectTypeException	This Exception is thrown when the application attempted to create a DSMCCStream or DSMCCStreamEvent object with an object or a path that did not correspond to a DSMCC Stream or DSMCC StreamEvent respectively
InsufficientResourcesException	This exception gets thrown when a request to perform a DSMCC related operation cannot be completed due to resource limitations.
InvalidAddressException	An InvalidAddressException is thrown when the format of an NSAP address is not recognized.
InvalidFormatException	An InvalidFormatException is thrown when an inconsistent DSMCC message is received.
InvalidPathNameException	The InvalidPathNameException is thrown when the path name to a DSMCCObject does not exist or if the service domain is not detached.
MPEGDeliveryException	An MPEGDEliveryException is thrown when an error (for instance, a time out or accessing the data would require tuning) occurs while loading data from an MPEG Stream.
NotEntitledException	This Exception is thrown when the user is not entitled to access the content of the object (the Elementary Stream is scrambled and the user is not entitled).
NothingToAbortException	A NothingToAbortException is thrown when the abort method is called and there is no loading in progress.
NotLoadedException	A NotLoadedException is thrown when an operation fails because information which is required to be loaded has not been.
ServerDeliveryException	A ServerDeliveryException is thrown when the local machine can not communicate with the server.
ServiceXFRException	A ServiceXFRException is thrown when a DSMCC Object can not be loaded in the current ServiceDomain but is available in an alternate ServiceDomain (i.e. for an object Carousel, the IOR of the object or one of its parent directories contains a Lite Option Profile Body).

Class Summary	
UnknownEventException	The UnknownEventException is thrown when a method tries to access to an unknown event.

org.dvb.dsmcc
AsynchronousLoadingEvent

Declaration

```
public abstract class AsynchronousLoadingEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

InsufficientResourcesEvent, InvalidFormatEvent, InvalidPathnameEvent, LoadingAbortedEvent, MPEGDeliveryErrorEvent, NotEntitledEvent, ServerDeliveryErrorEvent, ServiceXFRErrorEvent, SuccessEvent

Description

This class described an Object event which is used to notify the loading of a DSMCC object.

Constructors

AsynchronousLoadingEvent(DSMCCObject)

```
public AsynchronousLoadingEvent(org.dvb.dsmcc.DSMCCObject o)
```

Creates an AsynchronousLoadingEvent.

Parameters:

o - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:

getSource in class EventObject

Returns:

the DSMCCObject that generated the event.

org.dvb.dsmcc
AsynchronousLoadingEventListener

Declaration

```
public interface AsynchronousLoadingEventListener extends java.util.EventListener
```

All Superinterfaces:

`java.util.EventListener`

Description

Listener for applications which perform asynchronous loading, in order to be informed if the loading is done or if an error has occurred.

Methods

---

receiveEvent(AsynchronousLoadingEvent)

```
public void receiveEvent(org.dvb.dsmcc.AsynchronousLoadingEvent e)
```

Method called when an event is sent to the application.

Parameters:

`e` - an AsynchronousLoadingEvent event.

org.dvb.dsmcc
DSMCCException

Declaration

```
public class DSMCCException extends java.io.IOException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

IllegalObjectTypeException, InsufficientResourcesException, InvalidAddressException, InvalidFormatException, InvalidPathNameException, MPEGDeliveryException, NotEntitledException, NothingToAbortException, NotLoadedException, ServerDeliveryException, ServiceXFRException, UnknownEventException

Description

The DSMCCException is the root class of all DSMCC related exceptions

Constructors

DSMCCException()

```
public DSMCCException()
```

Construct a DSMCCException with no detail message

DSMCCException(String)

```
public DSMCCException(java.lang.String s)
```

Construct a DSMCCException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
DSMCCObject

Declaration

```
public class DSMCCObject extends java.io.File

java.lang.Object
  |
  +--java.io.File
        |
        +--org.dvb.dsmcc.DSMCCObject
```

All Implemented Interfaces:

`java.lang.Comparable`, `java.io.Serializable`

Description

A `DSMCCObject` extends the java.io.File class with a combination of features appropriate for any file system with a long access time and features specific to the DSMCC object carousel as one example of such a file system. Files referenced by a `DSMCCObject` exist within a file system. This may be represented by an instance of `ServiceDomain` but need not be, particularly for the file system in which the initial file of the application itself is carried.

A DSMCCObject is specified by a pathname, which can either be an absolute pathname or a relative pathname. Relative paths shall work as defined in "Broadcast Transport Protocol Access API" in the main body of the present document. Path names must follow the naming conventions of the host platform. The constructors of this class shall accept the absolute paths returned by java.io.File.getAbsolutePath().

To access the content of the object:

- For a Directory, the method list of the java.io.File class has to be used to get the entries of the directory.
- For a Stream object, the class DSMCCStream has to be used.
- For a File, the java.io.FileInputStream class or the java.io.RandomAccessFile has to be used.

NB:

- Obviously, for the Object Carousel, the write mode of java.io.RandomAccessFile is not allowed.

DSMCCObjects exist in two states, loaded and unloaded as returned by the isLoaded method. Transitions from unloaded to loaded are triggered by applications calling the asynchronousLoad or synchronousLoad or getSigners(boolean) methods. Transitions from loaded to unloaded are triggered by applications calling the unload method. Attempting to load an already loaded object does not cause it to be re-loaded.

The only state transitions for a DSMCCObject shall be only in response to these method calls. There shall be no implicit state transitions in either direction. When the application no longer has any references to an object in the loaded state, the system resources allocated should be freed by the system.

The state machine of DSMCCObject is disconnected from any state model of any cache for the file system that contains it. Objects may appear in that cache without any corresponding DSMCCObject being in the loaded state. Objects which are in that cache and where any corresponding DSMCCObject is not in the loaded state may disappear from that cache at any time. The contents of a object may be accessible to applications from the cache without the DSMCCObject ever being in the loaded state.

NOTE: DSMCCObjects in the loaded state will consume memory in the MHP receiver. If memory in the MHP receiver is short, this memory can only be recovered by the receiver killing the MHP application. Applications which can accept weaker guarantees about the data of a DSMCCObject being available should use the prefetch methods.

See Also:

`ServiceDomain`

Fields

FORCED_STATIC_CACHING

```
public static final int FORCED_STATIC_CACHING
```

Constant to indicate that the data for an object shall be returned from the cache if present, disregarding the cache priority signalling. If the data is not in the cache, it shall be retrieved from the network.

This strategy is intended solely for situations where generic DVB object carousels (as opposed to MHP object carousels) are being accessed and only the accessing application knows which files are static and which are dynamic. It should not be used to access files in MHP object carousels where the Caching priority descriptor can and should be used.

Since:
MHP 1.1.2

FROM_CACHE

```
public static final int FROM_CACHE
```

Constant to indicate that the data for an object shall only be retrieved where it is already in cache and meets the requirements of cache priority signaling. Where data is not in the cache, or the contents do not meet the requirements of the of cache priority signaling (i.e. cache priority signalling indicates that an object re-acquisition is required), attempts to load a DSMCCObject shall fail with `MPEGDeliveryException` or `MPEGDeliveryErrorEvent` for synchronousLoad and asynchronousLoad respectively.

Since:
MHP 1.0.1

FROM_CACHE_OR_STREAM

```
public static final int FROM_CACHE_OR_STREAM
```

Constant to indicate that the data for an object shall be automatically be retrieved from the network where the data is not already cached. Note that this method does not modify the caching policy controlled by the signaling in the OC. So, if the data is signalled as requiring transparent caching then data will be retrieved from the network if required.

Since:
MHP 1.0.1

FROM_STREAM_ONLY

```
public static final int FROM_STREAM_ONLY
```

Constant to indicate that the data for an object shall always be retrieved from the network even if the data has already been cached.

NOTE : This functionality is introduced deliberately to bypass any receiver cache allowing an application to be synchronised with the broadcast carousel. It should not be used simply to ensure up-to-date content is retrieved. It should also be noted here that this feature is provided to fulfil very specific application requirements (where other provided methods may not be suitable) and misuse of this functionality may seriously affect application/receiver performance.

Since:
MHP 1.0.1

Constructors

DSMCCObject(DSMCCObject, String)

```
public DSMCCObject(org.dvb.dsmcc.DSMCCObject dir, java.lang.String name)
```

Create a DSMCCObject object.

Parameters:

`dir` - the directory object.

`name` - the file pathname.

DSMCCObject(String)

```
public DSMCCObject(java.lang.String path)
```

Create a DSMCCObject object.

Parameters:

`path` - the path to the file.

DSMCCObject(String, String)

```
public DSMCCObject(java.lang.String path, java.lang.String name)
```

Create a DSMCCObject object.

Parameters:

`path` - the directory Path.

`name` - the file pathname.

Methods

abort()

```
public void abort()
            throws NothingToAbortException
```

This method is used to abort a load in progress. It can be used to abort either a synchronousLoad or an asynchronousLoad.

Throws:

`NothingToAbortException` - There is no loading in progress.

addObjectChangeEventListener(ObjectChangeEventListener)

```
public void addObjectChangeEventListener(org.dvb.dsmcc.ObjectChangeEventListener listener)
            throws InsufficientResourcesException
```

Subscribes an ObjectChangeEventListener to receive notifications of version changes of DSMCCObject.

This listener shall never be fired until after the object has successfully entered the loaded state for the first time. Hence objects which never successfully enter the loaded state (e.g. because the object cannot be found) shall never have this listener fire. Once an object has successfully entered the

loaded state once, this event shall continue to be fired when changes are detected by the MHP regardless of further transitions in or out of the loaded state.

NOTE: The algorithm used for this change monitoring is implementation dependent. In some implementations, this exception will always be thrown. In other implementations, it will never be thrown. In other implementations, whether it is thrown or not will depend on the complexity and design of the object carousel in which the object is carried. Even where no exception is thrown, implementations are not required to detect all possible forms in which an object may change.

Parameters:

`listener` - the ObjectChangeEventListener to be notified .

Throws:

`InsufficientResourcesException` - if there are not sufficient resources to monitor the object for changes.

---

asynchronousLoad(AsynchronousLoadingEventListener)

```
public void asynchronousLoad(org.dvb.dsmcc.AsynchronousLoadingEventListener l)
            throws InvalidPathNameException
```

This method starts the asynchronous loading of the data for a DSMCCObject. This method can fail either asynchronously with an event or synchronously with an exception. When it fails synchronously with an exception, no event shall be sent to the listener. For each call to this method which returns without throwing an exception, one of the following events will be sent to the application (by a listener mechanism) as soon as the loading is done or if an error has occurred: SuccessEvent, InvalidFormatEvent, InvalidPathNameEvent, MPEGDeliveryErrorEvent, ServerDeliveryErrorEvent, ServiceXFRErrorEvent, NotEntitledEvent, LoadingAbortedEvent, InsufficientResourcesEvent.

Parameters:

`l` - an AsynchronousLoadingEventListener to receive events related to asynchronous loading.

Throws:

`InvalidPathNameException` - the Object can not be found, or the service domain is not in an attached state.

---

getSigners()

```
public java.security.cert.X509Certificate[][] getSigners()
```

This method shall attempt to validate all certificate chains found for this file in the network. Valid chains do not need to originate from root certificates known to the MHP terminal, e.g. self signing of data files. Applications should note that calls to this method may take some time. If the `DSMCCObject` is not loaded, this method will return null. If the `DSMCCObject` is loaded, this method returns the same as getSigners(false), except if getSigners(false) would throw an exception, this method will return an outer array of size zero.

NOTE: If the file in the network changes between when it was loaded and when the hash file(s), signature & certificate files are read and those files have been updated to match the new version of the file then the hash value of the data which was loaded will not match the hash value in the hash file in the network and hence no certificate chains will be valid.

Returns:

a two-dimensional array of X.509 certificates, where the first index of the array determines a certificate chain and the second index identifies the certificate within the chain. Within one certificate chain the leaf certificate is first followed by any intermediate certificate authorities in the order of the chain with the root CA certificate as the last item.

Since:

MHP 1.0.1

getSigners(boolean)

```
public java.security.cert.X509Certificate[][] getSigners(boolean known_root)
            throws InvalidFormatException, InterruptedIOException, MPEGDeliveryException,
            ServerDeliveryException, InvalidPathNameException, NotEntitledException, Servi
            ceXFRException, InsufficientResourcesException
```

This method shall attempt to validate all certificate chains found for this file in the network. The process of determining validity is the same as the process of authentication except that when known_root is false, checking whether the root certificate is known is not included. The known_root parameter to the method defines whether the MHP terminal shall check if the root certificate in each chain is known to it or not. If the root certificate is checked then chains with unknown root certificates shall not be considered to be valid. If root certificates are not checked then the MHP application is responsible for comparing them with some certificate which it provides (e.g. for self signing of data files). The hash file(s), signature & certificate files shall be shall be fetched from the network in compliance with the caching priority defined in the main body of the present document. If the object is in the loaded state then the data of the file which was loaded shall be used and no new file contents loaded. If the object is not in the loaded state then this method shall attempt to load it as if synchronousLoad had been called. Applications should note that calls to this method may take some time.

NOTE: If the file in the network changes between when it was loaded and when the hash file(s), signature & certificate files are read and those files have been updated to match the new version of the file then the hash value of the data which was loaded will not match the hash value in the hash file in the network and hence no certificate chains will be valid.

Parameters:

`known_root` - if true then valid certificate chains are only those where the root is known to the MHP terminal. If false, the validity of the chain shall be determined without considering whether the root is known to the MHP terminal or not.

Returns:

a two-dimensional array of X.509 certificates, where the first index of the array determines a certificate chain and the second index identifies the certificate within the chain. Within one certificate chain the leaf certificate is first followed by any intermediate certificate authorities in the order of the chain with the root CA certificate as the last item. If no certificate chains are found to be valid then an outer array of size zero shall be returned.

Throws:

`java.io.InterruptedIOException` - the loading has been aborted.

`InvalidPathNameException` - the Object can not be found, or the service domain is not in an attached state.

`NotEntitledException` - the stream carrying the object is scrambled and the user has no entitlements to descramble the stream.

`ServiceXFRException` - the file system containing the DSMCCObject is a DSMCC object carousel and the IOR of the object or one of its parent directories is a Lite Option Profile Body and the referenced carousel is not already mounted by the MHP terminal.

`InvalidFormatException` - an error occured in the format of the file system containing the DSMCCObject, for instance an inconsistent DSMCC message has been received.

`MPEGDeliveryException` - an error has occurred while loading data for the file, for instance a timeout when reading data from an MPEG stream

`ServerDeliveryException` - when an MHP terminal cannot communicate with the server for files delivered over a bi-directional IP connection.

`InsufficientResourcesException` - there is not enough memory to load the object

Since:

MHP 1.0.3

---

getURL()

```
public java.net.URL getURL()
```

Returns a URL identifying this carousel object. If the directory entry for the object has not been loaded then null shall be returned.

Returns:
a URL identifying the carousel object or null

Since:
MHP 1.0.1

---

isLoaded()

```
public boolean isLoaded()
```

Returns a boolean indicating whether or not the DSMCCObject has been loaded.

Returns:
true if the file is already loaded, false otherwise.

---

isObjectKindKnown()

```
public boolean isObjectKindKnown()
```

Returns a boolean indicating if the kind of the object is known. (The kind of an object is known if the directory containing it is loaded).

Returns:
true if the type of the object is known, false otherwise.

---

isStream()

```
public boolean isStream()
```

Returns a boolean indicating whether or not the DSMCCObject is a DSMCC Stream object.

Returns:
true if the file is a stream, false if the object is not a stream or if the object kind is unknown.

---

isStreamEvent()

```
public boolean isStreamEvent()
```

Returns a boolean indicating whether or not the DSMCCObject is a DSMCC StreamEvent object. NB: If isStreamEvent is true then isStream is true also.

Returns:
true if the file is a stream event, false if the object is not a stream event or if the object kind is unknown.

---

loadDirectoryEntry(AsynchronousLoadingEventListener)

```
public void loadDirectoryEntry(org.dvb.dsmcc.AsynchronousLoadingEventListener l)
            throws InvalidPathNameException
```

Asynchronous loading of the directory entry information. Calling this is equivalent of calling the method `asynchronousLoad` on the parent directory of a `DSMCCObject`. This method can fail

either asynchronously with an event or synchronously with an exception. When it fails synchronously with an exception, no event shall be sent to the listener.

Parameters:

`l` - a listener which will be called when the loading is done.

Throws:

`InvalidPathNameException` - if the object cannot be found.

---

prefetch(DSMCCObject, String, byte)

```
public static boolean prefetch(org.dvb.dsmcc.DSMCCObject dir, java.lang.String path,
            byte priority)
```

Calling this method will issue a hint to the MHP for pre-fetching the object data for that DSMCC object into cache.

Parameters:

`dir` - the directory object in which to pre-fetch the data.

`path` - the relative path name of object to pre-fetch, starting from the directory object passes as parameter.

`priority` - the relative priority of this pre-fetch request (higher = more important)

Returns:

true if the MHP supports pre-fetching (i.e. will try to process the request) and false otherwise. Note that a return value of 'true' is only an indication that the MHP receiver supports pre-fetching. It is not a guarantee that the requested data will actually be loaded into cache as the receiver may decide to drop the request in order to make resources available for regular load requests.

---

prefetch(String, byte)

```
public static boolean prefetch(java.lang.String path, byte priority)
```

Calling this method will issue a hint to the MHP for pre-fetching the object data for that DSMCC object into cache.

Parameters:

`path` - the absolute pathname of the object to pre-fetch.

`priority` - the relative priority of this pre-fetch request (higher = more important)

Returns:

true if the MHP supports pre-fetching (i.e. will try to process the request) and false otherwise. Note that a return value of 'true' is only an indication that the MHP receiver supports pre-fetching. It is not a guarantee that the requested data will actually be loaded into cache as the receiver may decide to drop the request in order to make resources available for regular load requests.

---

removeObjectChangeEventListener(ObjectChangeEventListener)

```
public void removeObjectChangeEventListener(org.dvb.dsmcc.ObjectChangeEventListener
            listener)
```

Unsubscribes an ObjectChangeEventListener to receive notifications of version changes of DSMCCObject.

Parameters:

`listener` - a previously registered ObjectChangeEventListener.

setRetrievalMode(int)

```
public void setRetrievalMode(int retrieval_mode)
```

Set the retrieval mode for a `DSMCCObject`. The default retrieval mode is FROM_CACHE_OR_STREAM. The retrieval mode state is sampled when the object is loaded (whether explicitly or as described in “Constraints on the java.io.File methods for broadcast carousels”). Changing the retrieval mode for a loaded object has no effect until the object is unloaded and loaded again.

Parameters:

`retrieval_mode` - the retrieval mode to be used for the object specified as one of the public static final constants in this class.

Throws:

`java.lang.IllegalArgumentException` - if the retrieval_mode specified is not one listed defined for use with this method.

Since:

MHP 1.0.1

synchronousLoad()

```
public void synchronousLoad()
            throws InvalidFormatException, InterruptedIOException, MPEGDeliveryException,
            ServerDeliveryException, InvalidPathNameException, NotEntitledException, Servi
            ceXFRException, InsufficientResourcesException
```

This method is used to load a DSMCCObject. This method blocks until the file is loaded. It can be aborted from another thread with the abort method. In this case the InterruptedIOException is thrown. For DSMCCObjects contained within a DSMCC object carousel, if the IOR of the object itself or one of its parent directories is a Lite Option Profile Body and the referenced carousel is not attached, the MHP implementation will not attempt to resolve it: a ServiceXFRException is thrown to indicate to the application where the DSMCCObject is actually located.

Throws:

`java.io.InterruptedIOException` - the loading has been aborted.

`InvalidPathNameException` - the Object can not be found, or the service domain is not in an attached state.

`NotEntitledException` - the stream carrying the object is scrambled and the user has no entitlements to descramble the stream.

`ServiceXFRException` - the file system containing the DSMCCObject is a DSMCC object carousel and the IOR of the object or one of its parent directories is a Lite Option Profile Body and the referenced carousel is not already mounted by the MHP terminal.

`InvalidFormatException` - an error occured in the format of the file system containing the DSMCCObject, for instance an inconsistent DSMCC message has been received.

`MPEGDeliveryException` - an error has occurred while loading data for the file, for instance a timeout when reading data from an MPEG stream

`ServerDeliveryException` - when an MHP terminal cannot communicate with the server for files delivered over a bi-directional IP connection.

`InsufficientResourcesException` - there is not enough memory to load the object

unload()

```
public void unload()
            throws NotLoadedException
```

When calling this method, the applications gives a hint to the MHP that if this object is not consumed by another application/thread, the system can free all the resources allocated to this object. It is worth noting that if other clients use this object (e.g. a file input stream is opened on this object or if the corresponding stream or stream event is being consumed) the system resources allocated to this object will not be freed. This method puts the DSMCCObject into the unloaded state.

Throws:

`NotLoadedException` - the carousel object is not loaded.

org.dvb.dsmcc
DSMCCStream

Declaration

```
public class DSMCCStream

java.lang.Object
  |
  +--org.dvb.dsmcc.DSMCCStream
```

Direct Known Subclasses:

DSMCCStreamEvent

Description

The DSMCCStream class is used to manage DSMCC Stream Objects. The BIOP::Stream message shall be read from the network once only, before the constructor of this class returns. Hence methods which return information from that message shall not be affected by any subsequent changes to that information.

The methods in this class relating to the NPT mechanism shall also be mapped onto the DVB timeline as defined in the main part of this specification. NOTE: The NPT mechanism and scheduled stream events that depend on it are known to be vulnerable to disruption in many digital TV distribution networks. Existing deployed network equipment that re-generates the STC is unlikely to be aware of NPT and hence will not make the necessary corresponding modification to STC values inside NPT reference descriptors. Applications should only use NPT where they are confident that the network where they are to be used does not have this problem.

See Also:

DSMCCObject

Constructors

DSMCCStream(DSMCCObject)

```
public DSMCCStream(org.dvb.dsmcc.DSMCCObject aDSMCCObject)
            throws NotLoadedException, IllegalObjectTypeException
```

Creates a Stream Object from a DSMCC Object. The BIOP message referenced by the DSMCCObject has to be a Stream or StreamEvent BIOP message.

Parameters:

aDSMCCObject - the DSMCC object which describes the stream

Throws:

NotLoadedException - the DSMCCObject is not loaded.

IllegalObjectTypeException - the DSMCCObject is neither a DSMCC Stream nor a DSMCCStreamEvent

---

DSMCCStream(String)

```
public DSMCCStream(java.lang.String path)
            throws IOException, IllegalObjectTypeException
```

Create a Stream Object from its pathname. For an object Carousel, this method will block until the module which contains the object is loaded. The BIOP message referenced by the DSMCCObject pointed to by the parameter path has to be a Stream or StreamEvent BIOP message.

Parameters:
`path` - the pathname of the DSMCCStream Object.

Throws:
`java.io.IOException` - If an IO error occurred.

`IllegalObjectTypeException` - the DSMCCObject is neither a DSMCC Stream nor a DSMCCStreamEvent

---

DSMCCStream(String, String)

```
public DSMCCStream(java.lang.String path, java.lang.String name)
            throws IOException, IllegalObjectTypeException
```

Create a DSMCCStream from its pathname. For an object Carousel, this method will block until the module which contains the object is loaded. The BIOP message referenced by the DSMCCObject pointed to be the parameters path and name has to be a Stream or StreamEvent BIOP message.

Parameters:
`path` - the directory path.

`name` - the name of the DSMCCStream Object.

Throws:
`java.io.IOException` - If an IO error occurred.

`IllegalObjectTypeException` - the DSMCCObject is neither a DSMCC Stream nor a DSMCCStreamEvent

Methods

---

addNPTListener(NPTListener)

```
public void addNPTListener(org.dvb.dsmcc.NPTListener l)
```

Add a listener for timeline events on the `DSMCCStream` object. Adding the same listener a second time has no effect.

Parameters:
`l` - the listener

Since:
MHP 1.0.1

---

getDuration()

```
public long getDuration()
```

This function returns the duration in milliseconds of the DSMCC Stream. If the DSMCCStream BIOP message does not specify duration, zero will be returned.

Returns:
The duration in milliseconds of the DSMCC Stream.

getMediaTimeFromStream(long, Clock)

```
public javax.media.Time getMediaTimeFromStream(long time, javax.media.Clock c)
```

Convert a time measured according to a timeline in the stream into a JMF media time measured in a specified clock.

Parameters:

`time` - the time measured according to the timeline in the stream

`c` - the clock to express the media time

Returns:

the JMF media time corresponding to the specified time

Throws:

`java.lang.IllegalArgumentException` - if the Clock is not a Player which is presenting at least one of the streams of this collection (as returned by getStreamLocator).

getNPT()

```
public long getNPT()
            throws MPEGDeliveryException
```

This function is used to get value of the current timeline in milliseconds. Implementations are not required to continuously monitor for the timeline descriptors. In implementations which do not continuously monitor, this method will block while the current timeline is retrieved from the stream.

Returns:

the current time in milliseconds or zero if the DSMCC Stream object BIOP message does not contain any taps pointing to a timeline.

Throws:

`MPEGDeliveryException` - if there is an error in retrieving the timeline descriptors

getNPTRate()

```
public org.dvb.dsmcc.NPTRate getNPTRate()
            throws MPEGDeliveryException
```

Get the rate for the timeline referenced in the DSMCCStream object. Where the timeline is NPT, the NPT rate is returned. Where the timeline is the DVB timeline, 0/1 is returned if it is paused and 1/1 is returned if it is advancing. The method returns null if no timeline is referenced by the DSMCCStream object, (i.e. for NPT, no STR_NPT_USE tap in the list of taps).

Returns:

the NPT rate or null

Throws:

throws - MPEGDeliveryException if there is an error in retrieving NPT reference descriptors

`MPEGDeliveryException`

Since:

MHP 1.0.1

getStreamLocator()

```
public org.davic.net.Locator getStreamLocator()
```

This function returned a Locator referencing the streams of this collection. The interpretation of the return value is determined by the `isMPEGProgram` method.

Returns:

a locator.

---

isAudio()

```
public boolean isAudio()
```

This function returns a boolean indicating if the Stream Object refers to an audio stream. This is the case if the audio field in the Stream(Event) BIOP message has a value different from zero.

Returns:
true only if the Stream object refers to an audio stream

---

isData()

```
public boolean isData()
```

This function returns a boolean indicating if the Stream Object refers to a data stream. This is the case if the data field in the Stream(Event) BIOP message has a value different from zero.

Returns:
true only if the Stream object refers to a data stream

---

isMPEGProgram()

```
public boolean isMPEGProgram()
```

This method will return true if the Stream(Event) BIOP message contains a tap with use field BIOP_PROGRAM_USE, otherwise it will return false.

Returns:
true only if the Stream(Event) BIOP message is as described above

---

isVideo()

```
public boolean isVideo()
```

This function returns a boolean indicating if the Stream Object refers to an video stream. This is the case if the `video' field in the Stream(Event) BIOP message has a value different from zero otherwise false is returned.

Returns:
true only if the Stream object refers to an video stream

---

removeNPTListener(NPTListener)

```
public void removeNPTListener(org.dvb.dsmcc.NPTListener l)
```

Remove a listener for timeline events on the `DSMCCStream` object. Removing a non-subscribed listener has no effect.

Parameters:
`l` - the listener to remove

Since:
MHP 1.0.1

org.dvb.dsmcc
DSMCCStreamEvent

Declaration

```
public class DSMCCStreamEvent extends DSMCCStream

java.lang.Object
  |
  +--org.dvb.dsmcc.DSMCCStream
        |
        +--org.dvb.dsmcc.DSMCCStreamEvent
```

Description

The DSMCCStreamEvent class is used to manage DSMCC StreamEvent Objects. Applications wishing to monitor changes in the list of events which are part of this stream event should use `DSMCCObject.addObjectChangeEventListener` on the `DSMCCObject` representing which describes this set of stream events. The BIOP::StreamEvent message shall be read from the network once only, before the constructor of this class returns. Hence methods which return information from that message shall not be affected by any subsequent changes to that information.

The subscribe method only verifies that the event name can be bound to an eventId but it does not require that the stream event descriptors for that event id can be received at that moment. While the event listener is registered the MHP terminal shall filter the stream event descriptors as specified in the "Monitoring broadcast timebases and events" clause in the main body of the specification.

NOTE: The NPT mechanism and scheduled stream events that depend on it are known to be vulnerable to disruption in many digital TV distribution networks. Existing deployed network equipment that re-generates the STC is unlikely to be aware of NPT and hence will not make the necessary corresponding modification to STC values inside NPT reference descriptors. Applications should only use NPT where they are confident that the network where they are to be used does not have this problem.

Constructors

DSMCCStreamEvent(DSMCCObject)

```
public DSMCCStreamEvent(org.dvb.dsmcc.DSMCCObject aDSMCCObject)
            throws NotLoadedException, IllegalObjectTypeException
```

Create a `DSMCCStreamEvent` from a `DSMCCObject`. The Object has to be a DSMCC StreamEvent.

Parameters:

`aDSMCCObject` - the DSMCC object which describes the stream.

Throws:

`NotLoadedException` - the DSMCCObject is not loaded.

`IllegalObjectTypeException` - the DSMCCObject does not lead to a DSMCC StreamEvent.

DSMCCStreamEvent(String)

```
public DSMCCStreamEvent(java.lang.String path)
            throws IOException, IllegalObjectTypeException
```

Create a DSMCCStreamEvent Object from its pathname. The path has to lead to a DSMCCStreamEvent.

Parameters:
`path` - the pathname of the DSMCCStreamEvent object

Throws:
`java.io.IOException` - An IO error has occurred.

`IllegalObjectTypeException` - the path does not lead to a DSMCC StreamEvent.

DSMCCStreamEvent(String, String)

```
public DSMCCStreamEvent(java.lang.String path, java.lang.String name)
            throws IOException, IllegalObjectTypeException
```

Create a DSMCCStreamEvent from its pathname. For an object Carousel, this method will block until the module which contains the object is loaded. The path has to lead to a DSMCC Stream Event

Parameters:
`path` - the directory path.

`name` - the name of the DSMCCStreamEvent Object.

Throws:
`java.io.IOException` - If an IO error occurred.

`IllegalObjectTypeException` - the path does not lead to a DSMCC StreamEvent.

Methods

---

getEventList()

```
public java.lang.String[] getEventList()
```

This function is used to get the list of the events of the DSMCCStreamEvent object.

Returns:
The list of the eventName.

---

subscribe(String, StreamEventListener)

```
public int subscribe(java.lang.String eventName, org.dvb.dsmcc.StreamEventListener l)
            throws UnknownEventException, InsufficientResourcesException
```

This function is used to subscribe to an event of a DSMCC StreamEvent object.

Parameters:
`eventName` - the name of the event.

`l` - an object that implements the StreamEventListener Interface.

Returns:
The event Identifier.

Throws:
`UnknownEventException` - the event cannot be found at this time

`InsufficientResourcesException` - if resources needed to perform the subscription are not available

---

unsubscribe(int, StreamEventListener)

```
public void unsubscribe(int eventId, org.dvb.dsmcc.StreamEventListener l)
            throws UnknownEventException
```

This function is used to cancel the subscription to an event of a DSMCCEvent object.

Parameters:

`eventId` - Identifier of the event.

`l` - an object that implements the StreamEventListener Interface.

Throws:

`UnknownEventException` - The event can not be found.

---

unsubscribe(String, StreamEventListener)

```
public void unsubscribe(java.lang.String eventName, org.dvb.dsmcc.StreamEventListener l)
            throws UnknownEventException
```

This function is used to cancel the subscription to an event of a DSMCCEvent object.

Parameters:

`eventName` - the name of the event.

`l` - an object that implements the StreamEventListener Interface.

Throws:

`UnknownEventException` - The event can not be found.

org.dvb.dsmcc
IllegalObjectTypeException

Declaration

```
public class IllegalObjectTypeException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.IllegalObjectTypeException
```

All Implemented Interfaces:

java.io.Serializable

Description

This Exception is thrown when the application attempted to create a DSMCCStream or DSMCCStreamEvent object with an object or a path that did not correspond to a DSMCC Stream or DSMCC StreamEvent respectively

Constructors

IllegalObjectTypeException()

```
public IllegalObjectTypeException()
```

constructor of the exception with no detail message

IllegalObjectTypeException(String)

```
public IllegalObjectTypeException(java.lang.String s)
```

constructor of the exception

Parameters:

s - detail message

org.dvb.dsmcc
InsufficientResourcesEvent

Declaration

```
public class InsufficientResourcesEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.InsufficientResourcesEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is generated if there are insufficient resources available to load a DSMCCObject. e.g. if there is not enough memory.

Constructors

InsufficientResourcesEvent(DSMCCObject)

```
public InsufficientResourcesEvent(org.dvb.dsmcc.DSMCCObject o)
```

Create an InsufficientResourcesException object.

Parameters:

o - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject that generated the event

org.dvb.dsmcc
InsufficientResourcesException

Declaration

```
public class InsufficientResourcesException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.InsufficientResourcesException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception gets thrown when a request to perform a DSMCC related operation cannot be completed due to resource limitations. For example, no section filters or system timers may be available.

Since:

MHP 1.0.1

Constructors

InsufficientResourcesException()

```
public InsufficientResourcesException()
```

Construct an InsufficientResourcesException with no detail message

---

InsufficientResourcesException(String)

```
public InsufficientResourcesException(java.lang.String message)
```

Construct an InsufficientResourcesException with the specified detail message

Parameters:

message - the message for the exception

org.dvb.dsmcc
InvalidAddressException

Declaration

```
public class InvalidAddressException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.InvalidAddressException
```

All Implemented Interfaces:

java.io.Serializable

Description

An InvalidAddressException is thrown when the format of an NSAP address is not recognized.

Constructors

InvalidAddressException()

```
public InvalidAddressException()
```

Construct a InvalidAddressException with no detail message

InvalidAddressException(String)

```
public InvalidAddressException(java.lang.String s)
```

Construct a InvalidAddressException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
InvalidFormatEvent

Declaration

```
public class InvalidFormatEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.InvalidFormatEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is generated if the format of the data received is inconsistent.

Constructors

InvalidFormatEvent(DSMCCObject)

```
public InvalidFormatEvent(org.dvb.dsmcc.DSMCCObject o)
```

Create an InvalidFormatException object.

Parameters:

o - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject that generated the event

org.dvb.dsmcc
InvalidFormatException

Declaration

```
public class InvalidFormatException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.InvalidFormatException
```

All Implemented Interfaces:

java.io.Serializable

Description

An InvalidFormatException is thrown when an inconsistent DSMCC message is received.

Constructors

InvalidFormatException()

```
public InvalidFormatException()
```

Construct an InvalidFormatException with no detail message

InvalidFormatException(String)

```
public InvalidFormatException(java.lang.String s)
```

Construct an InvalidFormatException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
InvalidPathnameEvent

Declaration

```
public class InvalidPathnameEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.InvalidPathnameEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

The pathname does not exist or the ServiceDomain has been detached.

Constructors

InvalidPathnameEvent(DSMCCObject)

```
public InvalidPathnameEvent(org.dvb.dsmcc.DSMCCObject o)
```

Create an InvalidPathnameEvent.

Parameters:

o - the DSCMCCObject that generated this event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject that generated the event.

org.dvb.dsmcc
InvalidPathNameException

Declaration

```
public class InvalidPathNameException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.InvalidPathNameException
```

All Implemented Interfaces:

java.io.Serializable

Description

The InvalidPathNameException is thrown when the path name to a DSMCCObject does not exist or if the service domain is not detached.

Constructors

InvalidPathNameException()

```
public InvalidPathNameException()
```

Construct an InvalidPathNameException with no detail message

InvalidPathNameException(String)

```
public InvalidPathNameException(java.lang.String s)
```

Construct an InvalidPathNameException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
LoadingAbortedEvent

Declaration

```
public class LoadingAbortedEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.LoadingAbortedEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event will be sent to the AsynchronousEventListener when an asynchronous loading operation is aborted.

Since:

MHP 1.0.1

Constructors

LoadingAbortedEvent(DSMCCObject)

```
public LoadingAbortedEvent(org.dvb.dsmcc.DSMCCObject aDSMCCObject)
```

Creates a LoadingAbortedEvent object.

Parameters:

aDSMCCObject - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject whose loading was aborted

org.dvb.dsmcc
MPEGDeliveryErrorEvent

Declaration

```
public class MPEGDeliveryErrorEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.MPEGDeliveryErrorEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

An MPEGDeliveryErrorEvent indicates that an error (for instance, a time out or accessing the data would require tuning) has occurred while loading data from an MPEG Stream.

Constructors

MPEGDeliveryErrorEvent(DSMCCObject)

```
public MPEGDeliveryErrorEvent(org.dvb.dsmcc.DSMCCObject o)
```

Creates an MPEGDeliveryEvent.

Parameters:

o - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject that generated the event.

org.dvb.dsmcc
MPEGDeliveryException

Declaration

```
public class MPEGDeliveryException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.MPEGDeliveryException
```

All Implemented Interfaces:

java.io.Serializable

Description

An MPEGDEliveryException is thrown when an error (for instance, a time out or accessing the data would require tuning) occurs while loading data from an MPEG Stream.

Constructors

MPEGDeliveryException()

```
public MPEGDeliveryException()
```

Construct an MPEGDeliveryException with no detail message

MPEGDeliveryException(String)

```
public MPEGDeliveryException(java.lang.String s)
```

Construct an MPEGDeliveryException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
NotEntitledEvent

Declaration

```
public class NotEntitledEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.NotEntitledEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event is sent when an attempt to asynchronously load an object has failed because the elementary stream carrying the object is scrambled and the user is not entitled to access the content of the object.

Constructors

NotEntitledEvent(DSMCCObject)

```
public NotEntitledEvent(org.dvb.dsmcc.DSMCCObject o)
```

Creates a NotEntitledEvent object.

Parameters:

o - the DSMCCObject that generated the event.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the DSMCCObject that generated the event.

org.dvb.dsmcc
NotEntitledException

Declaration

```
public class NotEntitledException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.NotEntitledException
```

All Implemented Interfaces:

java.io.Serializable

Description

This Exception is thrown when the user is not entitled to access the content of the object (the Elementary Stream is scrambled and the user is not entitled).

Constructors

NotEntitledException()

```
public NotEntitledException()
```

construct a NotEntitledException with no detail message

NotEntitledException(String)

```
public NotEntitledException(java.lang.String s)
```

construct a NotEntitledException with a detail message

Parameters:

s - detail message

org.dvb.dsmcc
NothingToAbortException

Declaration

```
public class NothingToAbortException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.NothingToAbortException
```

All Implemented Interfaces:

java.io.Serializable

Description

A NothingToAbortException is thrown when the abort method is called and there is no loading in progress.

Constructors

NothingToAbortException()

```
public NothingToAbortException()
```

Construct a NothingToAbortException with no detail message

NothingToAbortException(String)

```
public NothingToAbortException(java.lang.String s)
```

Construct a NothingToAbortException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
NotLoadedException

Declaration

```
public class NotLoadedException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.NotLoadedException
```

All Implemented Interfaces:

java.io.Serializable

Description

A NotLoadedException is thrown when an operation fails because information which is required to be loaded has not been.

Constructors

NotLoadedException()

```
public NotLoadedException()
```

Construct a NotLoadedException with no detail message

NotLoadedException(String)

```
public NotLoadedException(java.lang.String s)
```

Construct a NotLoadedException with the specified detail message

Parameters:

s - the detail message

org.dvb.dsmcc
NPTDiscontinuityEvent

Declaration

```
public class NPTDiscontinuityEvent extends NPTStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.NPTStatusEvent
              |
              +--org.dvb.dsmcc.NPTDiscontinuityEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Sent when an MHP terminal detects a permanent value discontinuity in a broadcast timebase as defined in the main body of the present document. This may represent an error condition in the incoming broadcast.

Where the timebase is delivered using NPT, this event shall be sent following a PCR discontinuity when the MHP terminal has enough information to determine that there will be an NPT discontinuity. If the `NPTDiscontinuityEvent` is because of invalid data in a new NPTReferenceDescriptor then the event will be generated when that new NPTReferenceDescriptor is detected by the MHP terminal. If the `NPTDiscontinuityEvent` is because no new NPTReferenceDescriptor is detected within the time allowed by the main body of the present document then it will be generated when that time interval has elapsed.

Since:

MHP 1.0.1

Constructors

NPTDiscontinuityEvent(DSMCCStream, long, long)

```
public NPTDiscontinuityEvent(org.dvb.dsmcc.DSMCCStream source, long before, long after)
```

Construct an event. The `before` and `after` values used shall be the values at the time when the receiver determined that a NPT discontinuity has happened. If the `NPTDiscontinuityEvent` is because of invalid data in a new NPTReferenceDescriptor then this is the time when that new descriptor was known to be invalid. If `NPTDiscontinuityEvent` is because of the absence of a new NPTReferenceDescriptor then this will be when the MHP terminal detects that the time interval allowed by the present document for such new descriptors has elapsed. Where an NPT value is unknown or cannot be computed, -1 shall be used.

Parameters:

`source` - the stream whose NPT suffered a discontinuity

`before` - the last NPT value detected before the discontinuity or -1 for DVB timelines

`after` - the first NPT value detected after the discontinuity or -1 for DVB timelines

Methods

---

getFirstNPT()

```
public long getFirstNPT()
```

Return the first known stable value of NPT after the discontinuity

Returns:
an NPT value or -1 for DVB timelines

---

getLastNPT()

```
public long getLastNPT()
```

Return the last known stable value of NPT before the discontinuity

Returns:
an NPT value or -1 for DVB timelines

org.dvb.dsmcc
NPTListener

Declaration
```
public interface NPTListener extends java.util.EventListener
```

All Superinterfaces:
`java.util.EventListener`

Description
Objects that implement the `NPTListener` interface can receive `NPTStatusEvent` and `NPTRateChangedEvent` events.

Since:
MHP 1.0.1

Methods

---

receiveNPTStatusEvent(NPTStatusEvent)

```
public void receiveNPTStatusEvent(org.dvb.dsmcc.NPTStatusEvent e)
```

Send a `NPTStatusEvent` to a registered listener.

Parameters:
`e` - a `NPTStatusEvent` describing the status change

---

receiveRateChangedEvent(NPTRateChangeEvent)

```
public void receiveRateChangedEvent(org.dvb.dsmcc.NPTRateChangeEvent e)
```

Send a `NPTRateChangeEvent` to a registered listener.

Parameters:
`e` - the `NPTRateChangeEvent` event.

org.dvb.dsmcc
NPTPresentEvent

Declaration

```
public class NPTPresentEvent extends NPTStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.NPTStatusEvent
              |
              +--org.dvb.dsmcc.NPTPresentEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Sent to listeners on a DSMCCStream object when a broadcast timeline newly appears for that DSMCC stream when it was not previously present. This is specific to the particular timebase for this stream.

Since:

MHP 1.0.1

Constructors

NPTPresentEvent(DSMCCStream)

`public NPTPresentEvent(org.dvb.dsmcc.DSMCCStream source)`

Construct an event.

Parameters:

`source` - the DSMCCStream for which the broadcast timeline appeared.

org.dvb.dsmcc
NPTRate

Declaration

```
public class NPTRate

java.lang.Object
  |
  +--org.dvb.dsmcc.NPTRate
```

Description

Represents the rate at which an broadcast timeline progresses. Rates are expressed as the combination of a numerator and a denominator. Instances of this class are constructed by the platform and returned to applications. A rate of 1/1 shall indicate “the standard presentation rate” as defined in the NPT specification.

Since:

MHP 1.0.1

Methods

---

getDenominator()

```
public int getDenominator()
```

Get the NPT rate’s denominator.

Returns:

the denominator

---

getNumerator()

```
public int getNumerator()
```

Get the NPT rate’s numerator. A value of zero indicates that the NPT is not progressing.

Returns:

the numerator

org.dvb.dsmcc
NPTRateChangeEvent

Declaration

```
public class NPTRateChangeEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.NPTRateChangeEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Sent only when the rate of an broadcast timeline changes value.

Since:

MHP 1.0.1

Constructors

NPTRateChangeEvent(DSMCCStream, NPTRate)

```
public NPTRateChangeEvent(org.dvb.dsmcc.DSMCCStream source, org.dvb.dsmcc.NPTRate rate)
```

Construct an event.

Parameters:

`source` - the stream whose rate changed

`rate` - the new rate of that stream immediately following the change

Methods

---

getRate()

```
public org.dvb.dsmcc.NPTRate getRate()
```

Return the new rate of the stream immediately after the change.

Returns:

a `NPTRate` object encapsulating the new rate

---

getSource()

```
public java.lang.Object getSource()
```

Return the stream whose rate changed.

Overrides:

`getSource` in class `EventObject`

Returns:

the `DSMCCStream` object on which the rate change has occurred.

org.dvb.dsmcc
NPTRemovedEvent

Declaration

```
public class NPTRemovedEvent extends NPTStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.NPTStatusEvent
              |
              +--org.dvb.dsmcc.NPTRemovedEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Sent to listeners on a DSMCCStream object when a broadcast timeline which was present for that DSMCC stream is removed. This is specific to the particular timebase for this stream.

Since:

MHP 1.0.1

Constructors

NPTRemovedEvent(DSMCCStream)

```
public NPTRemovedEvent(org.dvb.dsmcc.DSMCCStream source)
```

Construct an event.

Parameters:

source - the DSMCCStream from which the broadcast timeline was removed

org.dvb.dsmcc
NPTStatusEvent

Declaration

```
public abstract class NPTStatusEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.NPTStatusEvent
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

NPTDiscontinuityEvent, NPTPresentEvent, NPTRemovedEvent

Description

Sent when an MHP terminal detects a change of status in the broadcast timeline of a stream.

Since:

MHP 1.0.1

Constructors

NPTStatusEvent(DSMCCStream)

```
public NPTStatusEvent(org.dvb.dsmcc.DSMCCStream source)
```

Construct an event.

Parameters:

source - the stream whose broadcast timeline status changed

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Return the stream whose broadcast timeline status changed.

Overrides:

getSource in class EventObject

Returns:

the DSMCCStream whose status changed

org.dvb.dsmcc
ObjectChangeEvent

Declaration

```
public class ObjectChangeEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.ObjectChangeEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This class describes an object change event that is used to monitor the arrival of a new version of a DSMCCObject. For files carried in a DSMCC object carousel, when a change in a module is detected, this event shall be sent to all registered listeners for all objects carried in that module.

Constructors

ObjectChangeEvent(DSMCCObject, int)

```
public ObjectChangeEvent(org.dvb.dsmcc.DSMCCObject source, int aVersionNumber)
```

Creates an ObjectChangeEvent indicating that a new version of the monitored DSMCC Object has been detected. It is up to the application to reload the new version of the object.

Parameters:

source - the DSMCCObject whose version has changed

aVersionNumber - the new version number.

Methods

---

getNewVersionNumber()

```
public int getNewVersionNumber()
```

This method is used to get the new version number of the monitored DSMCCObject. For files carried in a DSMCC object carousel, this method shall return the version number of the module carrying the file.

Returns:

the new version number.

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that has changed

Overrides:
`getSource` in class `EventObject`

Returns:
the DSMCCObject that has changed

org.dvb.dsmcc
ObjectChangeEventListener

Declaration
```
public interface ObjectChangeEventListener extends java.util.EventListener
```

All Superinterfaces:
```
java.util.EventListener
```

Description
The objects that implements the ObjectChangeEventListener interface can receive ObjectChangeEvent event.

Methods

---

receiveObjectChangeEvent(ObjectChangeEvent)

```
public void receiveObjectChangeEvent(org.dvb.dsmcc.ObjectChangeEvent e)
```

Send a ObjectChangeEvent to the ObjectChangeEventListener.

Parameters:
`e` - the ObjectChangeEvent event.

org.dvb.dsmcc
ServerDeliveryErrorEvent

Declaration

```
public class ServerDeliveryErrorEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.ServerDeliveryErrorEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

The local machine can not communicate with the server. This event is only used with files implemented by delivery over bi-directional IP connections. For the object carousel the `MPEGDeliveryErrorEvent` is used instead.

Constructors

ServerDeliveryErrorEvent(DSMCCObject)

`public ServerDeliveryErrorEvent(org.dvb.dsmcc.DSMCCObject o)`

Creates a ServerDeliveryEvent object.

Parameters:

`o` - the DSMCCObject that generated the event.

Methods

---

getSource()

`public java.lang.Object getSource()`

Returns the DSMCCObject that generated the event.

Overrides:

`getSource` in class `AsynchronousLoadingEvent`

Returns:

the DSMCCObject that generated the event.

org.dvb.dsmcc
ServerDeliveryException

Declaration

```
public class ServerDeliveryException extends DSMCCException
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.ServerDeliveryException
```

All Implemented Interfaces:

`java.io.Serializable`

Description

A ServerDeliveryException is thrown when the local machine can not communicate with the server. This exception is only used with files implemented by delivery over a bi-directional IP connection. For the object carousel the `MPEGDeliveryException` is used instead.

Constructors

ServerDeliveryException()

```
public ServerDeliveryException()
```

Construct a ServerDeliveryException with no detail message

ServerDeliveryException(String)

```
public ServerDeliveryException(java.lang.String s)
```

Construct a ServerDeliveryException with the specified detail message

Parameters:

`s` - the detail message

org.dvb.dsmcc
ServiceDomain

Declaration

```
public class ServiceDomain

java.lang.Object
   |
   +--org.dvb.dsmcc.ServiceDomain
```

Description

A `ServiceDomain` represents a group of DSMCC objects. The objects are sent either using the object carousel for a broadcast network or with the DSM-CC User-to-User protocol for an interactive network.

To access the objects of a `ServiceDomain`, it has to be attached to the file system name space of the MHP terminal. To access the content of an object, the application has four ways:

- It can instantiate the class that is used to read the object (java.io.FileInputStream or java.io.RandomAccessFile for a File or DSMCCStream for a stream) from its pathname. The loading of the object is implicit but the application has no way to abort it. NB: Obviously, for the Object Carousel, the write mode of java.io.RandomAccessFile is not allowed.
- It can instantiate a DSMCCObject and carry out a Synchronous loading. The loading can be aborted by the abort method of the DSMCCObject class. When the object is loaded, the application will instantiate the class used to read the object.
- It can instantiate a DSMCCObject and carry out an Asynchronous loading. So several loading can be started in parallel from the same thread.
- It is also possible to create directly a java.io.File for a DSMCC object.

Instances of `ServiceDomain` exist in two states, attached and detached. Newly created instances are always in the detached state. They become attached when a call to the `attach` method succeeds. They become detached following a call to the `detach` method.

When service domains in the attached state temporarily lose their network connection (e.g. if the MHP terminal tunes away from the transport stream where they are carried), the behaviour of DSMCC objects which are part of the service domain is specified in the main body of the present document. If such a network connection becomes available again then the service domain shall resume normal behaviour.

A service domain which is temporarily lost its network connection may be forced into the detached state by the implementation if the loss of the network connection becomes irrecoverable. The precise details of when this happens are implementation dependent. This is the only situation when shall be forced into the detached state. Once a ServiceDomain is detached, it will never be automatically attached.

Constructors

ServiceDomain()

```
public ServiceDomain()
```

Creates a ServiceDomain object.

Methods

attach(byte[])

```
public void attach(byte[] NSAPAddress)
            throws DSMCCException, InterruptedIOException, InvalidAddressException, MPEGDe
            liveryException
```

This function is used to attach a ServiceDomain from either an object carousel or from an interactive network. This call will block until the attachment is done.

Calling this method on a ServiceDomain object already in the attached state shall imply a detach of the ServiceDomain object before the attach operation unless the ServiceDomain is already attached to the correct location. Hence if the attach operation fails, the appropriate exception for the failure mode shall be thrown and the ServiceDomain is left in a detached state and not attached to the former object carousel / service domain. If the ServiceDomain is already attached to the correct location then the method call shall have no effect.

Parameters:

NSAPAddress - The NSAP Address of a ServiceDomain as defined in in ISO/IEC 13818-6

Throws:

java.io.InterruptedIOException - The attachment has been aborted.

InvalidAddressException - The NSAP Address is invalid.

DSMCCException - An error has occurred during the attachment.

MPEGDeliveryException - attaching to this domain would require tuning.

attach(Locator)

```
public void attach(org.davic.net.Locator l)
            throws DSMCCException, InterruptedIOException, MPEGDeliveryException
```

This function is used to attach a ServiceDomain from an object carousel. It loads the module which contains the service gateway object and mounts the ServiceDomain volume in the file system hierarchy. This call will block until the service gateway is loaded. It can be aborted by another thread with the method detach. In this case an InterruptedIOException is thrown.

Calling this method on a ServiceDomain object already in the attached state shall imply a detach of the ServiceDomain object before the attach operation unless the ServiceDomain is already attached to the correct location. Hence if the attach operation fails, the appropriate exception for the failure mode shall be thrown and the ServiceDomain is left in a detached state and not attached to the former object carousel / service domain. If the ServiceDomain is already attached to the correct location then the method call shall have no effect.

Parameters:

l - The locator pointing to the elementary stream carrying the DSI of the object carousel, or to a DVB service that carries one and only one object carousel.

Throws:

DSMCCException - An error has occurred during the attachment. For example, the locator does not point to a component carrying a DSI of an Object Carousel or to a service containing a single carousel

java.io.InterruptedIOException - The attachment has been aborted.

MPEGDeliveryException - attaching to this domain would require tuning.

attach(Locator, int)

```
public void attach(org.davic.net.Locator aDVBService, int aCarouselId)
            throws ServiceXFRException, InterruptedIOException, MPEGDeliveryException
```

This function is used to attach a ServiceDomain from an object carousel. It loads the module which contains the service gateway object and mounts the `ServiceDomain` volume in the file system hierarchy. This call will block until the service gateway is loaded. It can be aborted by another thread with the method detach. In this case an `InterruptedIOException` is thrown.

Calling this method on a `ServiceDomain` object already in the attached state shall imply a detach of the `ServiceDomain` object before the attach operation unless the `ServiceDomain` is already attached to the correct location. Hence if the attach operation fails, the appropriate exception for the failure mode shall be thrown and the `ServiceDomain` is left in a detached state and not attached to the former object carousel / service domain. If the `ServiceDomain` is already attached to the correct location then the method call shall have no effect.

Parameters:

`aDVBService` - The coordinates of the DVB service which contains the object carousel. This locator has to point to a DVB service.

`aCarouselId` - The identifier of the carousel.

Throws:

`java.io.InterruptedIOException` - The attachment has been aborted.

`MPEGDeliveryException` - An MPEG error occurred (such as time-out).

`ServiceXFRException` - The service gateway cannot be loaded in the current service domain. This exception shall not be thrown in this version of the specification.

---

detach()

```
public void detach()
            throws NotLoadedException
```

A call to this method is a hint that the applications gives to the MHP to unmount the volume and delete the objects of the service domain. When another application is using objects of the same service domain the method has no effects. When there are no other application using objects of the service domain, a call to this method is a hint that the MHP can free all the resources allocated to this service domain.

After this, the `ServiceDomain` will be in a non-attached state and will behave as if it had just been constructed. Subsequent calls to `detach` shall throw `NotLoadedException`.

Throws:

`NotLoadedException` - is thrown if the ServiceDomain is not attached or if there is no call to `attach` in progress.

---

getContextData(int)

```
public byte[] getContextData(int context_id)
            throws NotLoadedException
```

Returns the context_data_bytes from the service context list of the ServiceDomain's service gateway object.

Parameters:

`context_id` - the context_id whose context_data is to be returned

Returns:

an array containing the context_data_bytes or null if the context_id specified is not present in the service context list.

Throws:

`NotLoadedException` - if the service domain is not loaded

getLocator()

```
public org.davic.net.Locator getLocator()
```

Return the locator for this service domain. If this ServiceDomain instance was last attached by specifying a locator then an equivalent locator shall be returned except if the original locator contained extra information that is not necessary to identify the service domain in which case this extra information is removed. If the attach was done with the `attach(locator, int)` signature, the locator is complemented with the component_tag value that the platform has identified during attaching the ServiceDomain. If this ServiceDomain instance was last attached by specifying an NSAP address then the locator shall be generated from that address. If this ServiceDomain has never been attached then null shall be returned.

The syntax of the NSAP address is defined in section titled “LiteOptionsProfileBody” in annex B of the MHP specification. It contains the same fields as the locator syntax specified in the System integration aspects clause. The locator is constructed by taking the fields out of the NSAP address and encoding them in the locator syntax together with the component_tag value that the platform has identified during attaching the ServiceDomain.

Returns:
a locator for this service domain

Since:
MHP 1.0.1

getMountPoint()

```
public org.dvb.dsmcc.DSMCCObject getMountPoint()
```

Returns a `DSMCCObject` object describing the top level directory of this `ServiceDomain`. If the ServiceDomain object is not attached then null is returned.

Returns:
an instance of org.dvb.dsmcc.DSMCCObject if attached or null otherwise

Since:
MHP 1.0.1

getNSAPAddress()

```
public byte[] getNSAPAddress()
            throws NotLoadedException
```

This method returns the NSAP address of the `ServiceDomain`.

Returns:
the NSAP address of the `ServiceDomain`.

Throws:
`NotLoadedException` - is thrown if the `ServiceDomain` is not attached.

getURL(Locator)

```
public static java.net.URL getURL(org.davic.net.Locator l)
            throws NotLoadedException, InvalidLocatorException, FileNotFoundException
```

Obtain a java.net.URL corresponding to a ’dvb:’ locator. If the service domain corresponding to the locator is attached and the file referenced in the locator exists then an instance of `java.net.URL` is returned which can be used to reference this file.

Parameters:
`l` - a locator object encapsulating a ’dvb:’ locator which includes a ’dvb_abs_path’ element.

Returns:
a `java.net.URL` which can be used to access the file referenced by the 'dvb:' locator

Throws:
`org.davic.net.InvalidLocatorException` - if the locator is not a valid 'dvb:' locator or does not includes all elements including 'dvb_abs_path' element

`NotLoadedException` - is thrown if the locator is valid and includes enough information but it references a service domain which is not attached.

`java.io.FileNotFoundException` - if the service domain is attached but the file referenced by the locator does not exist

---

isAttached()

```
public boolean isAttached()
```

Return whether this service domain is in the attached or detached state.

Returns:
true if this service domain is in the attached state, otherwise false

Since:
MHP 1.0.1

---

isNetworkConnectionAvailable()

```
public boolean isNetworkConnectionAvailable()
```

Return whether the network connection for this service domain is available. This return value is independent of whether the service domain is attached or not. If a service domain is distributed across multiple network connections (e.g. using the optional support for DSMCC over IIOP) then this will reflect the availability of the network connection carrying the object mounted to the mount point.

Returns:
true if the network connection for this service domain is available otherwise false

Since:
MHP 1.0.1

org.dvb.dsmcc
ServiceXFRErrorEvent

Declaration

```
public class ServiceXFRErrorEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.ServiceXFRErrorEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

The object requested is available in an alternate ServiceDomain. When an application attempts to asynchronously load an object that has itself a LiteOptionProfileBody IOR or that has a parent directory that has a LiteOptionProfileBody IOR, this event shall be sent to the application. There is no implicit mounting by the implementation of the carousel that actually contains the object. This event is not sent if the Service Domain that actually contains the DSMCCObject is already mounted.

Constructors

ServiceXFRErrorEvent(DSMCCObject, ServiceXFRReference)

```
public ServiceXFRErrorEvent(org.dvb.dsmcc.DSMCCObject o,
            org.dvb.dsmcc.ServiceXFRReference ref)
```

Creates a ServiceXFRErrorEvent object.

Parameters:

`o` - the DSMCCObject that generated the event.

`ref` - the address of an alternate ServiceDomain where the object can be found.

Methods

---

getServiceXFR()

```
public org.dvb.dsmcc.ServiceXFRReference getServiceXFR()
```

This method is used to get a reference to the service domain that contains the requested object.

Returns:

The address of an alternate ServiceDomain where the object can be found.

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject that generated the event.

Overrides:
`getSource` in class `AsynchronousLoadingEvent`

Returns:
the DSMCCObject that generated the event.

org.dvb.dsmcc
ServiceXFRException

Declaration

```
public class ServiceXFRException extends DSMCCException

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.ServiceXFRException
```

All Implemented Interfaces:

`java.io.Serializable`

Description

A ServiceXFRException is thrown when a DSMCC Object can not be loaded in the current ServiceDomain but is available in an alternate ServiceDomain (i.e. for an object Carousel, the IOR of the object or one of its parent directories contains a Lite Option Profile Body). There is no implicit mounting by the implementation of the carousel that actually contain the object. This exception is not thrown if the Service Domain that actually contains the DSMCCObject is already mounted.

Constructors

ServiceXFRException(byte[], String)

```
public ServiceXFRException(byte[] NSAPAddress, java.lang.String pathName)
```

Creates a ServiceXFRException object.

Parameters:

`NSAPAddress` - The NSAP Address of a ServiceDomain as defined in ISO/IEC 13818-6

`pathName` - pathName of the object in the alternate ServiceDomain

ServiceXFRException(Locator, int, String)

```
public ServiceXFRException(org.davic.net.Locator aService, int carouselId,
            java.lang.String pathName)
```

Creates a ServiceXFRException object.

Parameters:

`aService` - Locator of the Service

`carouselId` - Carousel Identifier

`pathName` - pathName of the object in the alternate ServiceDomain

Methods

---

getServiceXFR()

```
public org.dvb.dsmcc.ServiceXFRReference getServiceXFR()
```

This method is used to get the alternate ServiceDomain which contains the object requested.

Returns:
the address of an alternate ServiceDomain where the object can be found.

org.dvb.dsmcc
ServiceXFRReference

Declaration

```
public class ServiceXFRReference

java.lang.Object
   |
   +--org.dvb.dsmcc.ServiceXFRReference
```

Description

A ServiceXFRReference object is used when a DSMCC Object can not be loaded in the current ServiceDomain but is available in an alternate ServiceDomain. Instances of this class are just containers. The parameters passed are merely stored and returned by the access methods. It is the responsibility of the platform when generating instances to use correct values.

Constructors

ServiceXFRReference(byte[], String)

```
public ServiceXFRReference(byte[] nsapAddress, java.lang.String pathName)
```

Creates a ServiceXFRReference object.

Parameters:

`nsapAddress` - The NSAP Address of a ServiceDomain as defined in ISO/IEC 13818-6

`pathName` - pathName of the object in the alternate ServiceDomain

ServiceXFRReference(Locator, int, String)

```
public ServiceXFRReference(org.davic.net.Locator serviceLocator, int carouselId,
            java.lang.String pathName)
```

Creates a ServiceXFRReference object.

Parameters:

`serviceLocator` - Locator of the Service

`carouselId` - Carousel Identifier

`pathName` - pathName of the object in the alternate ServiceDomain

Methods

---

getCarouselId()

```
public int getCarouselId()
```

This method returns the carousel identifier. If the object was constructed using the constructor which includes a carousel ID or if it was constructed using the constructor which includes an NSAP address and that NSAP address contains a carouselID then this method shall return that carousel ID otherwise this method shall return -1.

Returns:
the carousel identifier or -1.

---

getLocator()

```
public org.davic.net.Locator getLocator()
```

This method returns the Locator of the Service for an Object Carousel.

Returns:
the Locator of the Service for an Object Carousel. This method returns null, if the ServiceDomain is not associated with an Object Carousel. In this case the NSAP address must be used instead.

---

getNSAPAddress()

```
public byte[] getNSAPAddress()
```

This method returns the NSAP Address of a ServiceDomain as defined in ISO/IEC 13818-6. If the object was constructed using an NSAP address then this method shall return the NSAP address passed into the constructor. If the object was constructed with a locator and a carouselID then this method shall return an NSAP address derived from this information when locator is an instance of org.davic.net.dvb.DVBLocator. Otherwise this method shall return null

Returns:
the NSAP Address of a ServiceDomain as defined in ISO/IEC 13818-6 or null

---

getPathName()

```
public java.lang.String getPathName()
```

This method returns the pathname of the object in the alternate ServiceDomain.

Returns:
the pathname of the object in the alternate ServiceDomain.

org.dvb.dsmcc
StreamEvent

Declaration

```
public class StreamEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.StreamEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This class describes a Stream event which is used to synchronize an application with an MPEG Stream.

NOTE: The NPT mechanism and scheduled stream events that depend on it are known to be vulnerable to disruption in many digital TV distribution networks. Existing deployed network equipment that re-generates the STC is unlikely to be aware of NPT and hence will not make the necessary corresponding modification to STC values inside NPT reference descriptors. This may cause stream events scheduled against NPT to fire at the wrong time or to never fire at all. Applications should only use scheduled stream events with NPT where they are confident that the network where they are to be used does not have this problem. DVB Timeline, DSM-CC "do it now" events and events carried within DVB synchronised auxiliary data offer more reliable alternatives to NPT.

Constructors

StreamEvent(DSMCCStreamEvent, long, String, int, byte[])

```
public StreamEvent(org.dvb.dsmcc.DSMCCStreamEvent source, long npt, java.lang.String name,
            int eventId, byte[] eventData)
```

Creates a StreamEvent object.

Parameters:

`source` - The `DSMCCStreamEvent` that has generated the event.

`npt` - The value of the timeline when the event is triggered. For NPT based timelines, this value is equal to the field eventNPT in the DSMCC StreamEventDescriptor except where the event is a "do it now" event in which case the value -1 is returned (as the value of NPT may not be meaningful). For DVB timelines, this value is the to-be-completed

`name` - The name of this event. The list of event names is located in the DSMCC StreamEvent object. This list is returned by the method `DSMCCStreamEvent.getEventList`.

`eventId` - The eventId of this event. The list of event IDs is located in the DSMCC StreamEvent object.

`eventData` - The application specific data found in the DSMCC StreamEventDescriptor.

Methods

---

getEventData()

```
public byte[] getEventData()
```

This method is used to retrieve the private data associated with the event. For events signalled by a DVB synchronised event descriptor, these are the bytes carried in the synchronised_event_data_byte field. For events signalled by a DSMCC stream event descriptor, these are the contents of the privateDataByte field.

Returns:
The private data associated with the event.

---

getEventId()

```
public int getEventId()
```

This method is used to get the identifier of the StreamEvent.

Returns:
The identifier of the StreamEvent.

---

getEventName()

```
public java.lang.String getEventName()
```

This method is used to get the name of the StreamEvent

Returns:
the name of the StreamEvent

---

getEventNPT()

```
public long getEventNPT()
```

This method is used to get the value of the timeline when the event was triggered

Returns:
The value of the timeline in milliseconds.

---

getSource()

```
public java.lang.Object getSource()
```

This method returns the DSMCCStreamEvent that generated the event.

Overrides:
`getSource` in class `EventObject`

Returns:
the DSMCCStreamEvent that generated the event.

org.dvb.dsmcc
StreamEventListener

Declaration
```
public interface StreamEventListener extends java.util.EventListener
```

All Superinterfaces:
```
java.util.EventListener
```

Description
Objects that implement the StreamEventListener interface can receive StreamEvent event.

Methods

---

receiveStreamEvent(StreamEvent)

```
public void receiveStreamEvent(org.dvb.dsmcc.StreamEvent e)
```

Send a StreamEvent to the StreamEventListener.

Parameters:
`e` - the StreamEvent event.

org.dvb.dsmcc
SuccessEvent

Declaration

```
public class SuccessEvent extends AsynchronousLoadingEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.dsmcc.AsynchronousLoadingEvent
              |
              +--org.dvb.dsmcc.SuccessEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

This event indicates that the asynchronous loading was successful.

Constructors

SuccessEvent(DSMCCObject)

```
public SuccessEvent(org.dvb.dsmcc.DSMCCObject o)
```

Creates a SuccessEvent object.

Parameters:

o - the DSMCCObject which was successfully loaded.

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the DSMCCObject which was successfully loaded.

Overrides:

getSource in class AsynchronousLoadingEvent

Returns:

the loaded DSMCCObject

org.dvb.dsmcc
UnknownEventException

Declaration

```
public class UnknownEventException extends DSMCCException

java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--java.io.IOException
                    |
                    +--org.dvb.dsmcc.DSMCCException
                          |
                          +--org.dvb.dsmcc.UnknownEventException
```

All Implemented Interfaces:

java.io.Serializable

Description

The UnknownEventException is thrown when a method tries to access to an unknown event. This exception may get thrown because the event in question is not being signalled yet. It does not indicate that the event is permanently unavailable. Applications may choose to attempt to subscribe to the event again at a later point in time in the expectation that the event has become available since the previous attempt.

Constructors

UnknownEventException()

```
public UnknownEventException()
```

Construct an UnknownEventException with no detail message

UnknownEventException(String)

```
public UnknownEventException(java.lang.String s)
```

Construct an UnknownEventException with the specified detail message

Parameters:

s - the detail message

Annex Q (normative): Datagram Socket Buffer Control

Package
org.dvb.net

Description
Provides general networking features not found elsewhere.

Class Summary	
Classes	
DatagramSocketBuffer-Control	This class provides additional control over buffering for DatagramSockets.

org.dvb.net
DatagramSocketBufferControl

Declaration

```
public class DatagramSocketBufferControl

java.lang.Object
   |
   +--org.dvb.net.DatagramSocketBufferControl
```

Description

This class provides additional control over buffering for `DatagramSockets`.

Methods

---

getReceiveBufferSize(DatagramSocket)

```
public static int getReceiveBufferSize(java.net.DatagramSocket d)
            throws SocketException
```

Get value of the SO_RCVBUF option for this socket, that is the buffer size used by the platform for input on the this Socket. The value returned need not be the value previously set by setReceiveBufferSize (if any).

Parameters:

`d` - The DatagramSocket for which to query the receive buffer size.

Returns:

The size of the receive buffer, in bytes.

Throws:

`java.net.SocketException` - - If there is an error when querying the SO_RCVBUF option.

---

setReceiveBufferSize(DatagramSocket, int)

```
public static void setReceiveBufferSize(java.net.DatagramSocket d, int size)
            throws SocketException
```

Sets the SO_RCVBUF option to the specified value for this DatagramSocket. The SO_RCVBUF option is used by the platform's networking code as a hint for the size to use when allocating the underlying network I/O buffers.

Increasing buffer size can increase the performance of network I/O for high-volume connection, while decreasing it can help reduce the backlog of incoming data. For UDP, this sets the buffer size for received packets.

Because SO_RCVBUF is a hint, applications that want to verify what size the buffers were set to should call getReceiveBufferSize. This method shall throw IllegalArgumentException - if size is 0 or is negative.

Parameters:

`d` - The DatagramSocket for which to change the receive buffer size.

`size` - The requested size of the receive buffer, in bytes.

Throws:

`java.net.SocketException` - - If there is an error when setting the SO_RCVBUF option.

Annex R (normative): DVB-J Return Channel Connection Management API

Package org.dvb.net.rc

Description

Provides session management for bi-directional IP connections which are session based from the point of view of an application. The best example of this is a conventional modem.

Class Summary	
Interfaces	
ConnectionListener	This interface should be implemented by objects wishing to be notified about the connection status of a ConnectionRCInterface.
Classes	
ConnectionDroppedEvent	ConnectionDroppedEvent - An event generated after an attempt to setup a connection for a ConnectionRCInterface fails due to the connection being dropped by the target.
ConnectionEstablishedEvent	ConnectionEstablishedEvent - An event generated after a connection is established for a ConnectionRCInterface.
ConnectionFailedEvent	ConnectionFailedEvent - An event generated after an attempt to setup a connection for a ConnectionRCInterface fails.
ConnectionParameters	This class encapsulates the parameters needed to specify the target of a connection.
ConnectionRCEvent	ConnectionRCEvent - the base class for events related to connection oriented return channels.
ConnectionRCInterface	This class models a connection based return channel network interface for use in receiving and transmitting IP packets over a return channel.
ConnectionTerminatedEvent	ConnectionTerminatedEvent - An event generated after a connected ConnectionRCInterface is disconnected.
NoDialToneEvent	NoDialToneEvent - An event generated after an attempt to setup a connection for a ConnectionRCInterface of TYPE_PSTN fails due to there not being a dial tone on the return channel concerned.
RCInterface	This class models a return channel network interface for use in receiving and transmitting IP packets over a logical return channel.
RCInterfaceManager	This class is the factory and manager for all return channel interfaces in the system.
RCInterfaceReleasedEvent	This event informs an application that a RCInterface has been released by an application or other entity in the system.
RCInterfaceReservedEvent	This event informs an application that a RCInterface has been reserved by an application or other entity in the system.
RCPermission	This class is for return channel set-up permissions.
TargetBusyEvent	TargetBusyEvent - An event generated after an attempt to setup a connection for a ConnectionRCInterface fails due to the target of the connection being busy.
Exceptions	

Class Summary	
IncompleteTargetException	Thrown when the target for a connection is incompletely specified.
PermissionDeniedException	Thrown when an application calls a method which it does not have permission to call at that time.

org.dvb.net.rc
ConnectionDroppedEvent

Declaration

```
public class ConnectionDroppedEvent extends ConnectionFailedEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionFailedEvent
                    |
                    +--org.dvb.net.rc.ConnectionDroppedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

ConnectionDroppedEvent - An event generated after an attempt to setup a connection for a `ConnectionRCInterface` fails due to the connection being dropped by the target. For a ConnectionRCInterface of type `TYPE_PSTN`, this includes the following conditions:

- Connection was dropped after ringing but before it was answered
- Connection rang but was never answered and timed-out
- Connection was dropped after answering but before the IP connection was established
- Connection was answered but the IP connection was never established and timed-out

Constructors

ConnectionDroppedEvent(Object)

```
public ConnectionDroppedEvent(java.lang.Object source)
```

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose connection attempt failed

org.dvb.net.rc
ConnectionEstablishedEvent

Declaration

```
public class ConnectionEstablishedEvent extends ConnectionRCEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionEstablishedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

ConnectionEstablishedEvent - An event generated after a connection is established for a `ConnectionRCInterface`.

Constructors

ConnectionEstablishedEvent(Object)

`public ConnectionEstablishedEvent(java.lang.Object source)`

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose connection was established

org.dvb.net.rc
ConnectionFailedEvent

Declaration

```
public class ConnectionFailedEvent extends ConnectionRCEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionFailedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Direct Known Subclasses:

`ConnectionDroppedEvent`, `NoDialToneEvent`, `TargetBusyEvent`

Description

ConnectionFailedEvent - An event generated after an attempt to setup a connection for a `ConnectionRCInterface` fails.

Constructors

ConnectionFailedEvent(Object)

`public ConnectionFailedEvent(java.lang.Object source)`

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose connection attempt failed

org.dvb.net.rc
ConnectionListener

Declaration

```
public interface ConnectionListener extends java.util.EventListener
```

All Superinterfaces:

`java.util.EventListener`

Description

This interface should be implemented by objects wishing to be notified about the connection status of a `ConnectionRCInterface`.

Methods

---

connectionChanged(ConnectionRCEvent)

```
public void connectionChanged(org.dvb.net.rc.ConnectionRCEvent e)
```

This method is called to report events related to the setup and termination of return channel interface connections.

Parameters:

`e` - the event which happened

org.dvb.net.rc
ConnectionParameters

Declaration

```
public class ConnectionParameters

java.lang.Object
  |
  +--org.dvb.net.rc.ConnectionParameters
```

Description

This class encapsulates the parameters needed to specify the target of a connection.

Constructors

ConnectionParameters(String, String, String)

```
public ConnectionParameters(java.lang.String number, java.lang.String username,
            java.lang.String password)
```

Construct a set of connection parameters. Details of the DNS server to use are supplied by the server.

Parameters:

`number` - the target of the connection, e.g. a phone number

`username` - the username to use in connection setup

`password` - the password to use in connection setup

ConnectionParameters(String, String, String, InetAddress[])

```
public ConnectionParameters(java.lang.String number, java.lang.String username,
            java.lang.String password, java.net.InetAddress[] dns)
```

Construct a set of connection parameters.

Parameters:

`number` - the target of the connection, e.g. a phone number

`username` - the username to use in connection setup

`password` - the password to use in connection setup

`dns` - the list of DNS servers to try before reporting failure. The order in which they are interrogated is not specified. Once one result has been obtained, there is no requirement to try others.

Methods

---

getDNSServer()

```
public java.net.InetAddress[] getDNSServer()
```

Return the addresses of the DNS servers to use for the connection

Returns:
return the addresses of the DNS servers passed into the constructor of the instance or null if none was provided.

---

getPassword()

```
public java.lang.String getPassword()
```

Return the password used in establishing this connection The value returned shall be the one passed into the constructor of this instance.

Returns:
the password used in establishing this connection

---

getTarget()

```
public java.lang.String getTarget()
```

Return the target of this connection for example a phone number. The value returned shall be the one passed into the constructor of this instance.

Returns:
the target of the connection

---

getUsername()

```
public java.lang.String getUsername()
```

Return the username used in establishing this connection The value returned shall be the one passed into the constructor of this instance.

Returns:
the username used in establishing the connection

org.dvb.net.rc
ConnectionRCEvent

Declaration

```
public class ConnectionRCEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
```

All Implemented Interfaces:

java.io.Serializable

Direct Known Subclasses:

ConnectionEstablishedEvent, ConnectionFailedEvent, ConnectionTerminatedEvent

Description

ConnectionRCEvent - the base class for events related to connection oriented return channels.

Constructors

ConnectionRCEvent(Object)

```
public ConnectionRCEvent(java.lang.Object source)
```

Construct an event

Parameters:

source - the ConnectionRCInterface for which the event was generated.

org.dvb.net.rc
ConnectionRCInterface

Declaration

```
public class ConnectionRCInterface extends RCInterface implements
    org.davic.resources.ResourceProxy

java.lang.Object
  |
  +--org.dvb.net.rc.RCInterface
        |
        +--org.dvb.net.rc.ConnectionRCInterface
```

All Implemented Interfaces:

`org.davic.resources.ResourceProxy`

Description

This class models a connection based return channel network interface for use in receiving and transmitting IP packets over a return channel. Targets for connections are specified as strings including the number to dial. These strings can only include either numbers or a "+" character (as the first character only).

When a `ConnectionRCInterface` instance is first obtained by an application, the current target shall be set to the default. Applications which wish to use a non-default target need to set this target before attempting to reserve the `ConnectionRCInterface`. This is because if the application does not have the permission to use the default target, the `reserve()` method is required throw a `SecurityException`.

Constructors

ConnectionRCInterface()

```
protected ConnectionRCInterface()
```

Constructor for instances of this class. This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

addConnectionListener(ConnectionListener)

```
public void addConnectionListener(org.dvb.net.rc.ConnectionListener l)
```

Add a listener for events related to connections of this interface.

Parameters:

`l` - the listener for the connection related events

connect()

```
public void connect()
            throws IOException, PermissionDeniedException
```

Connect this return channel to the current target. If this ResourceProxy does not have the underlying resource reserved then a PermissionDeniedException will be thrown. Where the underlying resource is reserved but at the time the method is called, it is known that connection is impossible then an IOException will be thrown. Apart from this, this method is asynchronous and completion or failure is reported through the event listener on this class. If a connection is already established when this method is called then the method call shall have no effect.

Throws:

PermissionDeniedException - if this application does not own the resource

java.io.IOException - if connection is known to be impossible at the time when the method is called

disconnect()

```
public void disconnect()
            throws PermissionDeniedException
```

Disconnect this return channel from the current target. This method is asynchronous and completion is reported through the event listener on this class. This method does not release the underlying resource from the ResourceProxy. If no connection is established then this method shall have no effect.

Throws:

PermissionDeniedException - if this application does not own the resource

getClient()

```
public org.davic.resources.ResourceClient getClient()
```

Return the object which asked to be notified about withdrawal of the underlying resource. This is the object provided as the first parameter to the last call to the reserve method on this object. If this object does not have the underlying resource reserved then null is returned.

Specified By:

getClient in interface ResourceProxy

Returns:

the object which asked to be notified about withdrawal of the underlying physical resource from this resource proxy or null

getConnectedTime()

```
public int getConnectedTime()
```

Return the time an interface has been connected

Returns:

the time in seconds for which this interface has been connected or -1 if the device is not connected

getCurrentTarget()

```
public org.dvb.net.rc.ConnectionParameters getCurrentTarget()
            throws IncompleteTargetException
```

Get the current target for connections.

If this ConnectionRCInterface is connected then this method shall return the target to which the connection was made. If this ConnectionRCInterface is not connected then this method shall return the last target set by the setTarget method (if any) otherwise the default.

This returns either the default target or the last target set by this application calling the setTarget method on this instance before the connection was established. This applies regardless of whether the connection was established by another MHP application or if some of the connection parameters have been supplied by the server.

Returns:
the current set of connection target parameters

Throws:
`IncompleteTargetException` - if the current target is not completely configured

`java.lang.SecurityException` - if the application is not allowed to read the current target as defined by the security policy of the platform

---

getSetupTimeEstimate()

```
public float getSetupTimeEstimate()
```

Obtain an estimate of the setup time for a successful connection for this interface in seconds.

Returns:
an estimate of the setup time for a successful connection for this interface in seconds.

---

isConnected()

```
public boolean isConnected()
```

Check if this interface is connected. Connected means able to receive and transmit packets.

Returns:
true if the interface is connected, otherwise false

---

release()

```
public void release()
```

Release the right to control this return channel interface. If this object does not have the right to control this return channel interface then this method shall have no effect.

---

removeConnectionListener(ConnectionListener)

```
public void removeConnectionListener(org.dvb.net.rc.ConnectionListener l)
```

Remove a listener for events related to connections of this interface. If the listener specified is not currently receiving these events then this method has no effect.

Parameters:
`l` - the listener for the connection related events

---

reserve(ResourceClient, Object)

```
public void reserve(org.davic.resources.ResourceClient c, java.lang.Object requestData)
            throws PermissionDeniedException
```

Request the right to control this return channel interface. If the right to control the return channel interface has already been reserved then this method shall have no effect.

The details of the current connection target shall be obtained from the `ConnectionParameters` instance which is the current target during the call to this method. Hence changes to that `ConnectionParameters` instance before a call to this method shall be taken account of during the method call. Changes after the call to this method shall have no effect on that connection.

Parameters:

`c` - the object to be notified when resources are removed

`requestData` - Used by the Resource Notification API in the requestRelease method of the ResourceClient interface. The usage of this parameter is optional and a null reference may be supplied.

Throws:

`PermissionDeniedException` - if this interface cannot be reserved

`java.lang.SecurityException` - if the application is denied access to the resource by security policy.

---

setTarget(ConnectionParameters)

```
public void setTarget(org.dvb.net.rc.ConnectionParameters target)
            throws IncompleteTargetException, PermissionDeniedException
```

Set a non-default target for connections.

If this method is called for a ConnectionRCInterface which is connected then successful calls to this method shall not interrupt that connection. The newly set target shall just be stored until either the next time a connection is established with that ConnectionRCInterface instance or until a subsequent call to setTarget on that ConnectionRCInterface.

The details of the current connection target shall be obtained from the newly set target during the call to this method. Changes to that instance after the call to this method shall have no effect on the ConnectionRCInterface unless/until setTarget is called again for that instance or it is released and reserved again.

Parameters:

`target` - the new set of connection target parameters

Throws:

`IncompleteTargetException` - if the application owns the resource but the target is not completely specified

`PermissionDeniedException` - this exception shall never be thrown

`java.lang.SecurityException` - if the application is not allowed to modify the target as defined by the security policy of the platform

---

setTargetToDefault()

```
public void setTargetToDefault()
            throws PermissionDeniedException
```

Set the target for connections to the default.

Throws:

`PermissionDeniedException` - if this application does not own the resource

`java.lang.SecurityException` - if the application is not allowed to connect to the default target

org.dvb.net.rc
ConnectionTerminatedEvent

Declaration

```
public class ConnectionTerminatedEvent extends ConnectionRCEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionTerminatedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

ConnectionTerminatedEvent - An event generated after a connected `ConnectionRCInterface` is disconnected.

Constructors

ConnectionTerminatedEvent(Object)

`public ConnectionTerminatedEvent(java.lang.Object source)`

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose status changed

org.dvb.net.rc
IncompleteTargetException

Declaration

```
public class IncompleteTargetException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.net.rc.IncompleteTargetException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when the target for a connection is incompletely specified. This is thrown either when the default connection target is incompletely defined in the device or when an application provides an incompletely defined connection target to the device or when the connection target is badly formed, e.g. includes illegal characters in a number parameter.

Constructors

IncompleteTargetException()

```
public IncompleteTargetException()
```

Default constructor for the exception

IncompleteTargetException(String)

```
public IncompleteTargetException(java.lang.String reason)
```

Constructor for the exception with a specified reason

Parameters:

reason - the reason why the exception was raised

org.dvb.net.rc
NoDialToneEvent

Declaration

```
public class NoDialToneEvent extends ConnectionFailedEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionFailedEvent
                    |
                    +--org.dvb.net.rc.NoDialToneEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

NoDialToneEvent - An event generated after an attempt to setup a connection for a `ConnectionRCInterface` of `TYPE_PSTN` fails due to there not being a dial tone on the return channel concerned.

Constructors

NoDialToneEvent(Object)

`public NoDialToneEvent(java.lang.Object source)`

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose connection attempt failed

org.dvb.net.rc
PermissionDeniedException

Declaration

```
public class PermissionDeniedException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.net.rc.PermissionDeniedException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when an application calls a method which it does not have permission to call at that time.

Constructors

PermissionDeniedException()

```
public PermissionDeniedException()
```

Default constructor for the exception

PermissionDeniedException(String)

```
public PermissionDeniedException(java.lang.String reason)
```

Constructor for the exception with a specified reason

Parameters:

reason - the reason why the exception was raised

org.dvb.net.rc
RCInterface

Declaration

```
public class RCInterface

java.lang.Object
  |
  +--org.dvb.net.rc.RCInterface
```

Direct Known Subclasses:

ConnectionRCInterface

Description

This class models a return channel network interface for use in receiving and transmitting IP packets over a logical return channel. This can include real analog modems, cable return channel and all the other options allowed by the relevant DVB specification. This class does not model any concept of connection. Hence interfaces represented by this class and not by a sub-class of it are permanently connected.

Fields

TYPE_CATV

```
public static final int TYPE_CATV
```

Constant to indicate a CATV return channel.

TYPE_DECT

```
public static final int TYPE_DECT
```

Constant to indicate a DECT return channel.

TYPE_ISDN

```
public static final int TYPE_ISDN
```

Constant to indicate an ISDN return channel.

TYPE_LMDS

```
public static final int TYPE_LMDS
```

Constant to indicate a LMDS return channel.

TYPE_MATV

```
public static final int TYPE_MATV
```

Constant to indicate a MATV return channel.

TYPE_OTHER

```
public static final int TYPE_OTHER
```

Constant to indicate all other return channel technologies not having a suitable defined constant in this class.

NOTE: DVB does not intend to add future constants to this list for future return channel technologies. These should be represented as TYPE_OTHER.

TYPE_PSTN

```
public static final int TYPE_PSTN
```

Constant to indicate a PSTN return channel.

TYPE_RCS

```
public static final int TYPE_RCS
```

Constant to indicate a DVB-RCS return channel.

TYPE_UNKNOWN

```
public static final int TYPE_UNKNOWN
```

Constant to indicate an unknown return channel technology. There is an intermediate physical interface between the MHP terminal and the return channel device. This return value gives no information about whether the return channel is connection oriented or connectionless.

Constructors

RCInterface()

```
protected RCInterface()
```

Constructor for instances of this class. This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

getDataRate()

```
public int getDataRate()
```

Return the maximum data rate of the connection over the immediate access network to which this network interface is connected. For asymmetric connections, the data rate coming into the MHP terminal shall be returned. For connection oriented interfaces which are not currently connected, the value returned shall be that of the last connection established where that information is available. Where that information is not available, (e.g. where no connection has been established since an MHP terminal was power cycled), -1 shall be returned.

Returns:
a data rate in KBaud or -1 where this is not available

Since:
MHP 1.0.1

---

getType()

```
public int getType()
```

Return the type of return channel represented by this object. Note, applications wishing to discover whether a return channel interface is connection oriented or not are recommended to test whether an object is an instance of `ConnectionRCInterface` or not. A non-connection oriented interface really means a permanently connected return channel.

Returns:
the type of return channel represented by this object encoded as one of the constants defined in this class

org.dvb.net.rc
RCInterfaceManager

Declaration

```
public class RCInterfaceManager implements org.davic.resources.ResourceServer
```

```
java.lang.Object
  |
  +--org.dvb.net.rc.RCInterfaceManager
```

All Implemented Interfaces:

`org.davic.resources.ResourceServer`

Description

This class is the factory and manager for all return channel interfaces in the system. The methods on this class which return instances of the `RCInterface` will only return new instances of that class under the following conditions:

- on the first occasion an instance needs to be returned to a particular application for a particular interface.
- when new return channel interfaces are added to the system

Methods

---

addResourceStatusEventListener(ResourceStatusListener)

```
public void addResourceStatusEventListener(org.davic.resources.ResourceStatusListener
            listener)
```

This method informs a resource server that a particular object should be informed of changes in the state of the resources managed by that server.

Specified By:

`addResourceStatusEventListener` in interface `ResourceServer`

Parameters:

`listener` - the object to be informed of state changes

---

getInstance()

```
public static org.dvb.net.rc.RCInterfaceManager getInstance()
```

Factory method to obtain a manager. The RCInterfaceManager is either a singleton for each MHP application or a singleton for the MHP terminal.

Returns:

an instance of an RCInterfaceManager

---

getInterface(InetAddress)

```
public org.dvb.net.rc.RCInterface getInterface(java.net.InetAddress addr)
```

Return the interface which will be used when connecting to a particular host. Null is returned if this is not known when the method is called.

Parameters:
`addr` - the IP address of the host to connect to

Returns:
the interface which will be used or null if this is not known

---

getInterface(Socket)

```
public org.dvb.net.rc.RCInterface getInterface(java.net.Socket s)
```

Return the interface which is used for a particular socket.

Parameters:
`s` - the socket to use

Returns:
the interface which is used or null if the socket is not connected

---

getInterface(URLConnection)

```
public org.dvb.net.rc.RCInterface getInterface(java.net.URLConnection u)
```

Return the interface which is used for a particular URLConnection

Parameters:
`u` - the URLConnection to use

Returns:
the interface which is used or null if the URLConnection is not connected

---

getInterfaces()

```
public org.dvb.net.rc.RCInterface[] getInterfaces()
```

Factory method to return a list of all return channel interfaces visible to this application. The number of entries in the array will exactly match the number of return channel interfaces visible to the application. Null is returned if no interfaces are visible to this application.

Returns:
an array of available return channel interfaces

---

removeResourceStatusEventListener(ResourceStatusListener)

```
public void removeResourceStatusEventListener(org.davic.resources.ResourceStatusListener
            listener)
```

This method informs a resource server that a particular object is no longer interested in being informed about changes in state of resources managed by that server. If the object had not registered its interest initially then this method has no effect.

Specified By:
`removeResourceStatusEventListener` in interface `ResourceServer`

Parameters:
`listener` - the object which is no longer interested

org.dvb.net.rc
RCInterfaceReleasedEvent

Declaration

```
public class RCInterfaceReleasedEvent extends org.davic.resources.ResourceStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.davic.resources.ResourceStatusEvent
              |
              +--org.dvb.net.rc.RCInterfaceReleasedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

This event informs an application that a `RCInterface` has been released by an application or other entity in the system. It is generated when an application which had successfully reserved a `RCInterface` calls the `ConnectionRCInterface.release` method. It will also be generated if any other entities in the system own such an interface and then release that interface in such a way that it could then become available to applications using this API.

Constructors

RCInterfaceReleasedEvent(Object)

`public RCInterfaceReleasedEvent(java.lang.Object bg)`

Constructor for the event

Parameters:

`bg` - the `RCInterface` which has been released

Methods

---

getSource()

`public java.lang.Object getSource()`

Returns the device that has been released

Overrides:

`getSource` in class `ResourceStatusEvent`

Returns:

the `RCInterface` object representing the interface that has been released

org.dvb.net.rc
RCInterfaceReservedEvent

Declaration

```
public class RCInterfaceReservedEvent extends org.davic.resources.ResourceStatusEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.davic.resources.ResourceStatusEvent
              |
              +--org.dvb.net.rc.RCInterfaceReservedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

This event informs an application that a `RCInterface` has been reserved by an application or other entity in the system. It is generated when an application successfully reserves a `RCInterface`. It will also be generated if any other entities in the system reserve such an interface with the effect of something which was visible to applications using this API becoming unavailable.

Constructors

RCInterfaceReservedEvent(Object)

```
public RCInterfaceReservedEvent(java.lang.Object bg)
```

Constructor for the event

Parameters:

`bg` - the `RCInterface` representing the device which has been reserved

Methods

---

getSource()

```
public java.lang.Object getSource()
```

Returns the device that has been reserved

Overrides:

`getSource` in class `ResourceStatusEvent`

Returns:

an `RCInterface` representing the device that has been reserved

org.dvb.net.rc
RCPermission

Declaration

```
public class RCPermission extends java.security.BasicPermission

java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.net.rc.RCPermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for return channel set-up permissions. An RCPermission contains a name, but no actions list.

The permission name can be “target:default”, which indicates the permission to use the default connection parameters.

The permission name can also be “target:<phone number>”, which indicates the permission to use the specified phone number in the connection set-up (ConnectionRCInterface.setTarget(ConnectionParameters) method).

A wildcard may be used at the end of the permission name. In that case, all phone numbers starting with the number before the wildcard are included in the permission. A “+” may be used at the start of the phone number to indicate a phone number including the international country code.

Examples:

- target:0206234342 (Permission to dial the specified phone number)
- target:020* (Permission to dial phone numbers starting with 020)
- target:* (Permission to dial all phone numbers, including the default)

Note: ConnectionRCInterface.reserve(ResourceClient, Object) will throw a SecurityException if the application is not allowed to set-up a connection over the return channel at all (i.e., there is no valid target allowed).

Constructors

RCPermission(String)

`public RCPermission(java.lang.String name)`

Creates a new RCPermission with the specified name. The name is the symbolic name of the RCPermission.

Parameters:

`name` - the name of the RCPermission

RCPermission(String, String)

`public RCPermission(java.lang.String name, java.lang.String actions)`

Creates a new RCPermission object with the specified name. The name is the symbolic name of the RCPermission, and the actions String is unused and should be null. This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:
`name` - the name of the RCPermission

`actions` - should be null.

Methods

---

implies(Permission)

```
public boolean implies(java.security.Permission p)
```

Checks if this RCPermission “implies” the specified Permission.

More specifically, this returns true if and only if:

- p is an instance of RCPermission, and
- p’s name is implied by the name of this permission, as described by the wildcarding rules specified in the the description of this class.

Overrides:
`implies` in class `BasicPermission`

Parameters:
`p` - The Permission to check against.

Returns:
true if the specified Permission is implied by this object; false otherwise.

org.dvb.net.rc
TargetBusyEvent

Declaration

```
public class TargetBusyEvent extends ConnectionFailedEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.net.rc.ConnectionRCEvent
              |
              +--org.dvb.net.rc.ConnectionFailedEvent
                    |
                    +--org.dvb.net.rc.TargetBusyEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

TargetBusyEvent - An event generated after an attempt to setup a connection for a `ConnectionRCInterface` fails due to the target of the connection being busy.

Constructors

TargetBusyEvent(Object)

`public TargetBusyEvent(java.lang.Object source)`

Construct an event.

Parameters:

`source` - the `ConnectionRCInterface` whose connection attempt failed

Annex S (normative): Application Listing and Launching

Package
org.dvb.application

Description

Provides access to lists of applications which are available in this context and the ability to launch those applications.

Class Summary	
Interfaces	
AppAttributes	The AppAttributes class is a mapping of various information about a registered application.
AppProxy	An AppProxy Object is a proxy to an application.
AppsDatabaseEventListener	The AppsDatabaseListener class allows an application to monitor the application database so that it can keep an up to date interface without polling the state.
AppStateChangeEventListener	The AppStateChangeEventListener class allows a launcher application to keep track of applications it launches or other applications running as part of the same service.
DVBHTMLProxy	A DVBHTMLProxy Object is a proxy to a DVBHTML application.
DVBJProxy	A DVBJProxy Object is a proxy to a DVBJ application.
Classes	
AppIcon	The AppIcon encapsulates the information concerning the icon attached to the application
AppID	The AppID is a representation of the unique identifier for applications.
AppsControlPermission	This class represents a Permission to control the lifecycle of another application.
AppsDatabase	The AppsDatabase is an abstract view of the currently available applications.
AppsDatabaseEvent	The AppsDatabaseEvent class indicates either an entry in the application database has changed, or so many changes have occurred.
AppsDatabaseFilter	Abstract class for the filters.
AppStateChangeEvent	The AppStateChangeEvent class indicates a state transition of the application.
CurrentServiceFilter	Instances of CurrentServiceFilter are used to set a filter on the list of applications that are retrieved from the AppsDatabase (See methods getAppsAttributes and getAppsIDs).
RunningApplicationsFilter	Instances of RunningApplicationsFilter are used to set a filter on the list of applications that are retrieved from the AppsDatabase (See methods getAppsAttributes and getAppsIDs).
Exceptions	
IllegalProfileParameterException	The IllegalProfileParameter exception is thrown if the application attempts to ask for a version number for a profile not specified for the application.

Class Summary	
LanguageNotAvailable-Exception	The LanguageNotAvailableException exception is thrown if the application asks for the name of an application in a language not signalled in the AIT.

org.dvb.application
AppAttributes

Declaration
```
public interface AppAttributes
```

All Known Subinterfaces:
org.dvb.application.storage.ExtendedAppAttributes

Description
The AppAttributes class is a mapping of various information about a registered application. For applications which are signalled in an AIT, the mapping between the values returned by methods in this class and the fields and descriptors of the AIT shall be as specified in the main body of the present document.

Instances of objects implementing this interface are immutable and populated before the instance is first returned to an application.

Since:
MHP1.0

Fields

DVB_HTML_application

```
public static final int DVB_HTML_application
```

The DVB registered value for all DVB-HTML applications.

DVB_J_application

```
public static final int DVB_J_application
```

The DVB registered value for all DVB-J applications.

Methods

---

getAppIcon()

```
public org.dvb.application.AppIcon getAppIcon()
```

This method returns an object encapsulating the information about the icon(s) for the application.

Returns:
the information related to the icons that are attached to the application or null if no icon information is available

Since:
MHP1.0

---

getIdentifier()

```
public org.dvb.application.AppID getIdentifier()
```

This method returns the application identifier.

Returns:
the application identifier

Since:
MHP1.0

---

getIsServiceBound()

```
public boolean getIsServiceBound()
```

This method determines whether the application is bound to a single service.

Returns:
true if the application is bound to a single service, false otherwise.

Since:
MHP1.0

---

getName()

```
public java.lang.String getName()
```

This method returns the name of the application. If the default language (as specified in user preferences) is in the set of available language / name pairs then the name in that language shall be returned. Otherwise this method will return a name which appears in that set on a “best-effort basis”. If no application names are signalled, an empty string shall be returned.

Returns:
the name of the application

Since:
MHP1.0

---

getName(String)

```
public java.lang.String getName(java.lang.String iso639code)
            throws LanguageNotAvailableException
```

This method returns the name of the application in the language which is specified by the parameter passed as an argument. If the language specified is not in the set of available language /name pairs then an exception shall be thrown.

Parameters:
`iso639code` - the specified language, encoded as per ISO 639.

Returns:
returns the name of the application in the specified language

Throws:
`LanguageNotAvailableException` - if the name is not available in the language specified or if the parameter passed is null

Since:
MHP1.0

getNames()

```
public java.lang.String[][] getNames()
```

This method returns all the available names for the application together with their ISO 639 language code. If no application names are signalled, an array of length zero shall be returned.

Returns:
the possible names of the application, along with their ISO 639 language code. The first string in each sub-array is the ISO 639 language code. The second string in each sub-array is the corresponding application name.

Since:
MHP1.0

getPriority()

```
public int getPriority()
```

This method returns the priority of the application.

Returns:
the priority of the application.

Since:
MHP1.0

getProfiles()

```
public java.lang.String[] getProfiles()
```

This method returns those minimum profiles required for the application to execute. Profile names shall be encoded using the same encoding specified elsewhere in this specification as input for use with the `java.lang.System.getProperty` method to query if a profile is supported by this platform.

For example, for implementations conforming to the first version of the specification, the translation from AIT signaling values to strings shall be as follows:

- '1' in the signaling will be translated into 'mhp.profile.enhanced_broadcast'
- '2' in the signaling will be translated into 'mhp.profile.interactive_broadcast'

Only profiles supported by this particular MHP terminal shall be returned. Hence the method can return an array of size zero where all the profiles on which an application can execute are unknown.

Returns:
an array of Strings, each String describing a profile.

Since:
MHP1.0

getProperty(String)

```
public java.lang.Object getProperty(java.lang.String index)
```

The following method is included for properties that do not have explicit property accessors. The naming of properties and their return values are described in the main body of the present document.

Parameters:
`index` - a property name

Returns:
either the return value corresponding to the property name or null if the property name is unknown or null

Since:
MHP1.0

---

getServiceLocator()

```
public org.davic.net.Locator getServiceLocator()
```

This method returns the locator of the Service describing the application. For an application transmitted on a remote connection, the returned locator shall be the service for that remote connection. For applications not transmitted on a remote connection, the service returned shall be the currently selected service of the service context within which the application calling the method is running.

Returns:
the locator of the Service describing the application.

Since:
MHP1.0

---

getType()

```
public int getType()
```

This method returns the type of the application (as registered by DVB).

Returns:
the type of the application (as registered by DVB).

Since:
MHP1.0

---

getVersions(String)

```
public int[] getVersions(java.lang.String profile)
             throws IllegalProfileParameterException
```

This method returns an array of integers containing the version number of the specification required to run this application at the specified profile.

Parameters:
`profile` - a profile encoded as defined in the clause “Profile and version properties” in the main body of the present document. e.g. mhp.profile.interactive_broadcast for the interactive broadcast profile.

Returns:
an array of integers, containing the major, minor and micro values (in that order) required for the specified profile.

Throws:
`IllegalProfileParameterException` - thrown if the profile specified is not one of the minimum profiles required for the application to execute or if the parameter passed in is null

Since:
MHP1.0

---

isStartable()

```
public boolean isStartable()
```

This method determines whether the application is startable or not. An Application is not startable if any of the following apply.

- The application is transmitted on a remote connection, and either does not have an application storage descriptor, is not cached, or is not signalled as launchable completely from cache.
- The application is signalled as not_launchable_from_broadcast and is not stored at the time the App-Attributes instance is first returned to an application.
- The caller of the method does not have the Permissions to start it.
- if the application is signalled with a control code which is neither AUTOSTART nor PRESENT.

If none of the above apply, then the application is startable.

The value returned by this method does not depend on whether the application is actually running or not.

Returns:
true if an application is startable, false otherwise.

Since:
MHP1.0

---

isVisible()

```
public boolean isVisible()
```

This method determines whether the application is marked as being visible to users. An inter-operable application shall honour this visibility setting. Thus a generic launching application shall list applications that are marked as visible and shall not list applications that are not marked as visible.

Returns:
`true` if this application is marked as being visible to users, `false` otherwise.

Since:
MHP1.0.3

org.dvb.application
AppIcon

Declaration

```
public class AppIcon

java.lang.Object
  |
  +--org.dvb.application.AppIcon
```

Description

The `AppIcon` encapsulates the information concerning the icon attached to the application

Constructors

AppIcon()

```
protected AppIcon()
```

The constructor for the class. This constructor is intended for implementation convenience and evolution of the specification and not for use by MHP applications. Applications should obtain instances of this class from `AppAttributes.getAppIcon`.

See Also:
`AppAttributes.getAppIcon()`

Methods

---

getIconFlags()

```
public java.util.BitSet getIconFlags()
```

This method returns the flags identifying which icons are provided for the application.

Returns:
the icon flags encoded as a BitSet

Since:
MHP1.0

---

getLocator()

```
public org.davic.net.Locator getLocator()
```

This method returns the location of the directory containing the application icons.

Returns:
the location of the directory containing the application icons.

Since:
MHP1.0

org.dvb.application
AppID

Declaration

```
public class AppID

java.lang.Object
   |
   +--org.dvb.application.AppID
```

Description

The `AppID` is a representation of the unique identifier for applications.

Its string form is the Hex representation of the 48 bit number.

Constructors

AppID(int, int)

```
public AppID(int oid, int aid)
```

Create a new AppID based on the given integers. There is no range checking on these numbers.

Parameters:

`oid` - the globally unique organization number.

`aid` - the unique count within the organization.

Since:

MHP1.0

Methods

---

equals(Object)

```
public boolean equals(java.lang.Object obj)
```

Compares two AppIDs for equality.

Overrides:

`equals` in class `Object`

Parameters:

`obj` - the reference object with which to compare.

Returns:

`true` if this obj is an AppID and its Organisation ID and its Application ID match the IDs for this AppID; `false` otherwise.

---

getAID()

```
public int getAID()
```

This method returns the integer value of the application count supplied in the constructor

Returns:
the integer value of the application count supplied in the constructor

Since:
MHP1.0

---

getOID()

```
public int getOID()
```

This method returns the integer value of the organization number supplied in the constructor.

Returns:
the integer value of the organization number supplied in the constructor.

Since:
MHP1.0

---

hashCode()

```
public int hashCode()
```

Returns a hash code value for this AppID. The hashcode for two AppIDs with the same Organisation ID and Application ID are equal.

Overrides:
`hashCode` in class `Object`

Returns:
a hash code value for this AppID

---

toString()

```
public java.lang.String toString()
```

This method returns a string containing the Hex representation of the 48 bit number. The string shall be formatted as specified in the clause on “Text encoding of application identifiers” in the System Integration clause of the MHP specification.

Overrides:
`toString` in class `Object`

Returns:
a string containing the Hex representation of the 48 bit number.

Since:
MHP1.0

org.dvb.application
AppProxy

Declaration
public interface **AppProxy**

All Known Subinterfaces:
DVBHTMLProxy, DVBJProxy

Description
An AppProxy Object is a proxy to an application. A call to the start, stop or pause will cause the resident Application Manager to respectively start, stop or pause the application bound to this AppProxy object. Each of these three method calls can throw a Security Exception if the calling application is not entitled to do so.

Each of these method calls are asynchronous and will result in exactly one AppStateChangeEvent to be generated whether the method call was successful or not. If the method call was not successful, any call to the hasFailed method of the corresponding AppStateChangeEvent will return true.

Some of the methods here allow the AppProxy to transition through several states before the final state is reached. If this compound state transition is unsuccessful at any point, the resulting AppStateChangeEvent shall have a fromstate which is the last state in this transition which the AppProxy successfully entered and a toState which would have been the next state in the compound state transition.

For instance, if an application were to call start on an AppProxy for a DVB-J application in the NOT_LOADED state and that DVB-J application was to throw a XletStateChangeException from its startXlet method, the getFromState will return PAUSED and getToState will return STARTED. If an application were to call start on an AppProxy for a DVB-J application in the NOT_LOADED state and that DVB-J application was to throw a XletStateChangeException from its initXlet method, the getFromState will return NOT_LOADED and getToState will return PAUSED. Calling the start method for an application which is already running shall fail and generate an AppStateChangeEvent with hasFailed returning true and both fromstate and tostate being STARTED.″

See the definition of AppStateChangeEvent for more information. Having more than one application attempt to control the lifecycle of the same (other) application at the same time is not recommended. The ordering of AppStateChangeEvents if this is done will be implementation dependent.

See Also:
AppStateChangeEvent

Fields

DESTROYED
public static final int **DESTROYED**

The application is in the destroyed state. 1 The application instance is in the destroyed state and remains in this state. An AppProxy for a new instance of this application may be obtained from the AppsDatabase and started.

INVALID
public static final int **INVALID**

The application is not signalled in the currently selected service and hence not listed in the applications database. Once an AppProxy is in this state, all attempts to cause further state transitions on that AppProxy instance shall fail with an AppStateChangeEvent from INVALID to INVALID, even if a service is selected where that application is signalled.

NOT_LOADED

```
public static final int NOT_LOADED
```

The application has not yet been loaded from the network at all.

PAUSED

```
public static final int PAUSED
```

The application is in the paused state.

STARTED

```
public static final int STARTED
```

The application is in the active state.

Methods

---

addAppStateChangeEventListener(AppStateChangeEventListener)

```
public void addAppStateChangeEventListener(org.dvb.application.AppStateChangeEventListener
            listener)
```

Add a listener to the application proxy so that an application can be informed if the application changes state.

Parameters:
`listener` - the listener to be added.

Since:
MHP1.0

---

getState()

```
public int getState()
```

Return the current state of the application.

Returns:
the state of the application.

---

pause()

```
public void pause()
```

Request that the application manager pause the application bound to this information structure.

The `application` will be paused. Calls to this method shall fail if the application is not in the active state. If the application represented by this AppProxy is a DVB-J application, calling this method will,

if successful, result in the `pauseXlet` method being called on the Xlet making up the DVB-J application.

Throws:

`java.lang.SecurityException` - if the application is not entitled to pause this application. Note that if an application is entitled to stop an application, it is also entitled to pause it: having the right to stop an application is logically equivalent to having the right to pause it.

Since:

MHP1.0

---

removeAppStateChangeEventListener(AppStateChangeEventListener)

```
public void
            removeAppStateChangeEventListener(org.dvb.application.AppStateChangeEventListe
            ner listener)
```

Remove a listener on the database.

Parameters:

`listener` - the listener to be removed.

Since:

MHP1.0

---

resume()

```
public void resume()
```

Request that the application manager resume the execution of the application. The `application` will be started. This method will throw a security exception if the application does not have the authority to resume the application. Calls to this method shall fail if the application is not in the paused state.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the `AppStateChangeEvent` will return true. If the application represented by this AppProxy is a DVB-J application, calling this method will, if successful, result in the `startXlet` method being called on the Xlet making up the DVB-J application.

Throws:

`java.lang.SecurityException` - if the application is not entitled to resume this application.

Since:

MHP1.0

---

start()

```
public void start()
```

Request that the application manager start the application bound to this information structure.

The `application` will be started. This method will throw a security exception if the application does not have the authority to start applications. Calls to this method shall only succeed if the application if the application is signalled with a control code which is either AUTOSTART or PRESENT and any one of the following applies:

- if the application (DVB-J or DVB-HTML) is in the not loaded or paused states,
- if a DVB-J application is in the “loaded” state,
- if a DVB-HTML application is in the “loading” state.

If the application was not loaded at the moment of this call, then the application will be started. In the case of a DVB-J application, it will be initialized and then started by the Application Manager, hence

causing the Xlet to go from NotLoaded to Paused and then from Paused to Active. If the application was in the Paused state at the moment of the call and had never been in the Active state, then the application will be started. If the application represented by this AppProxy is a DVB-J application, calling this method will, if successful, result in the `startXlet` method being called on the Xlet making up the DVB-J application.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the `AppStateChangeEvent` will return true.

Throws:
`java.lang.SecurityException` - if the application is not entitled to start this application.

Since:
MHP1.0

---

start(String[])

```
public void start(java.lang.String[] args)
```

Request that the application manager start the application bound to this information structure passing to that application the specified parameters.

The `application` will be started. This method will throw a security exception if the application does not have the authority to start applications. Calls to this method shall only succeed if the application if the application is signalled with a control code which is either AUTOSTART or PRESENT and any one of the following applies:

- if the application (DVB-J or DVB-HTML) is in the not loaded or paused states,
- if a DVB-J application is in the "loaded" state,
- if a DVB-HTML application is in the "loading" state.

If the application was not loaded at the moment of this call, then the application will be started. In the case of a DVB-J application, it will be initialized and then started by the Application Manager, hence causing the Xlet to go from NotLoaded to Paused and then from Paused to Active. If the application was in the Paused state at the moment of the call and had never been in the Active state, then the application will be started. If the application represented by this AppProxy is a DVB-J application, calling this method will, if successful, result in the `startXlet` method being called on the Xlet making up the DVB-J application.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the `AppStateChangeEvent` will return true. If this AppProxy is a DVBJProxy and if init(String[]) has previously been called for this application instance, then the parameters are not passed into the application but are silently discarded. Those passed into init take precedence.

Parameters:
`args` - the parameters to be passed into the application being started

Throws:
`java.lang.SecurityException` - if the application is not entitled to start this application.

Since:
MHP1.0.1

---

stop(boolean)

```
public void stop(boolean forced)
```

Request that the application manager stop the application bound to this information structure.

The `application` will be stopped. A call to this method shall fail if the application was already in the destroyed state. This method call will stop the application if it was in any other state before the call. If the application is in the NOT_LOADED state then it shall move directly to the DESTROYED

state with no other action being taken. If the application represented by this AppProxy is a DVB-J application and is not in the DESTROYED state then calling this method will, if successful, result in the `destroyXlet` method being called on the Xlet making up the DVB-J application with the same value for the parameter as passed to this method.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the `AppStateChangeEvent` will return true.

Parameters:

`forced` - if true then do not ask the application but forcibly terminate it, if false give the application an opportunity to refuse.

Throws:

`java.lang.SecurityException` - if the application is not entitled to stop this application.

Since:

MHP1.0

org.dvb.application
AppsControlPermission

Declaration

```
public final class AppsControlPermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.application.AppsControlPermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class represents a Permission to control the lifecycle of another application.

Constructors

AppsControlPermission()

```
public AppsControlPermission()
```

Creates a new AppsControlPermission. There is a simple mapping between the Application control Permission requests and the way the AppsControlPermission are granted. This mapping is defined in the main body of the present document.

AppsControlPermission(String, String)

```
public AppsControlPermission(java.lang.String name, java.lang.String actions)
```

Creates a new AppsControlPermission. There is a simple mapping between the Application control Permission requests and the way the AppsControlPermission are granted. This mapping is defined in the main body of the present document. The actions string is currently unused and should be null. The name string is currently unused and should be empty. This constructor exists for use by the java.security.Policy object to instantiate new permission objects.

Parameters:

`name` - the name of the permission

`actions` - the actions string

Methods

---

equals(Object)

```
public boolean equals(java.lang.Object obj)
```

Checks for equality against this AppsControlPermission object.

Overrides:
`equals` in class `BasicPermission`

Parameters:
`obj` - the object to test for equality with this AppsControlPermission object.

Returns:
true if and only if obj is an AppsControlPermission

---

getActions()

`public java.lang.String getActions()`

Returns the list of actions that had been passed to the constructor - it shall return null.

Overrides:
`getActions` in class `BasicPermission`

Returns:
a null String.

---

hashCode()

`public int hashCode()`

Returns the hash code value for this object.

Overrides:
`hashCode` in class `BasicPermission`

Returns:
the hash code value for this object.

---

implies(Permission)

`public boolean implies(java.security.Permission permission)`

Checks if this AppsControlPermission object “implies” the specified permission.

Overrides:
`implies` in class `BasicPermission`

Parameters:
`permission` - the specified permission to check.

Returns:
true if and only if the specified permission is an instanceof AppsControlPermission

org.dvb.application
AppsDatabase

Declaration

```
public class AppsDatabase

java.lang.Object
  |
  +--org.dvb.application.AppsDatabase
```

Description

The AppsDatabase is an abstract view of the currently available applications. The entries will be provided by the application manager, and gleaned from the AIT signaling. When the service context in which an application is running undergoes service selection, instances of AppsDatabase used by that application shall be updated from the new service before an AppsDatabaseEvent is sent to the newDatabase method of any registered AppsDatabaseEventListeners. For applications fully signalled in the current service (i.e. excluding externally authorised ones), the attributes entries shall be the ones from the signalling of the current service even if the application was originally launched from another service and then survived service selection. For running externally authorised applications, the entries will be those from the last service in which they ran fully signalled.

Externally authorized applications shall not appear unless an instance of that application is actually running.

A generic launcher may be written which uses the database to display information in AppAttributes and uses an AppProxy to launch it

Methods on classes in this package do not block, they return the information the system currently has. Therefore applications should be aware that data may be stale, to within one refresh period of the AIT.

e.g.:

```
AppsDatabase theDatabase = AppsDatabase.getAppsDatabase();
if (theDatabase != null ) {
    CurrentServiceFilter filter = new CurrentServiceFilter();
    Enumeration attributes = theDatabase.getAppAttributes(filter)
    if(attributes != null) {
       while(attributes.hasMoreElements()) {
           AppAttributes info ;
           AppProxy proxy ;

           info = (AppAttributes)attributes.nextElement();
           proxy = (AppProxy)theDatabase.getAppProxy(info.getIdentifier());
           AppIcon icon = info.getAppIcon();
           // blah blah..
           // lets start it.
           proxy.start();
       }
    }
}
```

Where methods on this class as specified as working on “available” applications or “currently available” applications the following definition shall apply. An application is “currently available” if and only if one of the following applies in the service context within which the application calling the method is executing and the visibility of the application is not ’00’..

- it is signalled as being present or autostart in the currently selected service of that service context and could be started.
- it is signalled as being present or autostart in the currently selected service of that service context, it could be started if it was stored or cached on the terminal, it is signalled such that it could be stored or cached, and the MHP terminal supports application storage (i.e. the mhp.stored.services property is “SUPPORTED”). (Note this is **not** affected by whether or not the MHP terminal has sufficient storage space to store the application in question).

- it is currently running in that service context.

In addition to the methods listed below, all calls made using an AppsDatabaseFilter shall only use that filter to test "currently available" applications as defined here.

Applications whose information (e.g. signaling) is invalid (e.g. one or more mandatory descriptors are missing or incorrect) may not be listed in the AppsDatabase. Where applications are signalled in a broadcast AIT and the MHP terminal tunes away from the service on which the AIT is carried, but without selecting a new service, the `AppsDatabase` shall retain the entries as signalled in that AIT until a new service is selected.

Constructors

AppsDatabase()

`protected AppsDatabase()`

This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

addListener(AppsDatabaseEventListener)

`public void addListener(org.dvb.application.AppsDatabaseEventListener listener)`

Add a listener to the database so that an application can be informed if the database changes.

Parameters:
`listener` - the listener to be added.

Since:
MHP1.0

---

getAppAttributes(AppID)

`public org.dvb.application.AppAttributes getAppAttributes(org.dvb.application.AppID key)`

Returns the properties associated with the given ID. Returns null if no such application is available.

Only one AppAttributes object shall be returned in the case where there are several applications having the same (organisationId, applicationId) pair. In such a case, the same algorithm as would be used to autostart such applications shall be used to decide between the available choices by the implementation.

This method shall return instances which reflect the contents of the database at the time the method is called. After an AppsDatabaseEvent has been generated, new instances may be returned. After a service selection has taken place, applications which survived the service selection may call this method in order to discover the attributes of the applications signalled on the new service.

Parameters:
`key` - an application ID.

Returns:
the value to which the key is mapped in this dictionary if AppId corresponds to an application which is either a currently available application or remote application or both. Null otherwise.

Since:
MHP1.0

---

getAppAttributes(AppsDatabaseFilter)

```
public java.util.Enumeration getAppAttributes(org.dvb.application.AppsDatabaseFilter
            filter)
```

Returns an enumeration of AppAttributes of the applications available. The Enumeration will contain the set of AppAttributes that satisfy the filtering criteria. For implementations conforming to this version of the specification, only `CurrentServiceFilter` or `RunningApplicationsFilter` filters may return a non empty Enumeration. If the filter object is not an instance of `CurrentServiceFilter` or `RunningApplicationsFilter` or a subclass of either then, the method shall return an empty Enumeration.

This method shall return instances which reflect the contents of the database at the time the method is called. After an AppsDatabaseEvent has been generated, new instances may be returned. After a service selection has taken place, applications which survived the service selection may call this method in order to discover the attributes of the applications signalled on the new service.

This method will return an empty Enumeration if there are no attributes.

Parameters:
`filter` - the filter to apply

Returns:
an enumeration of the applications attributes.

Since:
MHP1.0

---

getAppIDs(AppsDatabaseFilter)

```
public java.util.Enumeration getAppIDs(org.dvb.application.AppsDatabaseFilter filter)
```

Returns an enumeration of the application IDs available. The Enumeration will contain the set of AppID that match the filtering criteria. For implementations conforming to this version of the specification, only `CurrentServiceFilter` or `RunningApplicationsFilter` filters may return a non empty Enumeration. If the filter object is not an instance of `CurrentServiceFilter` or `RunningApplicationsFilter` or one of their subclasses then, the method shall return an empty Enumeration.

This method shall return instances which reflect the contents of the database at the time the method is called. After an AppsDatabaseEvent has been generated, new instances may be returned. After a service selection has taken place, applications which survived the service selection may call this method in order to discover the identities of the applications signalled on the new service.

This method will return an empty Enumeration if there are no matching applications.

Parameters:
`filter` - the filter to apply

Returns:
the applications available matching the filtering criteria

Since:
MHP1.0

---

getAppProxy(AppID)

```
public org.dvb.application.AppProxy getAppProxy(org.dvb.application.AppID key)
```

Returns the ApplicationProxy associated with the given ID. Returns null if no such application available.

Only one AppProxy object shall be returned in the case where there are several applications having the same (organisationId, applicationId) pair. In such a case, the same algorithm as would be used to autostart such applications shall be used to decide between the available choices by the implementation.

If an application has an application instance in the destroyed state then a proxy for that appplication instance shall not be retrieved. Instead, what shall be retrieved is a proxy for another application instance which shall be in the not loaded state unless that application instance has already been started.

Parameters:
`key` - an application ID

Returns:
the AppProxy associated with the key parameter or null if the key is not an application ID, or not mapped to any application available.

Throws:
`java.lang.SecurityException` - shall not be thrown for AppIDs which are returned by getAppIDs(CurrentServiceFilter) or getAppIDs(RunningApplicationsFilter)

Since:
MHP1.0

---

getAppsDatabase()

```
public static org.dvb.application.AppsDatabase getAppsDatabase()
```

Returns the singleton AppsDatabase object. The AppsDatabase is either a singleton for each MHP application or a singleton for the MHP terminal.

Returns:
the singleton AppsDatabase object.

Since:
MHP1.0

---

removeListener(AppsDatabaseEventListener)

```
public void removeListener(org.dvb.application.AppsDatabaseEventListener listener)
```

remove a listener on the database.

Parameters:
`listener` - the listener to be removed.

Since:
MHP1.0

---

size()

```
public int size()
```

Returns the number of applications currently available.

Returns:
the number of applications currently available.

Since:
MHP1.0

org.dvb.application
AppsDatabaseEvent

Declaration

```
public class AppsDatabaseEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.application.AppsDatabaseEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

The AppsDatabaseEvent class indicates either an entry in the application database has changed, or so many changes have occurred. that the database should be considered totally new. An event with event_id NEW_DATABASE shall always be sent after switching to a new service. After such an event, the contents of the database (both the set of applications and their attributes) shall reflect the new database contents. All former contents of the database shall be discarded except for running externally authorised applications. It is platform dependant if and when a new database event is thrown while tuned to the same service except that a NEW_DATABASE event shall not be sent when only one application has changed within a service.

The APP_ADDED, APP_CHANGED and APP_DELETED events shall not be generated in response to the same database change as caused a NEW_DATABASE event to be generated.

Since:

MHP1.0

Fields

APP_ADDED

```
public static final int APP_ADDED
```

The addition event id. The APP_ADDED event is generated whenever an entry is added to the AppsDatabase. It is NOT generated when the entry already in the AppsDatabase changes.

APP_CHANGED

```
public static final int APP_CHANGED
```

The changed event id. The APP_CHANGED event is generated whenever any of the information about an application changes. It is NOT generated when the entry is added to or removed from the AppsDatabase. In such cases, the APP_ADDED or APP_DELETED events will be generated instead.

APP_DELETED

```
public static final int APP_DELETED
```

The deletion event id. The APP_DELETED event is generated whenever an entry is removed from the AppsDatabase.

NEW_DATABASE

```
public static final int NEW_DATABASE
```

The new database event id.

Constructors

AppsDatabaseEvent(int, AppID, Object)

```
public AppsDatabaseEvent(int id, org.dvb.application.AppID appid, java.lang.Object source)
```

Create a new AppsDatabaseEvent object for the entry in the database that changed, or for a new database.

Parameters:

`id` - the cause of the event

`appid` - the AppId of the entry that changed

`source` - the AppaDatabase object.

Since:

MHP1.0

Methods

---

getAppID()

```
public org.dvb.application.AppID getAppID()
```

gets the application ID object for the entry in the database that changed.

When the event type is NEW_DATABASE, AppID will be null.

Returns:

application ID representing the application

Since:

MHP1.0

---

getEventId()

```
public int getEventId()
```

gets the type of the event.

Returns:

an integer that matches one of the static fields describing events.

Since:

MHP1.0

org.dvb.application
AppsDatabaseEventListener

Declaration
```
public interface AppsDatabaseEventListener extends java.util.EventListener
```

All Superinterfaces:
`java.util.EventListener`

Description
The `AppsDatabaseListener` class allows an application to monitor the application database so that it can keep an up to date interface without polling the state. The application shall receive these events in a timely fashion after the AIT changes, however it is system dependant how often the AIT table is checked.

Since:
MHP1.0

Methods

---

entryAdded(AppsDatabaseEvent)

```
public void entryAdded(org.dvb.application.AppsDatabaseEvent evt)
```

The AppsDataBase has had an application entry added.

Parameters:
`evt` - the AppsDatabaseEvent.

Since:
MHP1.0

---

entryChanged(AppsDatabaseEvent)

```
public void entryChanged(org.dvb.application.AppsDatabaseEvent evt)
```

The AppsDataBase has had an application entry changed.

Parameters:
`evt` - the AppsDatabaseEvent.

Since:
MHP1.0

---

entryRemoved(AppsDatabaseEvent)

```
public void entryRemoved(org.dvb.application.AppsDatabaseEvent evt)
```

The AppsDataBase has had an application entry removed.

Parameters:
`evt` - the AppsDatabaseEvent.

Since:
MHP1.0

---

newDatabase(AppsDatabaseEvent)

```
public void newDatabase(org.dvb.application.AppsDatabaseEvent evt)
```

The AppsDataBase has radically changed.

Parameters:
`evt` - the AppsDatabaseEvent.

Since:
MHP1.0

org.dvb.application
AppsDatabaseFilter

Declaration

```
public abstract class AppsDatabaseFilter

java.lang.Object
  |
  +--org.dvb.application.AppsDatabaseFilter
```

Direct Known Subclasses:

CurrentServiceFilter, RunningApplicationsFilter

Description

Abstract class for the filters. Instances of concrete classes that extend `AppsDatabaseFilter` are passed to the AppsDatabase.getAppAttributes and AppsDatabase.getAppIDs methods to allow an applications to set a filter on the list of applications (respectively AppAttributes and AppIDs) that it wants to retrieve from the AppDatabase.

Since:

MHP 1.0

Constructors

AppsDatabaseFilter()

```
public AppsDatabaseFilter()
```

Construct an AppsDatabaseFilter object.

Methods

---

accept(AppID)

```
public abstract boolean accept(org.dvb.application.AppID appid)
```

Test if a specified appid should be included in the Enumeration.

Parameters:

`appid` - the specified appid to test.

Returns:

true if the application with identifier appid should be listed, false otherwise.

Since:

MHP1.0

org.dvb.application
AppStateChangeEvent

Declaration

```
public class AppStateChangeEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.application.AppStateChangeEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

The AppStateChangeEvent class indicates a state transition of the application. These events are only generated for running applications or for non-running applications where an attempt to control the application fails. If the state transition was requested by an application through this API, the method hasFailed indicates whether the state change failed or not. Where a state change succeeds, fromState and toState shall indicate the original and destination state of the transition. If it failed, fromState shall return the state the application was in before the state transition was requested and the toState method shall return the state the application would have been in if the state transition had succeeded.

Attempting to start an application which is already in the active state shall fail and generate an AppStateChangeEvent with hasFailed returning true and both fromstate and tostate being STARTED.

Since:

MHP1.0

Constructors

AppStateChangeEvent(AppID, int, int, Object, boolean)

```
public AppStateChangeEvent(org.dvb.application.AppID appid, int fromstate, int tostate,
            java.lang.Object source, boolean hasFailed)
```

Create an AppStateChangeEvent object.

Parameters:

appid - a registry entry representing the tracked application

fromstate - the state the application was in before the state transition was requested, where the value of fromState is one of the state values defined in the AppProxy interface or in the interfaces inheriting from it

tostate - state the application would be in if the state transition succeeds, where the value of toState is one of the state values defined in the AppProxy interface or in the interfaces inheriting from it

hasFailed - an indication of whether the transition failed (true) or succeeded (false)

source - the AppProxy where the state transition happened

Methods

---

getAppID()

```
public org.dvb.application.AppID getAppID()
```

The application the listener was tracking has made a state transition from `fromState` to `toState`.

Returns:
a registry entry representing the tracked application

Since:
MHP1.0

---

getFromState()

```
public int getFromState()
```

The application the listener is tracking was in`fromState`, where the value of fromState is one of the state values defined in the AppProxy interface or in the interfaces inheriting from it.

Returns:
the old state

Since:
MHP1.0

---

getToState()

```
public int getToState()
```

If the `hasFailed` method returns false, then the application the listener is tracking is now in `toState`. If the `hasFailed` method returns true, then the `toState` is the state where the state transition was attempted to but the transition failed. The value of `toState` is one of the state values defined in the `AppProxy` interface or in the interfaces inheriting from it.

Returns:
the intended or actual new state

Since:
MHP1.0

---

hasFailed()

```
public boolean hasFailed()
```

This method determines whether an attempt to change the state of an application has failed.

Returns:
true if the attempt to change the state of the application failed, false otherwise

Since:
MHP1.0

org.dvb.application
AppStateChangeEventListener

Declaration

```
public interface AppStateChangeEventListener extends java.util.EventListener
```

All Superinterfaces:

`java.util.EventListener`

Description

The `AppStateChangeEventListener` class allows a launcher application to keep track of applications it launches or other applications running as part of the same service.

Since:

MHP1.0

Methods

---

stateChange(AppStateChangeEvent)

```
public void stateChange(org.dvb.application.AppStateChangeEvent evt)
```

The application the listener was tracking has made a state transition from `fromState` to `toState` and this method will be given the state event.

Parameters:

`evt` - the AppStateChangeEvent.

Since:

MHP1.0

org.dvb.application
CurrentServiceFilter

Declaration

```
public class CurrentServiceFilter extends AppsDatabaseFilter

java.lang.Object
  |
  +--org.dvb.application.AppsDatabaseFilter
        |
        +--org.dvb.application.CurrentServiceFilter
```

Description

Instances of `CurrentServiceFilter` are used to set a filter on the list of applications that are retrieved from the AppsDatabase (See methods getAppsAttributes and getAppsIDs).

A `CurrentServiceFilter` is used to indicate that only applications that signalled as part of the current service shall be returned by the getAppsAttributes and getAppIDs methods of AppsDatabase. Externally authorized applications in the AIT are not considered to be signalled as part of the current service for this filter. Subclasses of CurrentServiceFilter can override the accept method so as to implement their own filter criteria on the AppIDs values.

Since:

MHP 1.0

Constructors

CurrentServiceFilter()

```
public CurrentServiceFilter()
```

public Constructor of the CurrentServiceFilter

Methods

---

accept(AppID)

```
public boolean accept(org.dvb.application.AppID appid)
```

Test if a specified appid should be included in the Enumeration.

Overrides:

`accept` in class `AppsDatabaseFilter`

Parameters:

`appid` - the specified appid to test.

Returns:

true if the application with identifier appid should be listed, false otherwise.

Since:

MHP1.0

org.dvb.application
DVBHTMLProxy

Declaration
```
public interface DVBHTMLProxy extends AppProxy
```

All Superinterfaces:
AppProxy

Description
A DVBHTMLProxy Object is a proxy to a DVBHTML application.

Fields

KILLED
```
public static final int KILLED
```
The application is in the killed state.

Since:
MHP 1.0.2

LOADING
```
public static final int LOADING
```
The application is in the loading state.

Since:
MHP 1.0.2

Methods

prefetch()
```
public void prefetch()
```
Loads the initial entry page of the application and waits for a signal. This method mimics the PREFETCH control code and is intended to be called instead of and not as well as start. Calling prefetch on a started application will have no effect.

Throws:
java.lang.SecurityException - if the calling application does not have permission to start applications

Since:
MHP1.0

---

startTrigger(Date)

```
public void startTrigger(java.util.Date starttime)
```

Sends the application a start trigger at the specified time.

Parameters:

`starttime` - the specified time to send a start trigger to the application. If the time has already passed the application manager shall send the trigger immediately. Dates pre-epoch shall always cause the application manager to send the trigger immediately.

Throws:

`java.lang.SecurityException` - if the calling application does not have permission to start applications

Since:

MHP1.0

---

trigger(Date, Object)

```
public void trigger(java.util.Date time, java.lang.Object triggerPayload)
```

Sends the application a trigger with the given payload at the specified time.

Parameters:

`time` - the specified time to send a start trigger to the application. If the time has already passed the application manager should send the trigger immediately. Dates pre-epoch shall always cause the application manager to send a 'now' trigger.

`triggerPayload` - the specified payload to deliver with the trigger. The payload is specified as object, but this will be refined once DVB-HTML Triggers are properly defined.

Throws:

`java.lang.SecurityException` - if the calling application does not have permission to start applications

Since:

MHP1.0

org.dvb.application
DVBJProxy

Declaration
```
public interface DVBJProxy extends AppProxy
```

All Superinterfaces:
AppProxy

Description
A DVBJProxy Object is a proxy to a DVBJ application.

Fields

LOADED

```
public static final int LOADED
```

The application is in the loaded state.

Methods

---

init()

```
public void init()
```

Requests the application manager calls the initXlet method on the application.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the AppStateChangeEvent will return true. Calls to this method shall only succeed if the application is in the NOT_LOADED or LOADED states. If the application is in the NOT_LOADED state, the application will move through the LOADED state into the PAUSED state before calls to this method complete.

In all cases, an AppStateChangeEvent will be sent, whether the call was successful or not.

Throws:
java.lang.SecurityException - if the application is not entitled to load this application. Being able to init an application requires to be entitled to start it.

Since:
MHP1.0

---

init(String[])

```
public void init(java.lang.String[] args)
```

Requests the application manager calls the initXlet method on the application passing to that application the specified parameters.

This method is asynchronous and its completion will be notified by an AppStateChangeEvent. In case of failure, the hasFailed method of the `AppStateChangeEvent` will return true. Calls to this method shall only succeed if the application is in the NOT_LOADED or LOADED states. If the application is in the NOT_LOADED state, the application will move through the LOADED state into the PAUSED state before calls to this method complete.

In all cases, an AppStateChangeEvent will be sent, whether the call was successful or not.

Parameters:

`args` - the parameters to be passed into the application being started

Throws:

`java.lang.SecurityException` - if the application is not entitled to load this application. Being able to init an application requires to be entitled to start it.

Since:

MHP1.1.2

---

load()

```
public void load()
```

Provides a hint to preload at least the initial class of the application into local storage, resources permitting. This does not require loading of classes into the virtual machine or creation of a new logical virtual machine which are implications of the `init` method.

This method is asynchronous and its completion will be notified by an `AppStateChangeEvent`. In case of failure, the `hasFailed` method of the `AppStateChangeEvent` will return true. Calls to this method shall only succeed if the application is in the NOT_LOADED state. In all cases, an AppStateChangeEvent will be sent, whether the call was successful or not.

Throws:

`java.lang.SecurityException` - if the application is not entitled to load this application. Being able to load an application requires to be entitled to start it.

Since:

MHP1.0

org.dvb.application
IllegalProfileParameterException

Declaration

```
public class IllegalProfileParameterException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.IllegalProfileParameterException
```

All Implemented Interfaces:

java.io.Serializable

Description

The IllegalProfileParameter exception is thrown if the application attempts to ask for a version number for a profile not specified for the application.

Since:

MHP1.0

Constructors

IllegalProfileParameterException()

```
public IllegalProfileParameterException()
```

Construct a IllegalProfileParameterException with no detail message

---

IllegalProfileParameterException(String)

```
public IllegalProfileParameterException(java.lang.String s)
```

Construct a IllegalProfileParameterException with a detail message

Parameters:

s - detail message

org.dvb.application
LanguageNotAvailableException

Declaration

```
public class LanguageNotAvailableException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.LanguageNotAvailableException
```

All Implemented Interfaces:

java.io.Serializable

Description

The LanguageNotAvailableException exception is thrown if the application asks for the name of an application in a language not signalled in the AIT.

Since:

MHP1.0

Constructors

LanguageNotAvailableException()

```
public LanguageNotAvailableException()
```

Construct a LanguageNotAvailableException with no detail message

---

LanguageNotAvailableException(String)

```
public LanguageNotAvailableException(java.lang.String s)
```

Construct a LanguageNotAvailableException with a detail message

Parameters:

s - detail message

org.dvb.application
RunningApplicationsFilter

Declaration

```
public class RunningApplicationsFilter extends AppsDatabaseFilter

java.lang.Object
  |
  +--org.dvb.application.AppsDatabaseFilter
        |
        +--org.dvb.application.RunningApplicationsFilter
```

Description

Instances of `RunningApplicationsFilter` are used to set a filter on the list of applications that are retrieved from the AppsDatabase (See methods getAppsAttributes and getAppsIDs).

A `RunningApplicationsFilter` is used to indicate that only applications that are running as part of the current service shall be returned by the getAppsAttributes and getAppIDs methods of AppsDatabase. Externally authorized applications in the AIT shall be returned if they are currently running in the same service context as the caller. Running applications whose visibility is '00' shall not be returned. Subclasses of RunningApplicationsFilter can override the accept method so as to implement their own filter criteria on the AppIDs values.

Since:

MHP 1.0

Constructors

RunningApplicationsFilter()

```
public RunningApplicationsFilter()
```

public Constructor of the RunningApplicationsFilter

Methods

---

accept(AppID)

```
public boolean accept(org.dvb.application.AppID appid)
```

Test if a specified appid should be included in the Enumeration.

Overrides:

`accept` in class `AppsDatabaseFilter`

Parameters:

`appid` - the specified appid to test.

Returns:

true if the application with identifier appid should be listed, false otherwise.

Since:

MHP1.0

Annex T (normative): Permissions

Package
org.dvb.net.ca

Description
Provides extensions to the conditional access API from DAVIC.

Class Summary	
Classes	
CAPermission	This class is for CA permissions.

org.dvb.net.ca
CAPermission

Declaration

```
public class CAPermission extends java.security.BasicPermission

java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.net.ca.CAPermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for CA permissions. A CAPermission contains a name, but no actions list.

A CAPermission contains a range of CA system ids and a specific permission for that range of CA system ids. Instead of a range of CA system ids, the CAPermission can also refer to a single CA system id.

The name has the following syntax:

CASystemIdRange ":" Permission

where CASystemIdRange = CASystemId ["-" CASystemId] | "*"
and Permission = "MMI" | "buy" | "entitlementInfo" | "messagePassing" | "*"

Examples:

- 0x1200-0x120A:buy (The permission to buy entitlement for all the CA systems with ids between 0x1200 and 0x120A inclusive.)
- 0x1201:entitlementInfo (The permission to get entitlement information for the CA system with id 0x1201)
- 0x120d:* (This wildcard expresses all the permissions for the CA system with id 0x120d).

Note: The CASystemId is expressed as a hexadecimal value.

The permission "MMI" corresponds with the SecurityException on CAModuleManager.addMMIListener(). The permission "buy" corresponds with the SecurityException on CAModule.buyEntitlement(). The permission "entitlementInfo" corresponds with the SecurityException on CAModule.queryEntitlement() and CAModule.listEntitlements(). The permission "messagePassing" corresponds with CAModule.openMessageSession(MessageListener)

Constructors

CAPermission(String)

```
public CAPermission(java.lang.String name)
```

Creates a new CAPermission with the specified name. The name is the symbolic name of the CAPermission.

Parameters:

`name` - the name of the CAPermission

CAPermission(String, String)

```
public CAPermission(java.lang.String name, java.lang.String actions)
```

Creates a new CAPermission object with the specified name. The name is the symbolic name of the CAPermission, and the actions String is unused and should be null. This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:

`name` - the name of the CAPermission

`actions` - should be null.

Methods

implies(Permission)

```
public boolean implies(java.security.Permission p)
```

Checks if the specified permission is “implied” by this object.

Overrides:

`implies` in class `BasicPermission`

Parameters:

`p` - the permission to check against.

Returns:

true if the passed permission is equal to or implied by this permission, false otherwise.

Package
org.dvb.net.tuning

Description
Provides extensions to the tuning API from DAVIC.

Class Summary	
Classes	
DvbNetworkInterface-SIUtil	Each SI database is associated with a network interface and vice versa.
TunerPermission	This class is for tuner permissions.

org.dvb.net.tuning
DvbNetworkInterfaceSIUtil

Declaration

```
public class DvbNetworkInterfaceSIUtil

java.lang.Object
  |
  +--org.dvb.net.tuning.DvbNetworkInterfaceSIUtil
```

Description

Each SI database is associated with a network interface and vice versa. This class allows the application to query this association.

Since:

MHP 1.0.1

Methods

---

getNetworkInterface(SIDatabase)

```
public static org.davic.net.tuning.NetworkInterface
            getNetworkInterface(org.dvb.si.SIDatabase sd)
```

Gets the network interface for a particular SI database.

Parameters:

`sd` - the SI database for which the associated network interface will be returned.

Returns:

the associated network interface

---

getSIDatabase(NetworkInterface)

```
public static org.dvb.si.SIDatabase getSIDatabase(org.davic.net.tuning.NetworkInterface ni)
```

Gets the SI database for a particular network interface.

Parameters:

`ni` - the network interface for which the associated SI database will be returned.

Returns:

the associated SI database

org.dvb.net.tuning
TunerPermission

Declaration

```
public class TunerPermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.net.tuning.TunerPermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for tuner permissions. The name and actions list of a TunerPermission contains no name and no actions list. The return value of the inherited getName() method is implementation dependent. If an application has the tuner permission, then it shall not receive a `SecurityException` from those methods in that API defined to throw one. Without such a permission, it shall receive such an exception.

Constructors

TunerPermission(String)

```
public TunerPermission(java.lang.String name)
```

Creates a new TunerPermission. The name string is currently unused and should be empty.

Parameters:

`name` - the name of the TunerPermission.

TunerPermission(String, String)

```
public TunerPermission(java.lang.String name, java.lang.String actions)
```

Creates a new TunerPermission. The name string is currently unused and should be empty. The actions string is currently unused and should be null. This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:

`name` - the name of the TunerPermission.

`actions` - the actions list

Methods

---

implies(Permission)

```
public boolean implies(java.security.Permission p)
```

Checks if the specified permission is “implied” by this object.

Since name and actions are not used, the only check needed is whether p is also a TunerPermission.

Overrides:
`implies` in class `BasicPermission`

Parameters:
`p` - the permission to check against.

Returns:
true if the passed permission is equal to or implied by this permission, false otherwise.

Annex U (normative): Extended graphics APIs

Package org.dvb.ui

Description

Provides extended graphics functionality.

Class Summary

Interfaces

TestOpacity	Interface implemented by Components or Containers in order to allow the platform to query whether their paint method is fully opaque.
TextOverflowListener	The TextOverflowListener is an interface that an application may implement and register in the DVBTextLayoutManager.

Classes

BufferedAnimation	A `BufferedAnimation` is an AWT component that maintains a queue of one or more image buffers.
DVBAlphaComposite	This `DVBAlphaComposite` class implements the basic alpha compositing rules for combining source and destination pixels to achieve blending and transparency effects with graphics, images and video.
DVBBufferedImage	The `DVBBufferedImage` subclass describes an `java.awt.Image` with an accessible buffer of image data.
DVBColor	A Color class which adds the notion of alpha.
DVBGraphics	The `DVBGraphics` class is a adapter class to support alpha compositing in an MHP device.
DVBTextLayoutManager	The DVBTextLayoutManager provides a text rendering layout mechanism for the org.havi.ui.HStaticText org.havi.ui.HText and org.havi.ui.HTextButton classes.
FontFactory	Provides a mechanism for applications to instantiate fonts that are not built into the system.

Exceptions

DVBRasterFormatException	This exception is thrown for some invalid operations on instances of `DVBBufferedImage`.
FontFormatException	Thrown when attempt is made to read a file describing a font when the contents of that file are not valid.
FontNotAvailableException	Thrown when attempt is made to instantiate a font that cannot be located.
UnsupportedDrawingOperationException	The `UnsupportedDrawingOperationException` class represents an exception that is thrown if an drawing operation is not supported on this platform.

org.dvb.ui
BufferedAnimation

Declaration

```
public class BufferedAnimation extends java.awt.Component

java.lang.Object
  |
  +--java.awt.Component
        |
        +--org.dvb.ui.BufferedAnimation
```

All Implemented Interfaces:

`java.awt.image.ImageObserver`, `java.io.Serializable`

Description

A `BufferedAnimation` is an AWT component that maintains a queue of one or more image buffers. This permits efficient flicker-free animation by allowing a caller to draw to an off-screen buffer, which the system then copies to the framebuffer in coordination with the video output subsystem. This class also allows an application to request a series of buffers, so that it can get a small number of frames ahead in an animation. This allows an application to be robust in the presence of short delays, e.g. from garbage collection. A relatively small number of buffers is recommended, perhaps three or four. A BufferedAnimation with one buffer provides little or no protection from pauses, but does provide double-buffered animation.

This class can be used for frame-synchronous animation. When animation is in progress, it maintains a count of the frame number in the underlying video output device. This frame number increases monotonically by one for each video frame output. It is not influenced by trick play of any video that might be playing on the same screen. However, the framerate of the `BufferedAnimation` may be determined by the framerate of such video; see `setFramerate(float)` and `getFramerate()` for details.

The implementation shall prevent tearing artifacts whenever possible. The maximum size and animation rate that can be achieved without tearing artifacts may be specified by the system model of a specification that includes this class. If it is necessary to avoid a tearing artifact, an implementation shall delay the copying of an internal buffer to the frame buffer by up to one frame.

The size of this component is set using the normal AWT mechanisms. When the method `setBuffers(Dimension, int, boolean, boolean)` is called, initialization is performed. At this time, the size of the graphics buffers is set.

When one of this component's buffers is copied to the frame buffer, it is done without regard to any AWT components which may overlap with this component. This is like the behavior when an application draws directly to the screen using a graphics object obtained with `java.awt.Component.getGraphics()`.

When the system copies a buffer to the frame buffer for a given frame *f*, it shall select the valid buffer associated with the highest-numbered frame *fb* such that *fb* <= *f*. A buffer is valid if `startFrame(int)` has been called for that buffer, `finishFrame(int)` has been called, and the given buffer has not been re-used for a subsequent frame as a result of another call to `startFrame(int)`.

The animation task proceeds at a high relative CPU priority, and can be considered to execute at a priority greater than Java's `Thread.NORM_PRIORITY`. However, when no new image buffer is ready, the system task must always block until one is. Drawing into the buffer is done within a Java thread, which is subject to the normal scheduling guarantees. In this way, a CPU-bound caller can avoid starving more important activities, such as responding to remote control input. CPU-bound applications may wish to invoke `Thread.yield()` after each frame, however, particularly if the application's animation thread is at the same priority level as other application threads.

A component that is not visible and is in the started state will run, but it will not display any buffers to the screen. It will block in the call to `startFrame()` until the component becomes visible, or until it is too late to draw the

requested frame, whichever comes first. Once it is too late, it will, of course, return -1, thus ensuring that the caller doesn't waste time drawing to an internal graphics buffer that wouldnt' be displayed.

For the behavior when this component is destroyed, see `removeNotify()`.

Sample usage:

```
BufferedAnimation anim = new BufferedAnimation();
 ... put anim in a component hierarchy
Dimension d = new Dimension(...);
int numBuffers = 4;
for (;;) {
    try {
        anim.setBuffers(d, 4, false, true);
        break;
    } catch (OutOfMemoryError err) {
        ... try smaller buffers, or fewer of them
    }
 }
 ... set framerate, if needed
 ... Make anim visible
Graphics2D[] bufs = anim.getBuffersGraphics();
anim.startAnimation();
//  Animate 1000 frames...
try {
    for (int f = 0; f < 1000; f++) {
        int n;
        try {
             n = anim.startFrame(f); // blocks until a buffer is free
        } catch (InterruptedException ex) {
             // someone else called stopAnimation. or removeNotify() was
             // called.  In any case, we're being asked to stop the
             // animation immediately.
             break;
        }
        if (n > -1) {
             try {
                 myDrawFrame(f, bufs[n]);
             } finally {
                 anim.finishFrame(f);
             }
         }
     }
 } finally {
     anim.stopAnimation(false);
 }
```

This class does not specify a return value for `Component.isDoubleBuffered()`. That method reports on a different kind of buffering, related to the `repaint()` call. `BufferedAnimation` objects might or might not be double-buffered, in the repaint-related sense meant by `Component.isDoubleBuffered()`.

NOTE: A future version of this API could potentially allow simultaneous drawing to two frames, by relaxing the synchronization condition on startFrame(int). However, it is unclear if this would yield benefits e.g. on a multi-core system, given memory bandwith limitations and the already existing ability to have parallel threads drawing into one frame or doing other computations.

Since:

MHP 1.1.3

Fields

FRAME_23_98

```
public static float FRAME_23_98
```

Constant representing a common video framerate, approximately 23.98 frames per second, and equal to `24000f/1001f`.

See Also:
`getFramerate()`, `setFramerate(float)`

FRAME_24

`public static float FRAME_24`

Constant representing a common video framerate, equal to `24f`.

See Also:
`getFramerate()`, `setFramerate(float)`

FRAME_25

`public static float FRAME_25`

Constant representing a common video framerate, equal to `25f`.

See Also:
`getFramerate()`, `setFramerate(float)`

FRAME_29_97

`public static float FRAME_29_97`

Constant representing a common video framerate, approximately 29.97 frames per second, and equal to`30000f/1001f`.

See Also:
`getFramerate()`, `setFramerate(float)`

FRAME_50

`public static float FRAME_50`

Constant representing a common video framerate, equal to `50f`.

See Also:
`getFramerate()`, `setFramerate(float)`

FRAME_59_94

`public static float FRAME_59_94`

Constant representing a common video framerate, approximately 59.94 frames per second, and equal to`60000f/1001f`.

See Also:
`getFramerate()`, `setFramerate(float)`

Constructors

BufferedAnimation()

`public BufferedAnimation()`

Create a new `BufferedAnimation` component. The BufferedAnimation functionality may be optional. Applications written to device specifications that do not make this functionality mandatory should be prepared to catch UnsupportedOperationException when invoking this constructor.

Throws:

`java.lang.UnsupportedOperationException` - If this feature is not supported on the device.

Methods

---

addNotify()

`public void` **`addNotify`**`()`

Makes this `Component` displayable by connecting it to a native screen resource. This method is called internally by the toolkit and should not be called directly by programs.

Overrides:

`addNotify` in class `Component`

---

finishFrame(int)

`public void` **`finishFrame`**`(int frameNumber)`

Notify the system that the frame currently being drawn is finished. Drawing the current frame is initiated with `startFrame(int)`. Once `finishFrame(int)` is called, the system can copy that frame to the framebuffer, and the caller can move on to preparing the next frame.

Parameters:

`frameNumber` - The frame number that is finished. This must match the value passed into startFrame(int).

Throws:

`java.lang.IllegalStateException` - if a startFrame call has not returned successfully for the given frame number (with a return value other than -1), if `finishFrame(int)` has already been called for this frame number since the startFrame call, or if `stopAnimation(boolean)` has been called since the corresponding startFrame call.

See Also:

`startFrame(int)`

---

getBuffersGraphics()

`public java.awt.Graphics2D[]` **`getBuffersGraphics`**`()`

Get the graphics objects for drawing into this component's internal image buffers. The size and number of buffers is determined by the `setBuffers` method.

After the first call, subsequent invocations of this method shall return the identical value (i.e. multiple calls will return values that are == to each other).

Other than the `setBuffers` mechanism, the size of the internal buffers will never change. If the component is resized, the system might scale the resulting animation, but this behavior is not guaranteed by the specification of this class. In all cases, the upper-left hand corner of the image buffer will be displayed in the upper-left hand corner of the component.

The initial contents of the graphics buffers is undefined. Callers may wish to initialize the buffers to a known state, such as fully transparent, before starting an animation. Once an animation is started,

drawing into a buffer outside of a `startFrame/finishFrame` pair may produce unpredictable results on the screen.

Returns:
An array of graphics objects that can be used to draw into the internal image buffers.

Throws:
`java.lang.IllegalStateException` - if the `setBuffers()` hasn't been successfully called.

See Also:
`setBuffers(Dimension, int, boolean, boolean)`

---

getBuffersSize()

`public java.awt.Dimension getBuffersSize()`

Get the size of the internal image buffers. If setBuffers has not yet been successfully called, then null is returned.

See Also:
`getBuffersGraphics()`, `setBuffers(Dimension, int, boolean, boolean)`

---

getFramerate()

`public float getFramerate()`

Get the actual framerate of the screen associated with this component. This class defines a number of common framerates as constants whose name begin with "`FRAME_`".

---

getMediaTime(Clock, int)

`public long getMediaTime(javax.media.Clock c, int frameNumber)`

Get the predicted media time of the given frameNumber for this animation. The predicted media time is calculated from the media time of the frame being presented on the screen, and extrapolating assuming a clock rate of 1.0.

The return value can be converted into a javax.media.Time value by calling the `javax.media.Time(long)` constructor.

This method is useful for keeping an animation aligned with a video source, even if "trick play" operations cause the media position to change. Note that because the computer generated animation might be a small number of frames "ahead" of the video due to the buffering this class provides, there might be a perceptable "lag" during trick play itself, but once the video returns to normal play mode, the animation would once again be frame-synchronized.

Parameters:
`c` - The clock to calculate media time relative to

`frameNumber` - the desired frame number of this animation

Returns:
The media time, in nanoseconds.

Throws:
`java.lang.IllegalStateException` - if this animation is not in the started state.

`javax.media.IncompatibleTimeBaseException` - If this Clock is incompatible with this animation. This will never be thrown if the Clock is associated with video being displayed on the same screen as this `BufferedAnimation` component.

`java.lang.IllegalStateException` - If this clock is not in the started state.

isStarted()

```
public boolean isStarted()
```

Return true if this animation is started. A `BufferedAnimation` can either be in the started or stopped state. A stopped `BufferedAnimation` will only draw to the framebuffer if it is in the process of flushing animation buffers due to a call to `stopAnimation(false)`

Returns:
true if this `BufferedAnimation` is started, false otherwise.

See Also:
`stopAnimation(boolean)`

paint(Graphics)

```
public void paint(java.awt.Graphics g)
```

If this component has an active animation, then this method paints either the last valid image buffer or the next valid image buffer to the given graphics object. If there is no available valid image buffer and a `startFrame/finishFrame` sequence is in progress, this method will block until `finishFrame` is called, thus generating a valid image buffer. If no animation is in progress or no valid frames have yet been generated, then this method does nothing.

Note that in normal operation, this method should be called by the platform very infrequently, if at all. It might be called, for example, due to an “expose event,” or due to a call to `Component.print(Graphics)`. Application authors should not request a call to `paint` via the repaint mechanism to animate this component, because this class uses a different model for animation.

Overrides:
`paint` in class `Component`

removeNotify()

```
public void removeNotify()
```

Make this component undisplayable by destroying any native resources, and freeing its image buffers. `stopAnimation(true)` shall be called by the implementation of this method.

Overrides:
`removeNotify` in class `Component`

setBuffers(Dimension, int, boolean, boolean)

```
public void setBuffers(java.awt.Dimension bufSize, int numBuffers, boolean forceSize,
            boolean forceAcceleration)
```

Set the size and number of the internal image buffers. If the system is capable of scaling a `BufferedAnimation`’s buffers to the component’s size in real-time, then the internal buffers will be of the requested size, and scaling will occur. If the system is not, then the results will depend on the value of `forceSize`.

On a system that cannot perform a requested scaling, if `forceSize` is true, then the buffers’ sizes will be set to the requested size regardless. The displayed result will be clipped or will have areas that are unpainted, as needed. In all cases, the upper-left hand corner of the buffers will be painted at to the upper-left hand corner of the component.

On a system that cannot perform scaling, if `forceSize` is false, the buffers’ size will be set to the current size of the component. That is, the requested buffer dimension will be ignored.

The system model of specifications that include this class may specify a set of supported scalings.

Note that the framebuffer itself might be scaled for display on the output device. For example, a specification including this class might include half-resolution mode, e.g. for half-resolution computer graphics over 1080i video.

Graphics Acceleration

Some systems have special faster video memory that gives accelerated graphics performance. The system model of a specification adopting this API may define a minimum amount of such memory. Other hardware architectures, such as “unified memory architecture” platforms, don’t have special accelerated memory. On these platforms, all video memory is considered “accelerated”, that is, the `forceAccelerated` parameter has no effect, and does not cause automatic failure.

On platforms with special accelerated video memory, the caller may indicate that all of the graphics buffers must be allocated from this accelerated memory. It does this by setting the `forceAcceleration` parameter true. This may make an OutOfMemoryError more likely. If forceAcceleration is not true, then the implementation will make a “best-effort” attempt to put the buffers in accelerated memory, but will fall back to normal heap memory, if required.

This method may be called more than once. If it exits with an exception, the state of this object will not be changed. If it returns normally, the new values will override anything set previously.

Parameters:

`bufSize` - The requested buffer size

`numBuffers` - The number of image buffers to allocate

`forceSize` - Force sizing the buffers to the requested size, even if this means clipping or having unpainted areas.

`forceAcceleration` - Force allocation of all buffers in accelerated memory.

Throws:

`java.lang.IllegalArgumentException` - if d.width or d.height is less than one, or numBuffers is less than one.

`java.lang.IllegalStateException` - if getBuffersGraphics has been called for this component.

`java.lang.IllegalStateException` - If this component isn’t displayable.

OutOfMemoryException - If there isn’t enough memory to allocate the needed buffers.

See Also:

`java.awt.Component.isDisplayable()`

---

setFramerate(float)

```
public void setFramerate(float rate)
```

Attempt to set the framerate of the screen associated with this component. Other factors, such as video being output to the same device or device limitations, might determine the framerate, thus causing this method to have no effect. The frameright might subsequently be changed, e.g. by video being presented on the screen or by other APIs. Unless other behavior is mandated by the system model of a specification incorporating this class, it is an allowable implementation option for this method to never change the framerate.

The system model of specifications including this class might determine under what conditions the framerate can be set, and what framerates are guaranteed to be supported. This class defines a number of common framerates as constants whose name begin with “`FRAME_`”.

Note that an application that wishes to animate at a lower framerate than that of the hardware may do so, by simply skipping frames. This is discussed in the `startFrame(int)` method.

Throws:
`java.lang.IllegalStateException` - If this component is not displayable.

See Also:
`java.awt.Component.isDisplayable()`, `startFrame(int)`

---

startAnimation()

```
public void startAnimation()
```

Start this animation immediately, and reset the frame number to zero. Frame zero will be the first frame that can be displayed; typically it will be one or two frames after the frame visible on the screen at the time this method is called.

Applications should only call this method on a stopped animation. However, if this method is called when an animation is already started, it is re-started; the effect is equivalent to calling `stopAnimation(true)` followed by `startAnimation()`.

See Also:
`isStarted()`

---

startAnimationAt(Clock, Time)

```
public void startAnimationAt(javax.media.Clock c, javax.media.Time t)
            throws IncompatibleTimeBaseException
```

Start this animation keyed to the clock at the given media time. If the clock's media time is already greater than the given time, this is equivalent to `startAnimation()`. Otherwise, once the clock's media time is greater than or equal to the given the given value, the animation will be started. Callers should not assume that frame zero of the animation will coincide with the desired time in all cases; for example, the clock's media time might advance in a discontinuous manner. Callers should always consult `getMediaTime(...)`.

This method can be used to initiate frame-accurate animation that is synchronized to video that is being presented on the same screen. The animation enters the started state, and drawing to graphics buffers can begin. The system will start copying these buffers to the framebuffer automatically, when the clock reaches the given time.

Subsequent calls to this method override any previous calls. If this method is called when an animation is already started, it is re-started; the effect is equivlanet to calling `stopAnimation(true)` followed by `startAnimationAt(...)`.

Parameters:
`c` - A JMF Clock that is associated with some media.

`t` - A media time of that clock when the animation should start.

Throws:
`javax.media.IncompatibleTimeBaseException` - If this Clock is incompatible with this animation. This will never be thrown if the Clock is associated with video being displayed on the same screen as this animation.

`java.lang.IllegalStateException` - If this clock is not in the started state.

See Also:
`isStarted()`, `getMediaTime(Clock, int)`

---

startFrame(int)

```
public int startFrame(int frameNumber)
            throws InterruptedException
```

Start drawing the given frame. The return value gives the index into the array obtained from `getBuffersGraphics()` for drawing of this frame, or -1 if the animation has fallen behind, and a later frame should now be drawn. After calling this method, if a value other than -1 is returned, the caller may draw to the indicated graphics buffer. When it is finished, it shall call `finishFrame()`.

If a buffer is not available for the given frame, this method will block until one is ready.

The caller can always skip frames. For example, a caller wishing to animate at half of the component's framerate could request frames 0, 2, 4, 6, 8, 10, etc. In this example, if there are four buffers and animation does not fall behind, the caller would be instructed to draw into buffer 0, 1, 2, 3, 0, 1, etc. A caller that wishes to start animating at a frame greater than 0 may do so by simply starting with a number greater than zero; when the lower-numbered frames are being presented, the component will simply do no drawing.

The content of the framebuffers is not modified by the system. Thus, a caller that is drawing into buffer number *n* could function correctly if it only drew to pixels that have changed since it last drew into buffer number *n*.

Parameters:

`frameNumber` - The frame number to draw. The first frame is frame 0.

Returns:

An index into the array of graphics objects for drawing the given frame, or -1 if animation has fallen behind, and a later frame should now be drawn.

Throws:

`java.lang.IllegalArgumentException` - if frameNumber is less than or equal to a number previously supplied to this animation, or is less than zero.

`java.lang.IllegalStateException` - if `startFrame()` has already been successfully called without a corresponding `finishFrame()`.

`java.lang.InterruptedException` - If this animation is in the stopped state, either when this method is called or due to a state transition while it is blocked waiting for a graphics buffer.

See Also:

`getBuffersGraphics()`, `isStarted()`

---

stopAnimation(boolean)

```
public void stopAnimation(boolean immediate)
```

Stops this animation. If it is already in the stopped state, this method has no effect. If it is in the started state, it is set to the stopped state. Once this component is in the stopped state, it will not draw into any pixels to the screen, or as a result of a call to the `paint()` method.

The caller may request that queued fames of animation be output to the screen. This will be done if the animation is in the started state, and immediate is set false.

If a successful call to `startFrame(int)` has not yet been matched with a call to `finishFrame(int)`, this object is set to the stopped state, which will cause `finishFrame(int)` ti fail. See that method for details.

After this method returns, `isStarted()` will return false. If this animation is not in the started state, calling this method will have no effect.

Parameters:

`immediate` - If the component should immediately stop copying buffers to the screen, instead of letting any queued animation frames be output.

See Also:

`isStarted()`, `finishFrame(int)`

org.dvb.ui
DVBAlphaComposite

Declaration

```
public final class DVBAlphaComposite

java.lang.Object
  |
  +--org.dvb.ui.DVBAlphaComposite
```

Description

This `DVBAlphaComposite` class implements the basic alpha compositing rules for combining source and destination pixels to achieve blending and transparency effects with graphics, images and video. The rules implemented by this class are a subset of the Porter-Duff rules described in T. Porter and T. Duff, "Compositing Digital Images", SIGGRAPH 84, 253-259.

If any input does not have an alpha channel, an alpha value of 1,0, which is completely opaque, is assumed for all pixels. A constant alpha value can also be specified to be multiplied with the alpha value of the source pixels.

The following abbreviations are used in the description of the rules:

- Cs = one of the color components of the source pixel without alpha.
- cs = color component of a source pixel pre-multiplied with alpha (cs = As*Ar*Cs)
- Cd = one of the color components of the destination pixel without alpha.
- cd = color component of a destination pixel pre-multiplied with alpha
- Cn = the new constructed color without alpha.
- cn = the new constructed color pre-multiplied with alpha
- As = alpha component of the source pixel.
- Ad = alpha component of the destination pixel.
- An = the new alpha after compositing
- Ar = alpha, specified by getInstance(int Rule, float Ar). Unless otherwise specified Ar = 1,0f
- Fs = fraction of the source pixel that contributes to the output.
- Fd = fraction of the input destination pixel that contributes to the output.

The color and alpha components produced by the compositing operation are calculated as follows:

```
cn = (As*Ar)*Cs*Fs + Ad*Cd*Fd
An = (As*Ar)*Fs + Ad*Fd
 Cn = cn/An
```

where Fs and Fd are specified by each rule.

The alpha resulting from the compositing operation is stored in the destination if the destination has an alpha channel. Otherwise, the resulting color is divided by the resulting alpha before being stored in the destination and the alpha is discarded. If the alpha value is 0,0, the color values are set to 0,0.

See Also:

`java.awt.AlphaComposite`

Fields

Clear

```
public static final org.dvb.ui.DVBAlphaComposite Clear
```

`DVBAlphaComposite` object that implements the opaque CLEAR rule with an alpha (Ar) of 1,0f.

See Also:

CLEAR

CLEAR

```
public static final int CLEAR
```

Porter-Duff Clear rule. Both the color and the alpha of the destination are cleared. Neither the source nor the destination is used as input.

Fs = 0 and Fd = 0, thus:

```
cn = 0
An = 0
 Cn = 0
```

Note that this operation is a fast drawing operation This operation is the same as using a source with alpha= 0 and the SRC rule

---

DST_IN

```
public static final int DST_IN
```

Porter-Duff Destination In Source rule. The part of the destination lying inside of the source replaces the destination.

Fs = 0 and Fd = (As*Ar), thus:

```
cn = Ad*Cd*(As*Ar)
An = Ad*(As*Ar)
 Cn = Cd
```

Note that this operation is faster than e.g. SRC_OVER but slower than SRC

DST_OUT

```
public static final int DST_OUT
```

Porter-Duff Destination Held Out By Source rule. The part of the destination lying outside of the source replaces the destination.

Fs = 0 and Fd = (1-(As*Ar)), thus:

```
cn = Ad*Cd*(1-(As*Ar))
An = Ad*(1-(As*Ar))
 Cn = Cd
```

Note that this operation is faster than e.g. SRC_OVER but slower than SRC

DST_OVER

```
public static final int DST_OVER
```

Porter-Duff Destination Over Source rule. The destination is composited over the source and the result replaces the destination.

Fs = (1-Ad) and Fd = 1, thus:

```
cn = (As*Ar)*Cs*(1-Ad) + Ad*Cd
An = (As*Ar)*(1-Ad) + Ad
```

Note that this can be a very slow drawing operation

DstIn

```
public static final org.dvb.ui.DVBAlphaComposite DstIn
```

DVBAlphaComposite object that implements the opaque DST_IN rule with an alpha (Ar) of 1,0f.

See Also:
DST_IN

DstOut

```
public static final org.dvb.ui.DVBAlphaComposite DstOut
```

DVBAlphaComposite object that implements the opaque DST_OUT rule with an alpha (Ar) of 1,0f.

See Also:
DST_OUT

DstOver

```
public static final org.dvb.ui.DVBAlphaComposite DstOver
```

DVBAlphaComposite object that implements the opaque DST_OVER rule with an alpha (Ar) of 1,0f.

See Also:
DST_OVER

Src

```
public static final org.dvb.ui.DVBAlphaComposite Src
```

DVBAlphaComposite object that implements the opaque SRC rule with an alpha (Ar) of 1,0f.

See Also:
SRC

SRC

```
public static final int SRC
```

Porter-Duff Source rule. The source is copied to the destination. The destination is not used as input.

Fs = 1 and Fd = 0, thus:

```
cn = (As*Ar)*Cs
An = As*Ar
 Cn = Cs
```

Note that this is a fast drawing routine

SRC_IN

```
public static final int SRC_IN
```

Porter-Duff Source In Destination rule. The part of the source lying inside of the destination replaces the destination.

Fs = Ad and Fd = 0, thus:

```
cn = (As*Ar)*Cs*Ad
An = (As*Ar)*Ad
 Cn = Cs
```

Note that this operation is faster than e.g. SRC_OVER but slower than SRC

SRC_OUT

```
public static final int SRC_OUT
```

Porter-Duff Source Held Out By Destination rule. The part of the source lying outside of the destination replaces the destination.

Fs = (1-Ad) and Fd = 0, thus:

```
cn = (As*Ar)*Cs*(1-Ad)
An = (As*Ar)*(1-Ad)
 Cn = Cs
```

Note that this operation is faster than e.g. SRC_OVER but slower than SRC

SRC_OVER

```
public static final int SRC_OVER
```

Porter-Duff Source Over Destination rule. The source is composited over the destination.

Fs = 1 and Fd = (1-(As*Ar)), thus:

```
cn = (As*Ar)*Cs + Ad*Cd*(1-(As*Ar))
An = (As*Ar) + Ad*(1-(As*Ar))
```

Note that this can be a very slow drawing operation

SrcIn

```
public static final org.dvb.ui.DVBAlphaComposite SrcIn
```

DVBAlphaComposite object that implements the opaque SRC_IN rule with an alpha (Ar) of 1,0f.

See Also:
SRC_IN

SrcOut

```
public static final org.dvb.ui.DVBAlphaComposite SrcOut
```

DVBAlphaComposite object that implements the opaque SRC_OUT rule with an alpha (Ar) of 1,0f.

See Also:
SRC_OUT

SrcOver

```
public static final org.dvb.ui.DVBAlphaComposite SrcOver
```

DVBAlphaComposite object that implements the opaque SRC_OVER rule with an alpha (Ar) of 1,0f.

See Also:
SRC_OVER

Methods

---

equals(Object)

```
public boolean equals(java.lang.Object obj)
```

Tests if the specified `java.lang.Object` is equal to this `DVBAlphaComposite` object.

Overrides:
`equals` in class `Object`

Parameters:
`obj` - the `Object` to test for equality

Returns:
`true` if `obj` is a DVBAlphaComposite and has the same values for rule and alpha as this object. Otherwise `false` shall be returned.

---

getAlpha()

```
public float getAlpha()
```

Returns the alpha value of this `DVBAlphaComposite`. If this `DVBAlphaComposite` does not have an alpha value, 1,0 is returned.

Returns:
the alpha value of this `DVBAlphaComposite`.

---

getInstance(int)

```
public static org.dvb.ui.DVBAlphaComposite getInstance(int rule)
```

Creates an `DVBAlphaComposite` object with the specified rule. The value for alpha shall be 1,0f.

Parameters:
`rule` - the compositing rule

Returns:
an `DVBAlphaComposite` object with the specified rule.

---

getInstance(int, float)

```
public static org.dvb.ui.DVBAlphaComposite getInstance(int rule, float alpha)
```

Creates an `DVBAlphaComposite` object with the specified rule and the constant alpha (Ar) to multiply with the alpha of the source (As). The source is multiplied with the specified alpha before being composited with the destination.

Parameters:
`rule` - the compositing rule

`alpha` - the constant alpha (Ar) to be multiplied with the alpha of the source (As). `alpha` must be a floating point number in the inclusive range [0,0, 1,0].

Returns:
an `DVBAlphaComposite` object with the specified rule and the constant alpha to multiply with the alpha of the source.

---

getRule()

```
public int getRule()
```

Returns the compositing rule of this `DVBAlphaComposite`.

Returns:

the compositing rule of this `DVBAlphaComposite`.

org.dvb.ui
DVBBufferedImage

Declaration

```
public class DVBBufferedImage extends java.awt.Image

java.lang.Object
  |
  +--java.awt.Image
        |
        +--org.dvb.ui.DVBBufferedImage
```

Description

The `DVBBufferedImage` subclass describes an `java.awt.Image` with an accessible buffer of image data. The DVBBufferedImage is an adapter class for java.awt.image.BufferedImage. It supports two different platform dependent sample models TYPE_BASE and TYPE_ADVANCED. Buffered images with the TYPE_BASE have the same sample model as the on screen graphics buffer, thus TYPE_BASE could be CLUT based. TYPE_ADVANCED has a direct color model but it is not specified how many bits are used to store the different color components. By default, a new DVBBufferedImage is transparent. All alpha values are set to 0; Instances of DVBBufferedImage shall be considered to be off-screen images for the purpose of the inherited method `Image.getGraphics`.

Since:

MHP 1.0

Fields

TYPE_ADVANCED

```
public static final int TYPE_ADVANCED
```

Represents an image stored in a best possible SampleModel (platform dependent) The image has a DirectColorModel with alpha. The color data in this image is considered not to be pre-multiplied with alpha. The data returned by getRGB() will be in the TYPE_INT_ARGB color model that is alpha component in bits 24 to 31, the red component in bits 16 to 23, the green component in bits 8 to 15, and the blue component in bits 0 to 7. The data for setRGB() shall be in the TYPE_INT_ARGB color model as well.

Since:

MHP 1.0

TYPE_BASE

```
public static final int TYPE_BASE
```

Represents an image stored in a platform dependent Sample Model. This color model is not visible to applications. The data returned by getRGB() will be in the TYPE_INT_ARGB color model that is alpha component in bits 24 to 31, the red component in bits 16 to 23, the green component in bits 8 to 15, and the blue component in bits 0 to 7. The data for setRGB() shall be in the TYPE_INT_ARGB color model as well.

Since:

MHP 1.0

Constructors

DVBBufferedImage(int, int)

```
public DVBBufferedImage(int width, int height)
```

Constructs a DVBBufferedImage with the specified width and height. The Sample Model used the image is the native Sample Model (TYPE_BASE) of the implementation. Note that a request can lead to an java.lang.OutOfMemoryError. Applications should be aware of this.

Parameters:

`width` - the width of the created image

`height` - the height of the created image

Since:

MHP 1.0

DVBBufferedImage(int, int, int)

```
public DVBBufferedImage(int width, int height, int type)
```

Constructs a new DVBBufferedImage with the specified width and height in the Sample Model specified by type. Note that a request can lead to an java.lang.OutOfMemoryError. Applications should be aware of this.

Parameters:

`width` - the width of the DVBBufferedImage

`height` - the height of the DVBBufferedImage

`type` - the ColorSpace of the DVBBufferedImage

Since:

MHP 1.0

Methods

createGraphics()

```
public org.dvb.ui.DVBGraphics createGraphics()
```

Creates a `DVBGraphics`, which can be used to draw into this `DVBBufferedImage`. Calls to this method after calls to the `dispose` method on the same instance shall return null.

Returns:

a `DVBGraphics`, used for drawing into this image.

Since:

MHP 1.0

dispose()

```
public void dispose()
```

Disposes of this buffered image. This method releases the resources (e.g. pixel memory) underlying this buffered image. After calling this method ;

- the image concerned may not be used again
- the image shall be considered to have a width and height of -1, -1 as specified for instances of

java.awt.Image where the width and height are not yet known.
- the `getGraphics` method may return null

Since:
MHP 1.0.1

---

flush()

```
public void flush()
```

Flushes all resources being used to cache optimization information. The underlying pixel data is unaffected. Calls to this method after calls to the `dispose` method on the same instance shall fail silently.

Overrides:
`flush` in class `Image`

---

getGraphics()

```
public java.awt.Graphics getGraphics()
```

This method returns a `java.awt.Graphics` , it is here for backwards compatibility. `createGraphics` is more convenient, since it is declared to return a `DVBGraphics`. Calls to this method after calls to the `dispose` method on the same instance shall return null.

Overrides:
`getGraphics` in class `Image`

Returns:
a `Graphics`, which can be used to draw into this image.

---

getHeight()

```
public int getHeight()
```

Returns the height of the `DVBBufferedImage`.

Returns:
the height of this `DVBBufferedImage`.

Since:
MHP 1.0

---

getHeight(ImageObserver)

```
public int getHeight(java.awt.image.ImageObserver observer)
```

Returns the height of the image.

Overrides:
`getHeight` in class `Image`

Parameters:
`observer` - the `ImageObserver` that receives information about the image

Returns:
the height of the image or `-1` if the height is not yet known.

See Also:
`java.awt.Image.getWidth(ImageObserver)`, `java.awt.image.ImageObserver`

getImage()

```
public java.awt.Image getImage()
```

Returns a java.awt.Image representing this buffered image. In implementations which implement java.awt.image.BufferedImage this returns a java.awt.image.BufferedImage cast to a java.awt.Image. Otherwise it is implementation dependent whether it returns this image or whether it returns an instance of an underlying platform specific sub-class of java.awt.Image. Calls to this method after calls to the `dispose` method on the same instance shall return null.

Returns:
a java.awt.image representing this buffered image

Since:
MHP 1.0

getProperty(String, ImageObserver)

```
public java.lang.Object getProperty(java.lang.String name,
            java.awt.image.ImageObserver observer)
```

Returns a property of the image by name. Individual property names are defined by the various image formats. If a property is not defined for a particular image, this method returns the `UndefinedProperty` field. If the properties for this image are not yet known, then this method returns `null` and the `ImageObserver` object is notified later. The property name “comment” should be used to store an optional comment that can be presented to the user as a description of the image, its source, or its author. Calls to this method after calls to the `dispose` method on the same instance shall return null.

Overrides:
`getProperty` in class `Image`

Parameters:
`name` - the property name

`observer` - the `ImageObserver` that receives notification regarding image information

Returns:
an `java.lang.Object` that is the property referred to by the specified `name` or `null` if the properties of this image are not yet known.

See Also:
`java.awt.image.ImageObserver`, `java.awt.Image.UndefinedProperty`

getRGB(int, int)

```
public int getRGB(int x, int y)
```

Returns the specified integer pixel in the default RGB color model (TYPE_INT_ARGB) and default sRGB colorspace. Color conversion takes place if the used Sample Model is not 8-bit for each color component There are only 8-bits of precision for each color component in the returned data when using this method. Note that when a lower precision is used in this buffered image getRGB may return different values than those used in setRGB()

Parameters:
`x` - the x-coordinate of the pixel

`y` - the y-coordinate of the pixel

Returns:
an integer pixel in the default RGB color model (TYPE_INT_ARGB) and default sRGB colorspace.

Throws:
`java.lang.ArrayIndexOutOfBoundsException` - if x or y is out of bounds or if the dispose method has been called on this instance

Since:
MHP 1.0

---

getRGB(int, int, int, int, int[], int, int)

```
public int[] getRGB(int startX, int startY, int w, int h, int[] rgbArray, int offset,
            int scansize)
```

Returns an array of integer pixels in the default RGB color model (TYPE_INT_ARGB) and default sRGB color space, from a rectangular region of the image data. There are only 8-bits of precision for each color component in the returned data when using this method. With a specified coordinate (x, y) in the image, the ARGB pixel can be accessed in this way:

```
pixel   = rgbArray[offset + (y-startY)*scansize + (x-startX)];
```

Parameters:
`startX` - the x-coordinate of the upper-left corner of the specified rectangular region

`startY` - the y-coordinate of the upper-left corner of the specified rectangular region

`w` - the width of the specified rectangular region

`h` - the height of the specified rectangular region

`rgbArray` - if not `null`, the rgb pixels are written here

`offset` - offset into the `rgbArray`

`scansize` - scanline stride for the `rgbArray`

Returns:
array of ARGB pixels.

Throws:
`java.lang.ArrayIndexOutOfBoundsException` - if the specified portion of the image data is out of bounds or if the dispose method has been called on this instance

Since:
MHP 1.0

---

getScaledInstance(int, int, int)

```
public java.awt.Image getScaledInstance(int width, int height, int hints)
```

Creates a scaled version of this image. A new `Image` object is returned which will render the image at the specified `width` and `height` by default. The new `Image` object may be loaded asynchronously even if the original source image has already been loaded completely. If either the `width` or `height` is a negative number then a value is substituted to maintain the aspect ratio of the original image dimensions. If the `dispose` method has been called on this instance then null shall be returned.

Overrides:
`getScaledInstance` in class `Image`

Parameters:
`width` - the width to which to scale the image.

`height` - the height to which to scale the image.

`hints` - flags to indicate the type of algorithm to use for image resampling.

Returns:

a scaled version of the image.

---

getSource()

```
public java.awt.image.ImageProducer getSource()
```

Returns the object that produces the pixels for the image.

Overrides:
`getSource` in class `Image`

Returns:
the `java.awt.image.ImageProducer` that is used to produce the pixels for this image.

If the `dispose` method has been called on this instance then null shall be returned. The source returned by this method is platform generated to provide access to the current contents of the `DVBBufferedImage` buffer.

See Also:
`java.awt.image.ImageProducer`

---

getSubimage(int, int, int, int)

```
public org.dvb.ui.DVBBufferedImage getSubimage(int x, int y, int w, int h)
            throws DVBRasterFormatException
```

Returns a subimage defined by a specified rectangular region. The returned `DVBBufferedImage` shares the same data array as the original image. If the `dispose` method has been called on this instance then null shall be returned.

Parameters:
`x` - the x-coordinate of the upper-left corner of the specified rectangular region

`y` - the y-coordinate of the upper-left corner of the specified rectangular region

`w` - the width of the specified rectangular region

`h` - the height of the specified rectangular region

Returns:
a `DVBBufferedImage` that is the subimage of this `DVBBufferedImage`.

Throws:
`DVBRasterFormatException` - if the specified area is not contained within this `DVBBufferedImage`.

Since:
MHP 1.0

---

getWidth()

```
public int getWidth()
```

Returns the width of the `DVBBufferedImage`.

Returns:
the width of this `DVBBufferedImage`.

Since:
MHP 1.0

---

getWidth(ImageObserver)

```
public int getWidth(java.awt.image.ImageObserver observer)
```

Returns the width of the image. If the width is not known yet then the `java.awt.image.ImageObserver` is notified later and `-1` is returned.

Overrides:
`getWidth` in class `Image`

Parameters:
`observer` - the `ImageObserver` that receives information about the image

Returns:
the width of the image or `-1` if the width is not yet known.

See Also:
`java.awt.Image.getHeight(ImageObserver)`, `java.awt.image.ImageObserver`

---

setRGB(int, int, int)

```
public void setRGB(int x, int y, int rgb)
```

Sets a pixel in this `DVBBufferedImage` to the specified ARGB value. The pixel is assumed to be in the default RGB color model, TYPE_INT_ARGB, and default sRGB color space. Calls to this method after calls to the `dispose` method on the same instance shall throw an `ArrayIndexOutOfBoundsException`.

Parameters:
`x` - the x-coordinate of the pixel to set

`y` - the y-coordinate of the pixel to set

`rgb` - the ARGB value

Since:
MHP 1.0

---

setRGB(int, int, int, int, int[], int, int)

```
public void setRGB(int startX, int startY, int w, int h, int[] rgbArray, int offset,
            int scansize)
```

Sets an array of integer pixels in the default RGB color model (TYPE_INT_ARGB) and default sRGB color space, into a rectangular portion of the image data. There are only 8-bits of precision for each color component in the returned data when using this method. With a specified coordinate (x, y) in the this image, the ARGB pixel can be accessed in this way:

```
pixel   = rgbArray[offset + (y-startY)*scansize + (x-startX)];
```

WARNING: No dithering takes place.

Calls to this method after calls to the `dispose` method on the same instance shall throw an `ArrayIndexOutOfBoundsException`.

Parameters:
`startX` - the x-coordinate of the upper-left corner of the specified rectangular region

`startY` - the y-coordinate of the upper-left corner of the specified rectangular region

`w` - the width of the specified rectangular region

`h` - the height of the specified rectangular region

`rgbArray` - the ARGB pixels

`offset` - offset into the `rgbArray`

`scansize` - scanline stride for the `rgbArray`

Since:

MHP 1.0

---

toString()

```
public java.lang.String toString()
```

Returns a `String` representation of this `DVBBufferedImage` object and its values.

Overrides:
`toString` in class `Object`

Returns:
a `String` representing this `DVBBufferedImage`.

org.dvb.ui
DVBColor

Declaration

```
public class DVBColor extends javax.tv.graphics.AlphaColor

java.lang.Object
  |
  +--java.awt.Color
        |
        +--javax.tv.graphics.AlphaColor
              |
              +--org.dvb.ui.DVBColor
```

All Implemented Interfaces:

`java.io.Serializable`, `java.awt.Transparency`

Description

A Color class which adds the notion of alpha. Because DVBColor extends Color the signatures in the existing classes do not change. Classes like Component should work with DVBColor internally. Instances of this class are a container for the values which are passed in to the constructor. Any approximations made by the platform are made when the colors are used. Note: org.dvb.ui.DVBColor adds support for alpha (compared to JDK1.1.8) and is intended to be compatible with the JDK1.2 java.awt.Color class - since org.dvb.ui.DVBColor extends javax.tv.graphics.AlphaColor which in turn extends java.awt.Color. In implementations where java.awt.Color supports alpha, such as JDK1.2, etc., the alpha-related methods in org.dvb.ui.DVBColor could just call super.

Since:

MHP 1.0

Constructors

DVBColor(Color)

```
public DVBColor(java.awt.Color c)
```

Constructs a new DVBColor using the specified color. If c supports alpha, e.g. if it is an instance of javax.tv.graphics.AlphaColor or JDK 1.2's java.awt.Color, then the alpha value of c shall be used. If this color has no alpha value, alpha will be set to 255 (opaque).

Parameters:

`c` - the java.awt.Color used to create a new DVBColor

DVBColor(float, float, float, float)

```
public DVBColor(float r, float g, float b, float a)
```

Creates an sRGB color with the specified red, green, blue, and alpha values in the range (0,0 to 1,0). The actual color used in rendering will depend on finding the best match given the color space available for a given output device.

Parameters:

`r` - the red component

`g` - the green component

b - the blue component

a - the alpha component

See Also:
java.awt.Color.getRed(), java.awt.Color.getGreen(), java.awt.Color.getBlue(), getAlpha(), getRGB()

DVBColor(int, boolean)

```
public DVBColor(int rgba, boolean hasalpha)
```

Creates an sRGB color with the specified combined RGBA value consisting of the alpha component in bits 24 to 31, the red component in bits 16 to 23, the green component in bits 8 to 15, and the blue component in bits 0 to 7. If the hasalpha argument is False, alpha is defaulted to 255.

Parameters:
rgba - the combined RGBA components

hasalpha - true if the alpha bits are valid, false otherwise

See Also:
java.awt.Color.getRed(), java.awt.Color.getGreen(), java.awt.Color.getBlue(), getAlpha(), getRGB()

DVBColor(int, int, int, int)

```
public DVBColor(int r, int g, int b, int a)
```

Creates an sRGB color with the specified red, green, blue, and alpha values in the range (0 to 255).

Parameters:
r - the red component

g - the green component

b - the blue component

a - the alpha component

See Also:
java.awt.Color.getRed(), java.awt.Color.getGreen(), java.awt.Color.getBlue(), getAlpha(), getRGB()

Methods

---

brighter()

```
public java.awt.Color brighter()
```

Creates a brighter version of this color. This method applies an arbitrary scale factor to each of the three RGB components of the color to create a brighter version of the same color. Although brighter and darker are inverse operations, the results of a series of invocations of these two methods may be inconsistent because of rounding errors. The alpha value shall be preserved.

Overrides:
brighter in class AlphaColor

Returns:
a new DVBColor object (cast to a java.awt.Color object) representing a brighter version of this color. Applications can recast it to a org.dvb.ui.DVBColor object

See Also:
`java.awt.Color.brighter()`

---

darker()

```
public java.awt.Color darker()
```

Creates a darker version of this color. This method applies an arbitrary scale factor to each of the three RGB components of the color to create a darker version of the same color. Although brighter and darker are inverse operations, the results of a series of invocations of these two methods may be inconsistent because of rounding errors. The alpha value shall be preserved.

Overrides:
`darker` in class `AlphaColor`

Returns:
a new DVBColor object (cast to a java.awt.Color object), representing a darker version of this color. Applications can recast it to a org.dvb.ui.DVBColor object

See Also:
`java.awt.Color.darker()`

---

equals(Object)

```
public boolean equals(java.lang.Object obj)
```

Determines whether another object is equal to this color. The result is true if and only if the argument is not null and is a DVBColor object that has the same red, green, blue and alpha values as this object.

Overrides:
`equals` in class `AlphaColor`

Parameters:
`obj` - - the object to compare with.

Returns:
true if the objects are the same; false otherwise.

Since:
MHP 1.0

---

getAlpha()

```
public int getAlpha()
```

Returns the alpha component. In the range 0 to 255.

Overrides:
`getAlpha` in class `AlphaColor`

Returns:
the alpha component

See Also:
`getRGB()`

---

getRGB()

```
public int getRGB()
```

Returns the RGB value representing the color in the default sRGB ColorModel. (Bits 24 to 31 are alpha, 16 to 23 are red, 8 to 15 are green, 0 to 7 are blue).

Overrides:
`getRGB` in class `AlphaColor`

Returns:
the RGB value representing the color in the default sRGB ColorModel.

Since:
MHP 1.0

See Also:
`java.awt.Color.getRed()`, `java.awt.Color.getGreen()`, `java.awt.Color.getBlue()`, `getAlpha()`

---

toString()

```
public java.lang.String toString()
```

Creates a string that represents this color and indicates the values of its ARGB components.

Overrides:
`toString` in class `AlphaColor`

Returns:
a representation of this color as a String object.

Since:
MHP 1.0

org.dvb.ui
DVBGraphics

Declaration

```
public abstract class DVBGraphics extends java.awt.Graphics2D
```

```
java.lang.Object
  |
  +--java.awt.Graphics
        |
        +--java.awt.Graphics2D
              |
              +--org.dvb.ui.DVBGraphics
```

Description

The `DVBGraphics` class is a adapter class to support alpha compositing in an MHP device. At all times, the DVBAlphaComposite returned by getDVBComposite and the Composite returned by the getComposite method inherited from Graphics2D shall be consistent. This means that the results of calling getRule and getAlpha on those shall be identical. **In MHP devices all Graphics Objects are DVBGraphics objects.** Thus one can get a DVBGraphics by casting a given Graphics object. The normal compositing rule used is **DVBAlphaComposite.SRC_OVER.** Note that the default rule of SRC_OVER may not give the highest performance. Under many circumstances, applications will find that the SRC rule will give higher performance. The intersection between setDVBCompsite in this class and the `setPaintMode` and `setXORMode` methods inherited from java.awt.Graphics shall be as follows.

- Calling `setPaintMode` on an instance of this class shall be equivalent to calling `setDVBComposite(DVBAlphaComposite.SrcOver)`.
- The present document does not tighten, refine or detail the definition of the `setXORMode` beyond what is specified for the parent class.

Note: Implementations of XOR mode may change colours with alpha to without and vice versa (reversibly).

Since:

MHP1.0

See Also:

`java.awt.Graphics`

Constructors

DVBGraphics()

```
protected DVBGraphics()
```

Constructs a new `DVBGraphics` object. This constructor is the default constructor for a graphics context.

Since `DVBGraphics` is an abstract class, applications cannot call this constructor directly. DVBGraphics contexts are obtained from other DVBGraphics contexts or are created by casting java.awt.Graphics to DVBGraphics.

Since:

MHP 1.0

See Also:

java.awt.Graphics.create(), java.awt.Component.getGraphics()

Methods

---

getAvailableCompositeRules()

```
public abstract int[] getAvailableCompositeRules()
```

Returns all available Porter-Duff Rules for this specific Graphics context. E.g. a devices could support the SRC_OVER rule when using a destination which does not have Alpha or where the alpha is null, while this rule is not available when drawing on a graphic context where the destination has alpha. Which rules are supported for the different graphics objects is defined in the Minimum Platform Capabilities of the MHP spec.

Returns:
all available Porter-Duff Rules for this specific Graphics context.

Since:
MHP 1.0

---

getBestColorMatch(Color)

```
public org.dvb.ui.DVBColor getBestColorMatch(java.awt.Color c)
```

Returns the best match for the specified Color as a DVBColor, in a device-dependent manner, as constrained by the MHP graphics reference model.

Parameters:
c - the specified Color.

Returns:
the best DVBColor match for the specified Color.

Since:
MHP 1.0

---

getColor()

```
public abstract java.awt.Color getColor()
```

Gets this graphics context's current color. This will return a DVBColor cast to java.awt.Color.

Overrides:
getColor in class Graphics

Returns:
this graphics context's current color.

Since:
MHP 1.0

See Also:
DVBColor, java.awt.Color, setColor(Color)

---

getDVBComposite()

```
public abstract org.dvb.ui.DVBAlphaComposite getDVBComposite()
```

Returns the current DVBAlphaComposite in the DVBGraphics context. This method could delegate to a java.awt.Graphics2D object where available

Returns:
the current DVBGraphics DVBAlphaComposite, which defines a compositing style.

Since:
MHP 1.0

See Also:
setDVBComposite(DVBAlphaComposite)

---

getType()

```
public int getType()
```

Returns the Sample Model (DVBBufferedImage.TYPE_BASE, DVBBufferedImage.TYPE_ADVANCED) which is used in the on/off screen buffer this graphics object draws into.

Returns:
the type of the Sample Model

Since:
MHP 1.0

See Also:
DVBBufferedImage

---

setColor(Color)

```
public abstract void setColor(java.awt.Color c)
```

Sets this graphics context's current color to the specified color. All subsequent graphics operations using this graphics context use this specified color. Note that color c can be a DVBColor

Overrides:
setColor in class Graphics

Parameters:
c - the new rendering color.

Since:
MHP 1.0

See Also:
java.awt.Color, DVBColor, getColor()

---

setDVBComposite(DVBAlphaComposite)

```
public abstract void setDVBComposite(org.dvb.ui.DVBAlphaComposite comp)
            throws UnsupportedDrawingOperationException
```

Sets the DVBAlphaComposite for the DVBGraphics context. The DVBAlphaComposite is used in all drawing methods such as drawImage, drawString, draw, and fill. It specifies how new pixels are to be combined with the existing pixels on the graphics device during the rendering process.

This method could delegate to a Graphics2D object or to an native implementation

Parameters:
comp - the DVBAlphaComposite object to be used for rendering

Throws:
UnsupportedDrawingOperationException - when the requested Porter-Duff rule is not supported by this graphics context

Since:
MHP 1.0

See Also:
`java.awt.Graphics.setXORMode(Color)`, `java.awt.Graphics.setPaintMode()`, `DVBAlphaComposite`

---

toString()

```
public java.lang.String toString()
```

Returns a `String` object representing this `DVBGraphics` object's value.

Overrides:
`toString` in class `Graphics`

Returns:
a string representation of this graphics context.

Since:
MHP 1.0

org.dvb.ui
DVBRasterFormatException

Declaration

```
public class DVBRasterFormatException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.ui.DVBRasterFormatException
```

All Implemented Interfaces:

java.io.Serializable

Description

This exception is thrown for some invalid operations on instances of DVBBufferedImage. The precise conditions are defined in the places where this exception is thrown.

Since:

MHP 1.0.1

See Also:

DVBBufferedImage

Constructors

DVBRasterFormatException(String)

```
public DVBRasterFormatException(java.lang.String s)
```

Constructs an instance of DVBRasterFormatException with the specified detail message.

Parameters:

s - the detail message

Since:

MHP1.0

org.dvb.ui
DVBTextLayoutManager

Declaration

```
public class DVBTextLayoutManager implements org.havi.ui.HTextLayoutManager

java.lang.Object
  |
  +--org.dvb.ui.DVBTextLayoutManager
```

All Implemented Interfaces:

`org.havi.ui.HTextLayoutManager`

Description

The DVBTextLayoutManager provides a text rendering layout mechanism for the org.havi.ui.HStaticText org.havi.ui.HText and org.havi.ui.HTextButton classes.

The semantics of the rendering behaviour and the settings are specified in the "Text presentation" annex of the present document. The DVBTextLayoutManager renders the text according to the semantics described in that annex.

Fields

HORIZONTAL_CENTER

```
public static final int HORIZONTAL_CENTER
```

The text should be centered horizontally.

HORIZONTAL_END_ALIGN

```
public static final int HORIZONTAL_END_ALIGN
```

The text should be horizontally to the horizontal end side (e.g. when start corner is upper left and line orientation horizontal, meaning text that is read left to right from top to bottom, this implies alignment to right).

HORIZONTAL_START_ALIGN

```
public static final int HORIZONTAL_START_ALIGN
```

The text should be aligned horizontally to the horizontal start side (e.g. when start corner is upper left and line orientation horizontal, meaning text that is read left to right from top to bottom, this implies alignment to left).

LINE_ORIENTATION_HORIZONTAL

```
public static final int LINE_ORIENTATION_HORIZONTAL
```

Horizontal line orientation.

LINE_ORIENTATION_VERTICAL

```
public static final int LINE_ORIENTATION_VERTICAL
```

Vertical line orientation.

START_CORNER_LOWER_LEFT

```
public static final int START_CORNER_LOWER_LEFT
```

Lower left text start corner.

START_CORNER_LOWER_RIGHT

```
public static final int START_CORNER_LOWER_RIGHT
```

Lower right text start corner.

START_CORNER_UPPER_LEFT

```
public static final int START_CORNER_UPPER_LEFT
```

Upper left text start corner.

START_CORNER_UPPER_RIGHT

```
public static final int START_CORNER_UPPER_RIGHT
```

Upper right text start corner.

VERTICAL_CENTER

```
public static final int VERTICAL_CENTER
```

The text should be centered vertically.

VERTICAL_END_ALIGN

```
public static final int VERTICAL_END_ALIGN
```

The text should be aligned vertically to the vertical end side (e.g. when start corner is upper left and line orientation horizontal, meaning text that is read left to right from top to bottom, this implies alignment to bottom).

This is defined by the clause “Vertical limits” in the “Text presentation” annex of the present document.

VERTICAL_START_ALIGN

```
public static final int VERTICAL_START_ALIGN
```

The text should be aligned vertically to the vertical start side (e.g. when start corner is upper left and line orientation horizontal, meaning text that is read left to right from top to bottom, this implies alignment to top).

This is defined by the clause “Vertical limits” in the “Text presentation” annex of the present document.

Constructors

DVBTextLayoutManager()

```
public DVBTextLayoutManager()
```

Constructs a DVBTextLayoutManager object with default parameters (HORIZONTAL_START_ALIGN, VERTICAL_START_ALIGN, LINE_ORIENTATION_HORIZONTAL, START_CORNER_UPPER_LEFT, wrap = true, linespace = (point size of the default font for HVisible) + 7, letterspace = 0, horizontalTabSpace = 56)

DVBTextLayoutManager(int, int, int, int, boolean, int, int, int)

```
public DVBTextLayoutManager(int horizontalAlign, int verticalAlign, int lineOrientation,
            int startCorner, boolean wrap, int linespace, int letterspace,
            int horizontalTabSpace)
```

Constructs a DVBTextLayoutManager object.

Parameters:

`horizontalAlign` - Horizontal alignment setting

`verticalAlign` - Vertical alignment setting

`lineOrientation` - Line orientation setting

`startCorner` - Starting corner setting

`wrap` - Text wrapping setting

`linespace` - Line spacing setting expressed in points

`letterspace` - Letterspacing adjustment relative to the default letterspacing. Expressed in units of 1/256th point as the required increase in the spacing between consecutive characters. May be either positive or negative.

`horizontalTabSpace` - Horizontal tabulation setting in points

Methods

addTextOverflowListener(TextOverflowListener)

```
public void addTextOverflowListener(org.dvb.ui.TextOverflowListener l)
```

Register a TextOverflowListener that will be notified if the text string does not fit in the component when rendering.

Parameters:

`l` - a listener object

getHorizontalAlign()

```
public int getHorizontalAlign()
```

Get the horizontal alignment.

Returns:

Horizontal alignment setting

getHorizontalTabSpacing()

```
public int getHorizontalTabSpacing()
```

Get the horizontal tabulation spacing.

Returns:
the horizontal tabulation spacing

getInsets()

```
public java.awt.Insets getInsets()
```

Returns the insets set by the setInsets method. These Insets are added to the ones passed to the `render` method for rendering the text. When not previously set, zero Insets are returned.

Returns:
Insets set by the setInsets method

getLetterSpace()

```
public int getLetterSpace()
```

Get the letter space setting. This is a 16 bit signed integer specifying in units of 1/256th point the required increase in the spacing between consecutive characters. It corresponds to the “track” parameter in the MHP text rendering rules.

Returns:
letter space setting

getLineOrientation()

```
public int getLineOrientation()
```

Get the line orientation.

Returns:
Line orientation setting

getLineSpace()

```
public int getLineSpace()
```

Get the line space setting.

Returns:
line space setting or -1, if the default line spacing is determined from the size of the default font used.

getStartCorner()

```
public int getStartCorner()
```

Get the starting corner.

Returns:
Starting corner setting

getTextWrapping()

```
public boolean getTextWrapping()
```

Get the text wrapping setting.

Returns:
text wrapping setting

---

getVerticalAlign()

```
public int getVerticalAlign()
```

Get the vertical alignment.

Returns:
Vertical alignment setting

---

removeTextOverflowListener(TextOverflowListener)

```
public void removeTextOverflowListener(org.dvb.ui.TextOverflowListener l)
```

Removes a TextOverflowListener that has been registered previously.

Parameters:
`l` - a listener object

---

render(String, Graphics, HVisible, Insets)

```
public void render(java.lang.String markedUpString, java.awt.Graphics g,
            org.havi.ui.HVisible v, java.awt.Insets insets)
```

Render the string. The `HTextLayoutManager` should use the passed `HVisible` object to determine any additional information required to render the string, e.g. `Font`, `Color` etc.

The text should be laid out in the layout area, which is defined by the bounds of the specified `HVisible`, after subtracting the insets. If the insets are `null` the full bounding rectangle is used as the area to render text into.

The `HTextLayoutManager` shall not modify the clipping rectangle of the `Graphics` object.

Specified By:
`render` in interface `HTextLayoutManager`

Parameters:
`markedUpString` - the string to render.

`g` - the graphics context, including a clipping rectangle which encapsulates the area within which rendering is permitted. If a valid insets value is passed to this method then text must only be rendered into the bounds of the widget after the insets are subtracted. If the insets value is `null` then text is rendered into the entire bounding area of the `HVisible`. It is implementation specific whether or not the renderer takes into account the intersection of the clipping rectangle in each case for optimization purposes.

`v` - the `HVisible` into which to render.

`insets` - the insets to determine the area in which to layout the text, or `null`.

---

setHorizontalAlign(int)

```
public void setHorizontalAlign(int horizontalAlign)
```

Set the horizontal alignment. The setting shall be one of `HORIZONTAL_CENTER`, `HORIZONTAL_END_ALIGN` or `HORIZONTAL_START_ALIGN`. The failure mode if other values are used is implementation dependent.

Parameters:
`horizontalAlign` - Horizontal alignment setting

---

setHorizontalTabSpacing(int)

`public void **setHorizontalTabSpacing**(int horizontalTabSpace)`

Set the horizontal tabulation spacing.

Parameters:
`horizontalTabSpace` - tab spacing in points

---

setInsets(Insets)

`public void **setInsets**(java.awt.Insets insets)`

Sets the insets which shall be used by this DVBTextLayoutManager to provide a "virtual margin". These shall be added to the insets passed to the `Render` method (which are to be considered as "bounds"). If this method is not called, the default insets are 0 at each edge.

Parameters:
`insets` - Insets that should be used

---

setLetterSpace(int)

`public void **setLetterSpace**(int letterSpace)`

Set the letter space setting. This is a 16 bit signed integer specifying in units of 1/256th point the required increase in the spacing between consecutive characters. It corresponds to the "track" parameter in the MHP text rendering rules.

Parameters:
`letterSpace` - letter space setting

---

setLineOrientation(int)

`public void **setLineOrientation**(int lineOrientation)`

Set the line orientation. The setting shall be one of `LINE_ORIENTATION_VERTICAL`, `LINE_ORIENTATION_HORIZONTAL`. The failure mode if other values are used is implementation dependent.

Parameters:
`lineOrientation` - Line orientation setting

---

setLineSpace(int)

`public void **setLineSpace**(int lineSpace)`

Set the line space setting. Using -1 as the line space setting shall cause the line spacing to be set to the default value as defined for the no-argument constructor for this class.

Parameters:
`lineSpace` - line space setting

---

setStartCorner(int)

`public void **setStartCorner**(int startCorner)`

Set the starting corner. The setting shall be one of START_CORNER_UPPER_LEFT, START_CORNER_UPPER_RIGHT, START_CORNER_LOWER_LEFT or START_CORNER_LOWER_RIGHT. The failure mode if other values are used is implementation dependent.

Parameters:
startCorner - Starting corner setting

---

setTextWrapping(boolean)

```
public void setTextWrapping(boolean wrap)
```

Set the text wrapping setting.

Parameters:
wrap - Text wrapping setting

---

setVerticalAlign(int)

```
public void setVerticalAlign(int verticalAlign)
```

Set the vertical alignment. The setting shall be one of VERTICAL_CENTER, VERTICAL_END_ALIGN or VERTICAL_START_ALIGN. The failure mode if other values are used is implementation dependent.

Parameters:
verticalAlign - Vertical alignment setting

org.dvb.ui
FontFactory

Declaration

```
public class FontFactory

java.lang.Object
  |
  +--org.dvb.ui.FontFactory
```

Description

Provides a mechanism for applications to instantiate fonts that are not built into the system. The two constructors of this class allow fonts to be downloaded either through the font index file of the application or directly from a font file in the format(s) specified in the main body of the present document.

Constructors

FontFactory()

```
public FontFactory()
            throws FontFormatException, IOException
```

Constructs a FontFactory for the font index file bound to this application in the application signalling. The call to the constructor is synchronous and shall block until the font index file has been retrieved or an an exception is thrown.

Throws:

`FontFormatException` - if there is an error in the font index file bound with the application.

`java.io.IOException` - if there is no font index file bound with the application, or if there is an error attempting to access the data in that file.

FontFactory(URL)

```
public FontFactory(java.net.URL u)
            throws IOException, FontFormatException
```

Constructs a FontFactory for the font file found at the given location. The call to the constructor is synchronous and shall block until the font file has been retrieved or an exception is thrown.

Parameters:

`u` - The location of the font file

Throws:

`java.io.IOException` - if there is an error attempting to access the data referenced by the URL

`java.lang.IllegalArgumentException` - if the URL is not both valid and supported

`java.lang.SecurityException` - if access to the specified URL is denied by security policy

`FontFormatException` - if the file at that URL is not a valid font file as specified in the main body of the present document

Methods

---

createFont(String, int, int)

```
public java.awt.Font createFont(java.lang.String name, int style, int size)
            throws FontNotAvailableException, FontFormatException, IOException
```

Creates a font object from the font source associated with this FontFactory. This font will remain valid even if the FontFactory is no longer reachable from application code. The name returned by Font.getName() might not be the same as the name supplied, for example, it might have a string prepended to it that identifies the source FontFactory in a platform-dependant manner. For FontFactory instances bound to the font index file of an application, the call to the method is synchronous and shall block until either an exception is thrown or any required network access has completed.

The value of the style argument must be as defined in java.awt.Font. Valid values are the following:

- `java.awt.Font.PLAIN`
- `java.awt.Font.BOLD`
- `java.awt.Font.ITALIC`
- `java.awt.Font.BOLD + java.awt.Font.ITALIC`

Parameters:

`name` - the font name

`style` - the constant style used, such as java.awt.Font.PLAIN.

`size` - the point size of the font

Throws:

`FontNotAvailableException` - if a font with given parameters cannot be located or created.

`java.io.IOException` - if there is an error retrieving a font from the network. Thrown only for font factory instances bound to the font index file of an application.

`java.lang.IllegalArgumentException` - if the style parameter is not in the set of valid values, or if the size parameter is zero or negative.

`FontFormatException` - if the font file is not a valid font file as specified in the main body of the present document. Thrown only for font factory instances bound to the font index file of an application.

org.dvb.ui
FontFormatException

Declaration

```
public class FontFormatException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.ui.FontFormatException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when attempt is made to read a file describing a font when the contents of that file are not valid.

Constructors

FontFormatException()

```
public FontFormatException()
```

Constructs a FontFormatException with null as its error detail message.

FontFormatException(String)

```
public FontFormatException(java.lang.String s)
```

Constructs a FontFormatException with the specified detail message. The error message string s can later be retrieved by the java.lang.Throwable.getMessage() method of class java.lang.Throwable.

Parameters:

s - the detail message.

org.dvb.ui
FontNotAvailableException

Declaration

```
public class FontNotAvailableException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.ui.FontNotAvailableException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when attempt is made to instantiate a font that cannot be located.

Constructors

FontNotAvailableException()

```
public FontNotAvailableException()
```

Constructs a FontNotAvailableException with null as its error detail message.

FontNotAvailableException(String)

```
public FontNotAvailableException(java.lang.String s)
```

Constructs a FontNotAvailableException with the specified detail message. The error message string s can later be retrieved by the java.lang.Throwable.getMessage() method of class java.lang.Throwable.

Parameters:

s - the detail message.

org.dvb.ui
TestOpacity

Declaration
```
public interface TestOpacity
```

All Known Implementing Classes:
`org.havi.ui.HComponent`

Description
Interface implemented by Components or Containers in order to allow the platform to query whether their paint method is fully opaque.

Methods

---

isOpaque()

```
public boolean isOpaque()
```

Returns true if the entire area of the component as given by the getBounds method, is fully opaque. Hence its paint method (or surrogate methods) guarantees that all pixels are painted in an opaque Color.

Classes implementing this interface shall return true from their implementation of this method if and only if their implementation can guarantee full opacity. The consequences of an invalid overridden value are implementation specific.

Returns:

true if all the pixels with the java.awt.Component#getBounds method are fully opaque, otherwise false.

org.dvb.ui
TextOverflowListener

Declaration

```
public interface TextOverflowListener extends java.util.EventListener
```

All Superinterfaces:

`java.util.EventListener`

Description

The TextOverflowListener is an interface that an application may implement and register in the DVBTextLayoutManager. This listener will be notified if the text string does not fit within the component as a result of a call to the render method. It is the rendering process which triggers this event to be dispatched. The timing of this is implementation dependent.

Methods

---

notifyTextOverflow(String, HVisible, boolean, boolean)

```
public void notifyTextOverflow(java.lang.String markedUpString, org.havi.ui.HVisible v,
            boolean overflowedHorizontally, boolean overflowedVertically)
```

This method is called by the DVBTextLayoutManager if the text does not fit within the component

Parameters:

`markedUpString` - the string that was successfully rendered within the component

`v` - the HVisible object that was being rendered

`overflowedHorizontally` - true if the text overflowed the bounds of the component in the horizontal direction; otherwise false

`overflowedVertically` - true if the text overflowed the bounds of the component in the vertical direction; otherwise false

org.dvb.ui
UnsupportedDrawingOperationException

Declaration

```
public class UnsupportedDrawingOperationException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.ui.UnsupportedDrawingOperationException
```

All Implemented Interfaces:

java.io.Serializable

Description

The UnsupportedDrawingOperationException class represents an exception that is thrown if an drawing operation is not supported on this platform. E.g. DVBGraphics.setComposite could throw an Exception when setting the DST_IN rule on some devices while the SRC_OVER rule will always work.

Since:

MHP 1.0

Constructors

UnsupportedDrawingOperationException(String)

```
public UnsupportedDrawingOperationException(java.lang.String s)
```

Constructs an instance of UnsupportedDrawingOperationException with the specified detail message.

Parameters:

s - the detail message

Since:

MHP1.0

Annex V : Void

Annex W (informative): DVB-J examples

W.1 DVB-J Application lifecycle implementation example

```
import org.havi.ui.HScene;
import org.havi.ui.HSceneFactory;
import java.awt.Component;
import java.awt.BorderLayout;
import org.dvb.ui.DVBColor;
import javax.tv.xlet.Xlet;
import javax.tv.xlet.XletContext;
import javax.tv.xlet.XletStateChangeException;


public class HelloDVB extends Component implements Xlet {

   private XletContext context;
   private HScene scene;

   public void initXlet(XletContext context) throws XletStateChangeException {
      this.context = context;
      scene = HSceneFactory.getInstance().getDefaultHScene();
      scene.setBounds( 90,72,540,432 );
      scene.setLayout(new BorderLayout(0, 0));
      scene.add(this, "Center");
   }

   public void startXlet() throws XletStateChangeException {
      scene.setVisible(true);
      requestFocus();
   }

   public void pauseXlet() {
      scene.setVisible(false);
   }

   public void destroyXlet(boolean unconditional) throws XletStateChangeException {
      scene.dispose();
   }

   public void paint(java.awt.Graphics g) {
      g.setColor(new DVBColor(0, 0, 70, 180));
      g.fillRect(0, 0, getSize().width, getSize().height);
      g.setColor(DVBColor.yellow);
      g.drawString("Hello DVB", (getSize().width-110) / 2, getSize().height / 2);
   }
}
```

A simple example of Xlet lifecycle is a stock ticker application that uses a back channel to retrieve stock quotes, which it displays on the viewer's television.

a) The application manager retrieves the Xlet's code.

b) The application manager creates an instance of the XletContext Object and initializes it for the new Xlet.

c) The application manager initializes the Xlet by calling its `initXlet()` method and passing it the context object.

d) The Xlet uses the context object to initialize itself and enters the `Paused` state.

e) The application manager calls the Xlet's `startXlet()` method. The application manager assumes that the Xlet is performing its service.

f) Upon receiving this signal, the Xlet creates a new thread that opens the back channel to retrieve the stock quotes. The Xlet is now in the `Active` state.

g) The Xlet begins to show the stock quotes.

h) Due to circumstances beyond the control of the Xlet, it is no longer able to retrieve updated stock quotes.

i) The Xlet decides to continue displaying the most recent quotes it has.

NOTE: The Xlet is still in the `Active` state.

j) After a time, the Xlet is still unable to open the back channel. It decides that the quotes it is displaying are too old to present and that it can no longer perform its service. It chooses to take itself out of the `Active` state. It calls the `paused()` method on XletContext to signal this change to the application manager.

k) Finally, the Xlet decides it no longer has any chance of performing its service, so it decides it should be terminated. It calls the `destroyed()` method on the XletContext to signal application manager that it has entered the `Destroyed` state. The Xlet does some final clean up.

l) The application manager prepares the Xlet for garbage collection.

W.2 Example of exporting an object for inter-application communication

```
public interface MyService extends java.rmi.Remote {
      public String getData() throws java.rmi.RemoteException;
   }

   public class MyServer implements MyService {

      private static javax.tv.xlet.XletContext ctx;

      public String getData() throws java.rmi.RemoteException {
         return "Hello from " + ctx.getXletProperty("dvb.app.id");
      }

      //
      // Called upon Xlet initialization
      //
      public static void export(XletContext ctx) {
         this.ctx = ctx;
         Remote server = new MyServer();
         org.dvb.io.ixc.IxcRegistry.bind(ctx, "myserver", server);
      }

      //
      //  Try to import the object that we previously exported.
      // Note that this would typically be done from a different
      // Xlet, but importing from yourself works, too.
      // Called when the Xlet is run.
      //
      public static void import(XletContext ctx) {
         String appId = (String) ctx.getXletProperty("dvb.app.id");
         String orgId = (String) ctx.getXletProperty("dvb.org.id");

         Remote obj;
         try {
            org.dvb.io.ixc.IxcRegistry.lookup(ctx, "/" + orgId + "/" + appId + "/myserver");
            MyService r = (MyService) obj;
            System.out.println("Success " + r
                               + ", " + r.getData());
         } catch (Exception ex) {
         }
      }
   }
```

W.3 Example of use of video drip feed

```
import java.lang.*;
import java.io.*;
import javax.tv.xlet.*;
import javax.media.*;
import java.net.URL;
import org.dvb.media.DripFeedPermission;
import org.dvb.media.DripFeedDataSource;
```

```
/**
 * VideoDripTest creates an instance of DripFeedDataSource and creates a player
 * using this source.
 */
public class SingleVideoDripTest implements javax.tv.xlet.Xlet
{
   static final int    MAX_DRIP_DATA_SIZE = 32000;
   private DripFeedDataSourcedripDataSource = null;
   private Player dripPlayer = null, oldPlayer = null;

   public void initXlet(XletContext ctx) throws XletStateChangeException
   {

      /* Check if this application has permission to play video drip
       * feed or not.
       */
      System.err.println("initXlet called");

      SecurityManager sm = System.getSecurityManager();

      System.err.println("Checking the permission");

      if (sm != null) {
         try {
            sm.checkPermission(new DripFeedPermission(""));
         }
         catch(java.lang.SecurityException ex) {
            throw new XletStateChangeException(ex.getMessage());
         }
      }

      System.err.println("Exiting initXlet method");
   }

   public void startXlet() throws XletStateChangeException
   {
      byte[] dripData = new byte[MAX_DRIP_DATA_SIZE];

      /* Assumption: No media player is active. If this is not true, we
       * need to get the current player and stop/close it.
       */
      System.err.println("startXlet called");

      try {
         /* Create a data source for video drip */
         dripDataSource = new DripFeedDataSource();

         System.err.println("Got the DataSource");

         /* Create a player and start it */
         dripPlayer = Manager.createPlayer(dripDataSource);
      }
      catch (IOException ioe1)
      {
         System.err.println(ioe1.getMessage());
         throw new XletStateChangeException(ioe1.getMessage());
      }
      catch (NoPlayerException pse)
      {
         System.err.println(pse.getMessage());
         throw new XletStateChangeException(pse.getMessage());
      }

      System.err.println("Starting Drip Player");

      dripPlayer.start();

      System.err.println("Started the player");

      /* Read drip data from a file */
```

```
      try
      {
         FileInputStream fin = new FileInputStream("images.mpg");
         fin.read(dripData);
         fin.close();
      }
      catch (IOException ioe2)
      {
         System.err.println("IOException: " + ioe2.getMessage());
         throw new XletStateChangeException(ioe2.getMessage());
      }
      catch (SecurityException se)
      {
         System.err.println(se.getMessage());
         throw new XletStateChangeException("Security Exception" + se.getMessage());
      }

      System.err.println("Feeding data to the datasource");

      /* Feed the data to the data source */
      dripDataSource.feed(dripData);

      System.err.println("Fed data to the datasource");
   }

   public void pauseXlet()
   {
   }

   public void destroyXlet(boolean unconditional)
   {
      dripPlayer.close();
   }
}
```

W.4 Example of CPU bound animation

```
/**
 * This is an example of doing CPU-bound animation.  This
 * code attempts to do animation as fast as possible, using
 * a low-priority thread so that the animation doesn't interfere
 * with more important tasks, like responding to user input.  Animation
 * is limited to 25 frames per second, just in case we're running on
 * a really fast box.
 **/

import java.awt.Graphics;
import java.awt.Component;
import java.awt.Dimension;
import java.awt.Toolkit;
import org.dvb.ui.DVBBufferedImage;

public abstract class AnimatedView extends Component implements Runnable {

    private Thread worker = null;
    private Graphics theScreen = null;
    private DVBBufferedImage buffer = null;
    private boolean stopping = false;

    /**
     * Called by the Xlet to start animation.  Must never be called
     * when animation is in progress!
     */
    public synchronized void startAnimation() {
        if (worker != null) {
            throw new IllegalStateException();    // It's a bug
        }
        worker = new Thread(this);
        worker.setPriority(2);        // Animation is CPU-bound
        theScreen = getGraphics();    // Component.getGraphics()
        Dimension d = getSize();
```

```
    buffer = new DVBBufferedImage(d.width, d.height);
    stopping = false;
    worker.start();
}

/**
 * Stop animation, and don't return until it has stopped.
 */
public synchronized void stopAnimation() {
    if (worker == null) {
        throw new IllegalStateException();    // it's a bug
    }
    stopping = true;
    for (;;) {        // Wait until stopped
        if (Thread.interrupted()) {        // Xlet being terminated
            return;
        }
        notifyAll();
        try {
            wait();
        } catch (InterruptedException ex) {
           Thread.currentThread().interrupt();
        }
        if (!stopping) {
            theScreen.dispose();
            theScreen = null;
            buffer.flush();
            buffer = null;
            worker = null;
            return;
        }
    }
}

/**
 * Run the animation until stopped.  Called from the worker thread
 * only.  This will probably be CPU-bound, as it sets an ambitious
 * target of 25fps animation.
 */
public void run() {

    long start = System.currentTimeMillis();
    long lastFrameTime = start - 40;
    long now = 0;

    animation:
    for (;;) {

        // Wait until at least 1/25 of a second after last frame, and
        // bail out of thread if we're stopping
        synchronized(this) {
        for (;;) {
            if (stopping) {
                stopping = false;
                notifyAll();
                return;
            }
            if (Thread.interrupted()) {        // Xlet being terminated
                return;
            }
            now = System.currentTimeMillis();
            long delta = now - lastFrameTime;
            if (delta >= 40) {
                break;
            } else {
                try {
                    wait(40 - delta);
                } catch (InterruptedException ex) {
                    Thread.currentThread().interrupt();
                }
            }
```

```
            }
        }
        lastFrameTime = now;
        long timeSinceStart = now - start;

        Graphics g = buffer.getGraphics();

        for (int part = 0; part < getNumParts(); part++) {
            drawPart(part, g, timeSinceStart);

            if (shouldStop()) {
                continue animation;    // Bail out if animation should stop
            }
        }

        g.dispose();
        theScreen.drawImage(buffer, 0, 0, null);
        Toolkit.getDefaultToolkit().sync();

        // It is essential to yield this thread.  In the
        // Java threading model, a CPU-bound low priority
        // thread can prevent a higher priority thread from
        // running if the low priority thread never yields
        // or waits.
        Thread.currentThread().yield();
        }
    }

    private synchronized boolean shouldStop() {
        return Thread.interrupted() || stopping;
    }

    public synchronized void paint(Graphics g) {
        if (worker == null || stopping) {
            // Paint whatever we paint when we're not animating
        } else {
            // Probably do nothing.  If our animation target were
            // significantly less than 25 fps, we'd want to set a variable
            // to cause a repaint ASAP, then call notifyAll() to break
            // the animation loop out of any wait() it might be in.
        }
    }

    /**
     * Draw a part of the animation. For each frame, AnimatedView will call
     * this method first for part 0, then part 1, up to getNumParts()-1.
     * Between each part, AnimatedView will check if animation needs to
     * stop for some reason.
     * <p>
     * Subclasses should ensure that drawing the entire scene is divided
     * into enough parts to ensure that animation can be stopped quickly.
     *
     * @see #getNumParts
     */
    protected abstract void drawPart(int num, Graphics g, long timeSinceStart);

    /**
     * @return the number of parts in this animation.  This determines how
     * many times drawPart will be called.
     *
     * @see #drawPart
     */
    protected abstract int getNumParts();
}
```

W.5 Example of using optional APIs

```
/**
 * This is an example of writing application code that uses
 * an optional API that may not be present on all MHP
```

```
 * platforms.  In this case, the application tests for
 * the presence of the class org.dvb.internet.WWWBrowserService.
 * If it is present, then the application has available to
 * it that API, and other APIs needed for internet access.
 * <p>
 * This is the main Xlet class
 **/

public class MyXlet implements javax.tv.xlet.Xlet {
    ...

    public wFeatures wFeatures = null;
    // This object is the gateway to all of the Xlet
    // code that relies on the internet access profile.  If
    // null, the Xlet is running on a box not supporting
    // the internet access profile.

    public void initXlet(javax.tv.xlet.XletContext ctx) {
        ...

        try {
            Class c = Class.forName(
                "org.dvb.internet.WWWBrowserService");
                    // We have a www browser!
                c = Class.forName("wFeaturesImpl");
                    // An Xlet class
                wFeatures = c.newInstance();
                    // Calls default constructor
        } catch (ClassNotFoundException ex) {
            // No internet profile support, so we leave wFeatures null.
        }

    }
}

/**
 * This interface is used by the Xlet to call into
 * code that uses a www browser in any way.  It
 * is essential that the only code in the Xlet that
 * uses classes not present on the IA profile be reached
 * via the class that implements this interface.  If an
 * Xlet directly references an API from some other place, then
 * the entire Xlet might fail to load on valid MHP
 * implementations.
 * <p>
 * In technical terms, when a class is loaded, a valid Java
 * implementation may load the transitive closure of all
 * statically-referenced classes, and fail to load the first
 * class if any of the other classes are not found.  Thus,
 * if an Xlet directly references an API that is not present,
 * the entire Xlet could fail to load on valid MHP
 * implementations.  As examples, static references can
 * be the types of data members or local variables in code
 * blocks, even if those code blocks are never executed.
 * <p>
 * To put the APIs that might not be present outside of the
 * transitive closure of statically referenced classes, we
 * introduce this interface, and dynamically load the single
 * class that implements it using Class.forName().  The class
 * that implements this interface can contain static references
 * to APIs that might not be present, and it can contain static
 * references to classes that reference such classes.
 *  <p>
 *  This interface can be thought of as a Facade.
 *  See the Facade pattern on page 185 of GoF
 *  ("Design Patterns" by Gamma et al, ISBN
 *  0-201-63361-2).
 **/

public interface wFeatures {
```

```
    /**
     * Set up the www browser, and get ready for the Xlet
     * to run.
     **/
    public void init();

    ... Here, there are declarations of all of the features
    of the Xlet that use the www browser.
    There might be other methods, to manage
    the www browser during Xlet state transitions,
    such as to the paused or destroyed state  ...

}


/**
 * This class contains implementations of all features of the
 * xlet that depend on the presence of a www browser.  It
 * can safely reference classes that are not present in the
 * IA profile, and it can safely reference classes that
 * reference such classes.
 **/

public class wFeaturesImpl implements wFeatures {

    private org.dvb.internet.WWWBrowserService;

    public void init() {

        javax.tv.service.ServiceType s=org.dvb.internet.InternetServiceType.INTERNET_CLIENT;
    }

    ...  Here, there are implementations of the features
    declared above ...

}
```

W.6 Example of xlet Identity Verification

```
/**
 * The following is an example of two xlets verifying eachothers' identities
 * via inter-xlet communication.  When an xlet imports an object from another
 * xlet, the importer knows the organisation ID and application ID of the exporter,
 * but the exporter has no way of verifying the identity of the importer.  If a
 * service were exported without verifying identities, some kinds of spoofing
 * attacks might be possible.  These can be protected against with code modeled
 * on the following Java-like pseudocode.  In this pseudocode, failures (e.g.
 * exceptions) are not addressed.
 **/

public interface VerifiedExporter extends java.rmi.Remote {
    public void acceptConnection(VerifiedImporter im, String orgId, Stirng appId);
}

public interface VerifiedImporter extends java.rmi.Remote {
    public void verifyExporter(VerifiedExporter ex);
}

/**
 * The exporting xlet binds a singleton instance of VerifiedExporterImpl to
 * the name "dvb:/ixc/org_id/app_id/Exporter", where VerifiedExporterImpl contains
 * the following:
 **/

public class VerifiedExporterImpl implements VerifiedExporter {

    public void acceptConnection(VerifiedImporter im, String appId, String orgId) {
        javax.microedition.xlet.ixc.IxcRegistry reg = ... this xlet's registry ...;
        ...  verify orgId and appId represent someone we're willing to talk to ...
        String name = "dvb:/ixc/" + appId + "/" + orgId + "/Importer";
        VerifiedImporter regImp = (VerifiedImporter) reg.lookup(name);
```

```
        if (regImp != im) {
            throw new RuntimeException("Spoofing attack foiled");
        }
        ...  Add imp to a collection of objects we're willing to talk to ...
        im.verifyExporter(this);
    }
}

/**
 * The importing xlet binds a singleton instance of VerifiedImporterImpl to
 * the name "dvb:/ixc/org_id/app_id/Importer", where VerifiedImporterImpl contains
 * the following:
 **/

public class VerifiedImporterImpl implements VerifiedImporter {

    private VerifiedExporter peer;

    private VerifiedImporterImpl(VerifiedExporter peer) {
        this.peer = peer;
    }

    public static setupConnection(VerifiedExporter ex) {
        javax.microedition.xlet.ixc.IxcRegistry reg = ... this xlet's registry ...;
        String nm = ... the name of the VerifiedExporter instance ...;
        VerifeedExporter ex = (VerifiedExporter) reg.lookup(name);
        VerifiedImporter im = new VerifiedImporter(ex);
        String orgId = our organisation ID;
        String appId =  our application ID;
        String name = "dvb:/ixc/" + appId + "/" + orgId + "/Importer";
        reg.bind(name, im);
        ex.acceptConnection(im, orgId, appId);
    }

    public void verifyExporter(VerifiedExporter ex) {
        if (ex != peer) {
            throw new RuntimeException("Spoofing attack foiled");
        }
        ...  Add ex to a collection of objects we're willing to talk to ...
    }
}

/**
 * Note that this technique relies on the == relation being true for an object
 * reference that's sent to a different xlet, then sent back.  This is guaranteed to be
 * true for IXC, but is not a feature of RMI.  For this reason, the above technique
 * will not work with RMI.
 **/
```

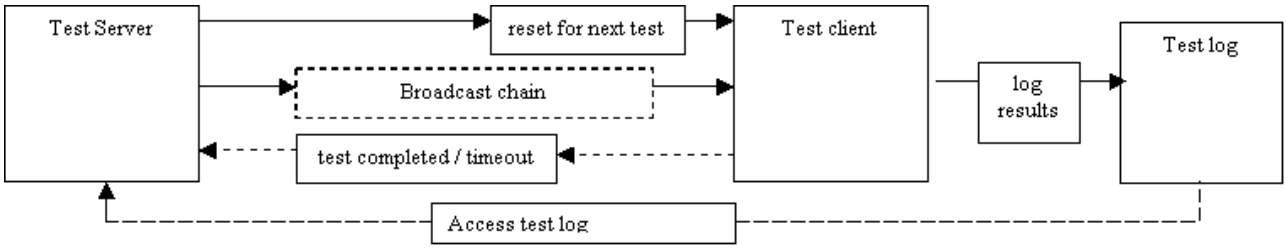
Annex X (normative): Test support

Package
Broadcast model

Description

In a broadcast-based conformance system, there are effectively three main entities involved in an automated test process:

1. The test server that is used to hold and initiate all of the tests.
2. The test client which runs the tests and logs the results.
3. The broadcast chain that is used to transfer applications and application data from the server to the client.



The communication order is as follows:

1. The test-server uses the "reset for next test" mechanism to set the test client into a known default state, ready to receive the test-application.
2. The test-server uses the "broadcast chain" mechanism to supply the test-application to the test client and to signal that the test-application should be executed.
3. The test-client runs the test-application.
4. The test-application either:

- finishes within a given timelimit, the result of the test is known and shall be considered to be the value reported by the test application for the purposes of compliance.
- Optionally, the test-client may signal to the test-server that the test-application has finished executing and that the test-client is ready to be reset in order to receive the next test-application.
- fails to finish the test-application within a given timeout, the result of the test is unknown and shall be treated as a failure for the purposes of compliance. The test-server may treat the test-client as ready to be reset in order to receive the next application.

[Successive tests are then repeated from stage 1.]

"Reset for next test"

The "reset for next test" path is used by the test server to reset the test client to receive the next test. The reset for next test API is considered to be a private implementation issue between the test-server and test-client and therefore has no public Java API implications. Note that this "communication" needs to take place prior to any application being executed. Note that the precise manner of the reset mechanism is intentionally not specified —- in the worst case, this may involve "power cycling" the test client.

Test log

Communication from the test client to the test log is considered as write-only access. Hence, results from successive tests cannot overwrite results from previous ones. Multiple (intermediate) results may be sent to the test log for any given test. It is recommended that all communication to the test log is synchronous.

See the DVBTest.log method for details of the proposed API and implementation issues.

"Test completed"

The "test completed" path is used by the test client to indicate to the test server that it has completed the previous test and is now able to accept a subsequent one. Note that this communication path is an optimization, since direct communication from the client to the server is not actually required, e.g. the server might simply "time-out" the client, and then perform a "reset for next test" action. However, this optimization may be important when large numbers of tests are being performed on a "capable" platform, since e.g. if a 30 second timeout is applied for 1 000 test cases which typically run within say 6 seconds, then the timeout implies a typical running time of 500 minutes, i.e. ~4,5 hours ——- rather than 100 minutes, i.e. ~1,5 hours.

See the DVBTest.terminate method for details of the proposed API and implementation issues.

Access test log

The mechanism by which the test-log is accessed is not considered in this document, this is a private mechanism, which might include reading a file from flash / RAM. Similarly, the mechanism by which results are recovered from the test log is not considered in the present document, e.g. the test-log may actually reside on the test server, e.g. as in the case that results are transmitted over an IP connection.

Class Summary	
Classes	
DVBTest	The DVBTest class allows test applications to log messages during their execution and to indicate their termination condition in a platform independent manner.

org.dvb.test
DVBTest

Declaration

```
public class DVBTest

java.lang.Object
   |
   +--org.dvb.test.DVBTest
```

Description

The DVBTest class allows test applications to log messages during their execution and to indicate their termination condition in a platform independent manner.

A number of constants are defined in the DVBTest class and are reserved as follows

- Zero and negative values defined within the class are reserved by DVB.
- Positive return values are available for test application specific return values, which must be defined within the procedure for executing the test application as to their precise meaning as regards conformance.

Fields

FAIL

```
public static final int FAIL
```

The application executed and terminated unsuccessfully and has therefore operated in a non-conformant manner.

HUMAN_INTERVENTION

```
public static final int HUMAN_INTERVENTION
```

The application is unable to determine whether it has operated conformantly and therefore requires some human intervention to determine whether conformance has been achieved. Until the application has been checked the result of the application should be considered as non-conformant.

It is envisaged that tests returning this value may be those requiring evaluation of presented content, such as graphics, etc. Such presentation may require (subjective) human evaluation.

OPTION_UNSUPPORTED

```
public static final int OPTION_UNSUPPORTED
```

The platform does not contain the option under test and therefore the test is inapplicable, the test result should not be considered when determining the status of the platform's conformance.

PASS

```
public static final int PASS
```

The application executed and terminated successfully and has therefore operated in a conformant manner.

UNRESOLVED

```
public static final int UNRESOLVED
```

A setup stage necessary to execute the application failed, and hence the result of the application is unknown and therefore should be considered to have operated in a non-conformant manner.

UNTESTED

```
public static final int UNTESTED
```

The application ran successfully, but the particular test was unable to execute. Hence the result of is unknown, and may require human evaluation to determine conformance.

For example, an out of disk space test may not execute within a fixed number of iterations (within a practical amount of time) for devices with large capacity storage, etc.

Methods

log(String, int)

```
public static void log(java.lang.String id, int no)
            throws IOException
```

This method has the same behaviour, implementation options and restrictions as log(String, String) - except that. it allows an integer value to be logged, rather than a String, which may prove a useful option for automating tests.

Parameters:

`id` - a string identifying the application (thread) that is logging the test result.

`no` - the integer value that the application wishes to be logged.

Throws:

`java.io.IOException` - under the same conditions as log(String, String).

log(String, String)

```
public static void log(java.lang.String id, java.lang.String message)
            throws IOException
```

This synchronous, blocking, method logs a result (intermediate result) of a test application using write-only access. The method takes both an identifier string, e.g. “Test number 1” and a message to output, e.g. “Now invoking the xletPause method...”. The application is not required to open a file or network connection, per se, and the log() method is always available for writing (in principle).

The precise format of the logged message is left deliberately unspecified, implementers may choose to output compressed messages, XML documents, or other formats of their choice (obviously provided that the original information can be recovered). It is an implementation option to include additional information with each logging message, e.g. including:

- version of the specification being implemented
- compiler version and options.
- build-version
- timestamp
- date
- debug info

Messages sent using this method should “atomic”, i.e. that they are not interleaved with other messages sent using the methods defined in the DVBTest class.

Implementation

The precise mechanism(s) by which the this method may be implemented are intentionally unspecified, implementation options might include:

- logging the message to a local file system.
- logging the message to a mounted remote file system.
- logging the message to a RAM disk, etc.
- logging the message via an RS-232 (or other serial) connection.
- logging the message to a remote host via some IP / UDP based mechanism, e.g. using a socket-based connection.

Note that the implementation of the log method may use the same or a different mechanism to that used by the terminate method.

The log method does not require any explicit initialisation on the part of the application under test. For example if messages are being stored to a file system, then the application is not required to mount / open any storage file. Similarly, if the messages are being logged via a network connection, then the application is not required to open a connection to the storage host, etc. In principle, the mechanism should always be available to accept messages.

If this method is implemented on top of some buffering mechanism, it is strongly recommended that the buffer be flushed for each occurrence of a message being logged.

Security and implementation options

There is no Java security mechanism that is used to secure the log method.

Note that even if the log method is based on a particular implementation option, it shall be able to operate in spite of that particular implementation option itself being subject to security checks. For example, a log method implemented using the java.net.Socket class shall always be able to log a message from a test-application, even if the test-application is unable to directly access the java.net.Socket class due to security restrictions, etc.

It is an allowed implementation option to require that the test-client be put into some particular “test-mode” before any test-results are logged. This mechanism is required to reduce any inadvertent interaction due to downloaded applications accessing the test methods.

Authoring guidelines

The log method is not intended to be accessed by downloaded applications directly, it is purely intended for the use of conformance test applications. Authors of downloaded applications should not call this method, since there may be interactions between this method and normal in-field operation of the test-client (MHP platform).

It is an allowed implementation option to require that the test-client be put into some particular “test-mode” before any test-results are logged. This mechanism is required to reduce any inadvertent interaction due to downloaded applications accessing the test methods.

It is an allowed implementation option to have a number of “test-modes” that are appropriate to different elements being conformance tested, for example, it is a valid implementation for a test-client to have a test-mode where results are stored via a serial port, and a separate test-mode where results are stored via a RAM disk. It is allowable for a conformance test to be performed with the test-client in some specific test- mode, e.g. a java.net test (using a serial modem) might have its test results logged to a RAM disk, to avoid interaction between test-log messages and the serial protocol.

The mechanism by which a test-client is put into a given test mode is intentionally left unspecified.

Relationship to java.io

It is an implementation option to map the implementation of this method onto corresponding write method(s) of appropriate java.io classes. These classes may in turn be obtained, e.g. from java.net Socket classes, etc.

Parameters:

`id` - a string identifying the application (thread) that is logging the test result.

`message` - the message that the application wishes to be logged.

Throws:

`java.io.IOException` - if there is any problem in providing synchronous logging to an application. This IOException may be due to failure to write to a file system, inability to access a remote socket, etc. the precise causes are deliberately unspecified and are implementation dependent.

---

prompt(String, int, String)

```
public static void prompt(java.lang.String id, int controlCode, java.lang.String message)
            throws IOException
```

This is a method is used to “approximately” synchronise a test-client and test-server, the method blocks until the test-server positively or negatively acknowledges the particular message. The intended use of this method is to remove critical timing issues from conformance tests, e.g. a conformance test to ensure that an Xlet responds to a change in broadcast signalling must first ensure that the Xlet is in a state where it is able to respond to such signalling —- since the time taken for an Xlet to achieve such a state is reliant on aspects outside of the scope of the conformance test itself (delivery bit rate, hardware and CPU capabilities of the test-client, etc.).

Messages sent using this method should “atomic”, i.e. that they are not interleaved with other messages sent using the methods defined in the DVBTest class.

Implementation

The precise mechanism(s) by which the this method may be implemented are intentionally unspecified. Implementation options for sending the prompt might include:

- logging the controlCode via an RS-232 (or other serial) connection.
- logging the controlCode to a remote host via some IP / UDP based mechanism, e.g. using a socket-based connection.
- displaying the message on-screen for a (human) test operator, e.g. for systems not implementing a return channel capability.

Implementation options for receiving the acknowledgement might include:

- acknowledgement via an RS-232 (or other serial) connection.
- acknowledgement from a remote host via some IP / UDP based mechanism, e.g. using a socket-based connection.
- a (human) test operator manually acknowledging the message, e.g. for systems not implementing a return channel capability.

Parameters:

`id` - a string identifying the application (thread) that is sending the prompt.

`controlCode` - an integer value (unique within a given Xlet) intended for use by some automated test process (corresponding to the readable message).

`message` - a message (unique within a given Xlet) intended to be readable by a (human) test operator (corresponding to the automated controlCode).

Throws:

`java.io.IOException` - If there is any problem in receiving a positive acknowledgement from the test-server, then an this shall be thrown. This may be due to a negative acknowledgement from the test-server, or due to other communication based causes —- which are deliberately left unspecified.

terminate(String, int)

```
public static void terminate(java.lang.String id, int terminationCondition)
            throws IOException
```

This synchronous, blocking, method logs the termination condition of a test application using write-only access. The method takes both an identifier string, e.g. “Test number 1” and a integer value to output, e.g. org.dvb.test.DVBTest.PASS. In addition to logging the termination condition of the test, invoking this method also indicates that the test application has terminated its operation. Note that termination of operation does not necessarily correspond to the application being in any particular lifecycle state (as defined in the “Application Model” clause of the MHP specification). The application is not required to open a file or network connection, per se, and the terminate() method is always available for writing (in principle).

The precise format of the termination message is left deliberately unspecified, implementers may choose to output compressed messages, XML documents, or other formats of their choice (obviously provided that the original information can be recovered). It is an implementation option to include additional information with each termination message, e.g. including:

- version of the specification being implemented
- compiler version and options.
- build-version
- timestamp
- date
- debug info

On test-clients whose implementation of the terminate() method supports external communication to its test-server, implementations of this method may optionally indicate to the test-server that the test-client can be reset by its test-server so that another test may be initiated. The precise mechanism by which this communication takes place is not specified it may be via a IP / socket, serial port, etc.

In the case of an test-client that does not support communication to its test-server, or in the case of an unsuccessful (hanging) test, or inability of this method to return (without throwing an exception) the test-server must be prepared to “time out” the application running on the test-client and then reset the test-client.

Implementation

The precise mechanism(s) by which the this method may be implemented are intentionally unspecified, implementation options might include:

- storing the termination condition to a local file system.
- storing the termination condition to a mounted remote file system.
- storing the termination condition to a RAM disk, etc.
- storing the termination condition via an RS-232 (or other serial) connection.
- storing the termination condition to a remote host via some IP / UDP based mechanism, e.g. using a socket-based connection.

Messages sent using this method should “atomic”, i.e. that they are not interleaved with other messages sent using the methods defined in the DVBTest class.

Note that the implementation of the terminate method may use the same or a different mechanism to that used by the log method.

The terminate method does not require any explicit initialisation on the part of the application under test. For example if termination conditions are being stored to a file system, then the application is not required to mount / open any storage file. Similarly, if the results are being logged via a network connection, then the application is not required to open a connection to the storage host, etc. In principle, the mechanism should always be available to accept termination messages.

If this method is implemented on top of some buffering mechanism, it is strongly recommended that the buffer be flushed for each occurrence of a message being logged.

Security and implementation options

There is no Java security mechanism that is used to secure the terminate method.

Note that even if the terminate methods is based on a particular implementation option, it shall be able to operate in spite of that particular implementation option itself being subject to security checks. For example, a terminate method implemented using the java.net.Socket class shall always be able to log the termination condition of a test-application, even if the test-application is unable to directly access the java.net.Socket class due to security restrictions, etc.

It is an allowed implementation option to require that the test-client be put into some particular "test-mode" before any test-results are logged. This mechanism is required to reduce any inadvertent interaction due to downloaded applications accessing the test methods.

Authoring guidelines

The terminate method is not intended to be accessed by downloaded applications directly, it is purely intended for the use of conformance test applications. Authors of downloaded applications should not call this method, since there may be interactions between this method and normal in-field operation of the test-client (MHP platform).

It is an allowed implementation option to require that the test-client be put into some particular "test-mode" before any test-results are logged. This mechanism is required to reduce any inadvertent interaction due to downloaded applications accessing the test methods.

It is an allowed implementation option to have a number of "test-modes" that are appropriate to different elements being conformance tested, for example, it is a valid implementation for a test-client to have a test-mode where results are stored via a serial port, and a separate test-mode where results are stored via a RAM disk. It is allowable for a conformance test to be performed with the test-client in some specific test- mode, e.g. a java.net test (using a serial modem) might have its test results logged to a RAM disk, to avoid interaction between test-log messages and the serial protocol.

The mechanism by which a test-client is put into a given test mode is intentionally left unspecified.

Relationship to java.io

It is an implementation option to map the implementation of this method onto corresponding write method(s) of appropriate java.io classes. These classes may in turn be obtained, e.g. from java.net Socket classes, etc.

Parameters:

`id` - a string identifying the application (thread) that is terminating the test.

`terminationCondition` - the termination condition of the test application.

Throws:

`java.io.IOException` - thrown if there is any problem in terminating an application. This may be due to failure to write to a file system, inability to access a remote socket, etc. the precise causes are deliberately unspecified.

Annex Y (normative): Inter-application and Inter-Xlet communication API

Package
org.dvb.io.ixc

Description
Provides support for inter-application communication.

Class Summary	
Classes	
IxcRegistry	This is the bootstrap mechanism for obtaining references to remote objects residing in other Xlets executing on the same MHP terminal, using a URL-like syntax.

org.dvb.io.ixc
IxcRegistry

Declaration

```
public class IxcRegistry

java.lang.Object
  |
  +--org.dvb.io.ixc.IxcRegistry
```

Description

This is the bootstrap mechanism for obtaining references to remote objects residing in other Xlets executing on the same MHP terminal, using a URL-like syntax. The identification of a remote object is given using a syntax indicating the organisation ID and application ID:
/organisation_id/application_id/name
organisation_id = the organisation ID of the Xlet, as signalled in the application_identifier record, defined in the MHP specification.
application_id = the application ID of the Xlet, as signalled in the application_identifier record, defined in the MHP specification.
name = the name under which the remote object was exported.

The organisation ID and the application ID shall each be encoded as a hexadecimal string, as would be accepted by java.lang.Integer.parseInt(String s, 16).

When RMI is used to communicate over a network, stubs generated by a tool like rmic are often required. This is not necessary for inter-xlet communication initiated with IxcRegistry. If such stubs are present, they shall be ignored.

Similarly, network RMI objects often extend the class server.RemoteObject, in order to get appropriate implementations for Object.hashCode(), Object.equals(), and Object.toString(). Overriding Object's implementation of these methods in this way is not necessary for inter-xlet communication initiated with IxcRegistry, although it is not harmful. Note that the class server.RemoteObject is not required in all MHP profiles.

Fields

GLOBAL

```
public static final int GLOBAL
```

Definition of the scope for bind or rebind - exported object is visible to any Xlet running within the same MHP terminal subject to requirements of the security model.

Since:
MHP 1.1.2

PAGE

```
public static final int PAGE
```

Definition of the scope for bind or rebind - exported object is only visible to Xlets within the same DVB-HTML application. Note that an embedded Xlet with a different app ID than its enclosing HTML page is still considered to be the same application as that which contains the enclosing page.

Since:
MHP 1.1.2

SERVICE

```
public static final int SERVICE
```

Definition of the scope for bind or rebind - exported object is only visible to Xlets running within the same service context

Since:
MHP 1.1.2

Methods

bind(XletContext, String, Remote)

```
public static void bind(javax.tv.xlet.XletContext xc, java.lang.String name,
            java.rmi.Remote obj)
            throws AlreadyBoundException
```

Exports an object under a given name in the namespace of an Xlet. The name can be any valid non-null String. No hierarchical namespace exists, e.g. the names “foo” and “bar/../foo” are distinct. If the exporting xlet has been destroyed, this method may fail silently.

The object shall be made visible to other applications running in the same service context. A call to bind(xc, name, obj) is thus equivalent to a call to bind(xc, name, obj, SERVICE).

Parameters:
`xc` - The context of the Xlet exporting the object.

`name` - The name identifying the object.

`obj` - The object being exported

Throws:
`java.rmi.AlreadyBoundException` - if this Xlet has previously exported an object under the given name.

`java.lang.NullPointerException` - if xc, name or obj is null

bind(XletContext, String, Remote, int)

```
public static void bind(javax.tv.xlet.XletContext xc, java.lang.String name,
            java.rmi.Remote obj, int scope)
            throws AlreadyBoundException
```

Exports an object under a given name in the namespace of an Xlet. The name can be any valid non-null String. No hierarchical namespace exists, e.g. the names “foo” and “bar/../foo” are distinct. If the exporting xlet has been destroyed, this method may fail silently.

Parameters:
`xc` - The context of the Xlet exporting the object.

`name` - The name identifying the object.

`obj` - The object being exported

`scope` - The scope to which the object is to be exported

Throws:
`java.rmi.AlreadyBoundException` - if this Xlet has previously exported an object under the given name.

`java.lang.NullPointerException` - if xc, name or obj is null

Since:
MHP 1.1

---

list(XletContext)

```
public static java.lang.String[] list(javax.tv.xlet.XletContext xc)
```

Returns an array of string path objects available in the registry. The array contains a snapshot of the names present in the registry that the current Xlet would be allowed to import using IxcRegistry.lookup.

Parameters:
`xc` - The context of the current Xlet.

Returns:
A non-null array of strings containing a snapshot of the path names of all objects available to the caller in this registry.

See Also:
`lookup(XletContext, String)`

---

lookup(XletContext, String)

```
public static java.rmi.Remote lookup(javax.tv.xlet.XletContext xc, java.lang.String path)
            throws NotBoundException, RemoteException
```

Returns a remote object previously exported by an Xlet that has not been destroyed. The identification of a remote object is given using a syntax indicating the organisation ID and application ID:
/organisation_id/application_id/name
organisation_id = the organisation ID of the Xlet, as signalled in the application_identifier record.
application_id = the application ID of the Xlet, as signalled in the application_identifier record.
name = the name under which the remote object was exported.

The organisation ID and the application ID shall each be encoded as a hexadecimal string, as would be accepted by java.lang.Integer.parseInt(String s, 16). If the caller is not authorized to import a given object due to the security policy, then this API will behave as though the object had not been exported, that is, a NotBoundException shall be thrown.

Parameters:
`xc` - The context of the current Xlet (that is, the Xlet importing the object).

`path` - A file pathname-like string identifying the Xlet and the name of the object to be imported.

Returns:
A remote object

Throws:
`java.rmi.NotBoundException` - If the path is not currently bound.

`java.rmi.RemoteException` - If a remote stub class cannot be generated for the object being imported.

`java.lang.IllegalArgumentException` - If the path is not formatted in the syntax given above.

`java.lang.NullPointerException` - if path is null

---

rebind(XletContext, String, Remote)

```
public static void rebind(javax.tv.xlet.XletContext xc, java.lang.String name,
            java.rmi.Remote obj)
```

Rebind the name to a new object in the context of an Xlet; replaces any existing binding. The name can be any valid non-null String. No hierarchical namespace exists, e.g. the names “foo” and “bar/../foo” are distinct. If the exporting xlet has been destroyed, this method may fail silently.

The object shall be made visible to other applications running in the same service context. A call to rebind(xc, name, obj) is thus equivalent to a call to rebind(xc, name, obj, SERVICE).

Parameters:

`xc` - The context of the Xlet that exported the object.

`name` - The name identifying the object.

`obj` - The object being exported

Throws:

`java.lang.NullPointerException` - if xc, name or obj is null

---

rebind(XletContext, String, Remote, int)

```
public static void rebind(javax.tv.xlet.XletContext xc, java.lang.String name,
            java.rmi.Remote obj, int scope)
```

Rebind the name to a new object in the context of an Xlet; replaces any existing binding. The name can be any valid non-null String. No hierarchical namespace exists, e.g. the names “foo” and “bar/../foo” are distinct. If the exporting xlet has been destroyed, this method may fail silently.

Narrowing the scope of the binding (e.g. from GLOBAL to SERVICE) shall have the same effect as a call to unbind for any applications which had references to that object and which were in scope but which are now out of scope.

Parameters:

`xc` - The context of the Xlet that exported the object.

`name` - The name identifying the object.

`obj` - The object being exported

`scope` - The scope to which the object is to be exported

Throws:

`java.lang.NullPointerException` - if xc, name or obj is null

Since:

MHP 1.1

---

unbind(XletContext, String)

```
public static void unbind(javax.tv.xlet.XletContext xc, java.lang.String name)
            throws NotBoundException
```

Unbind the name.

Parameters:

`xc` - The context of the Xlet that exported the object to be unbound.

`name` - The name identifying the object.

Throws:

`java.rmi.NotBoundException` - if this is not currently any object exported by this Xlet under the given name.

`java.lang.NullPointerException` - if xc or name is null

Annex Z (informative):Services, Service Contexts and Applications in an MHP Environment

Z.1 Introduction

The present document describes the concepts that link the various parts of an MHP execution environment so that it can display a complete MHP service, including media and applications. This is really an overview to the MHP application lifecycle model, but does include some additional information.

We assume some familiarity with MHP and the Java TV specification.

Z.2 Basic concepts

The unit for the presentation and execution of content in the MHP specification is the service. A service in MHP represents a group of pieces of content which are intended to be presented together to the end-user. In this version of the specification, the service is the contents of a broadcast DVB service, including audio/video streams, data streams and all the service information, applications and application signalling that is being broadcast. The current service will largely be responsible for determining what media and applications are presented to the user.

Every service that gets presented by an MHP platform is presented within a service context. These form one of the foundations for the runtime environment and the execution model. A service context is an "environment" in which a service gets presented - it defines the boundaries of the service (letting the platform and applications identify which of the pieces of content that are being presented make up a given service). It also enables that service to be addressed and controlled as a single entity. A DVB-J application can call the select method on a service context (represented by javax.tv.service.selection.ServiceContext) and the platform will stop presenting all of the content that makes up the current service being presented by that service context and start presenting the content that makes up the new service. In this case, "content" may include one or more applications.

A service context has some major differences from a DVB-J Xlet context. It is not necessary to have one service context for every possible service that can or will get presented - one service context is needed for every service that can be presented simultaneously, but that is all. Also, a service context is not destroyed when the service within it is stopped, unlike the Xlet context for a DVB-J application. The service context exists until an application or the platform explicitly destroys it. In normal operational mode, the built-in navigator or EPG for an MHP system will create one single service context when it starts and never destroy that. MHP applications will run in that service context.

Z.3 Presenting a service in MHP

From the MHP point of view, the content of a service can be one of two types - media or applications. Media is the simplest case and is described first.

Z.3.1 Presenting the media components of a service

If there are several different streams of media that may get presented (such as several different video streams) then the platform uses a variety of methods to tell which streams should be used. These include user preferences and platform defaults, but will also include using service information do determine which streams get presented to the user.

For a DVB-J application, all real-time media components sharing the same clock are presented by the same JMF player. These players are directly linked to the service context, and the service context can be queried to find out which JMF Players are linked with it. It is also possible for applications to create JMF Player objects directly without linkage to the applications service context.

Z.3.2 Presenting the application components of a service

Applications are handled in a slightly different way. The lifecycle of all applications in an MHP environment is controlled by an application manager, a software entity that forms part of the MHP runtime environment. It takes its instructions on which applications to start and stop from the user, but also from information that is included in the MHP broadcast (called an "AIT", can logically be considered an extension to MPEG's PMT) and the free resources in the platform.

The information carried in the AIT (Application Information Table) not only says which applications are available, but also provides some instructions to the application manager about whether an application should be started automatically or whether an application should be killed automatically. The application manager monitors this information for changes, and creates, starts or kills applications as appropriate.

Every DVB-J application executes within an Xlet context. This is a similar concept to the applet context that a Java applet executes in, and it provides the Xlet with a link to its environment, both for accessing system properties and for telling the environment that the Xlet has changed its own state.

Since every Xlet executes as part of a DVB service, there is also a link between the Xlet and its associated service. This link is the class javax.tv.service.selection.ServiceContextFactory. Using methods on this class, an Xlet can lookup its service context from its xlet context. From the service context, an Xlet can discover which service it is current running as part of. It can also register for events to be told when the service being presented in its service context changes.

The application manager must maintain a list of all the applications in a system, so that it knows which ones are currently executing. It must also know (directly or indirectly) which applications are associated with which service context, so that if the service being presented in that service context changes due to a new service being selected, it can kill the applications that are not signalled in the new service. When a service is selected in a service context, the following steps happen in approximately this order:

a) The platform examines the MPEG PMT for the service that has been selected (tuning first if necessary) and works out which media streams are to be presented.

b) Any media streams currently playing are stopped and any new media streams that need to be presented are started. Any JMF players presenting the old content are stopped and destroyed, and players for the new content are created and started if necessary.

c) The platform monitors the application information table for the new service to find out which applications should be running. Any applications that are currently running but which are not signalled in the application information table of the new service (or which are signalled as killed) are killed and the Xlet contexts of DVB-J applications associated with the old service are destroyed.

d) For any applications which are signalled as autostart and are not currently running, the following steps are taken:

- The platform attaches to the object carousel signalled in the application information table.
- The platform attempts to load the main application file as signalled in the application information table.
- For a DVB-J application, the platform creates an instance of the main class using the default constructor, creates an XletContext object for the application and calls the Xlet.initXlet() method on the newly loaded class, passing the XletContext object as a parameter. Once this call is complete, the platform calls the Xlet.startXlet() method.

If several applications are signalled as autostart, the platform will load and start every one in the same way. Each DVB-J application will have a different Xlet context and will execute independently, although they are all associated with the same service context.

Z.4 Service Context Object Design

Z.4.1 Overview

This clause explains the underlying design behind service contexts, resources such as video and audio decoders, and JMF players.

Z.4.2 Single-Application Model

For simplicity, we will first consider the operation of this API when a single application is executing.

A service context represents the context in which services execute. There are different kinds of services, including application-only services, stand-alone stored services, services including audio/video content, and recorded services. All services may have applications, but some kinds of services cannot include audio/video content. Some, but not all services are played from a tuner. Thus, a service context:

- Has the ability to present applications
- May control resources needed to present broadcast or recorded services, such as a tuner, a video decoder, and audio decoder.
- Is the entity an application accesses to select a new service.

Applications may select a different audio/video stream without selecting a new service. For example, an EPG that runs within an EPG service might wish to display the picture and play the audio associated with a different service, without actually selecting that service. This is not done by manipulating a service context; rather, it is done by using a JMF Player (which is not a `ServiceMediaHandler`), and if needed the tuning API. This is explained in greater detail below

A service context is exposed to applications using the `javax.tv.service.ServiceContext` interface. The model underlying the `ServiceContext` interface is pictured in the following UML class diagram. The types shown without stereotypes indicating otherwise (e.g. "<<Hardware>>") are part of the public API. They are taken from different packages, but are pictured without the full package name for readability.

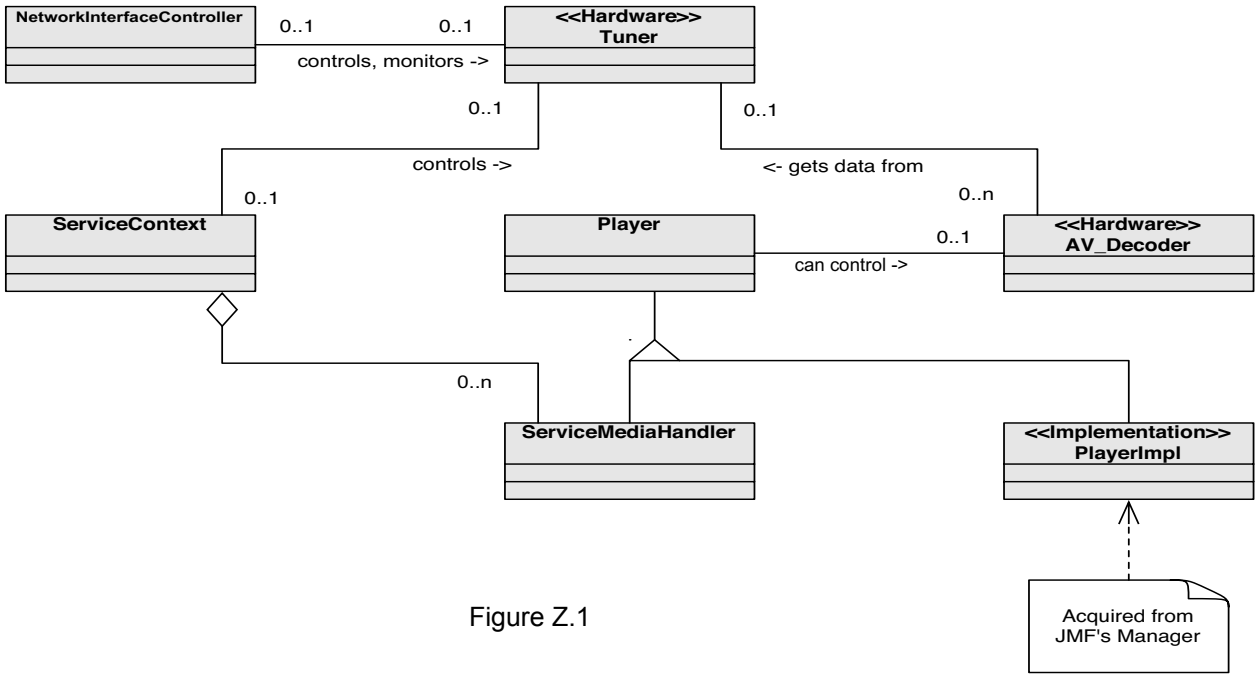


Figure Z.1

All `ServiceContext` instances act as a context to present services. Services may include applications, audio content, or video content. When a service containing A/V content is selected in a `ServiceContext`, the appropriate `ServiceMediaHandler` will attempt to acquire the underlying A/V decoder in hardware. If an application wishes to present a different A/V stream without selecting a new service (and thus, without potentially selecting a new set of applications), it cannot do so using the `ServiceMediaHandler` associated with the `ServiceContext`, because `ServiceMediaHandler` is restricted to only presenting streams within the service. Instead, the application may acquire a `Player` from the JMF `Manager`. This JMF player can be set to present a different A/V stream, but it is not allowed to tune. If that is required, the application must acquire a DAVIC `NetworkController` to manually tune; on an MHP terminal with a single tuner, this would necessarily cause the underlying hardware for the tuner to be taken away from the `ServiceContext`.

Z.4.3 Multiple-Application Model

When multiple applications are running as part of the same service, it is important to understand the relationship between the `javax.tv.service.ServiceContext` instances in the two applications. Both applications may obtain `ServiceContext` instances using `ServiceContext.getServiceContext(XletContext)`, in order to manipulate the service context in which the two applications are running. In this case the two applications will, of course, have different instances of `ServiceContext`, but they represent the same underlying service context. That is, when one application uses its `ServiceContext` instance, for example to select a different service, it causes this action to happen in the underlying service context. If, then, the other application selects yet another service, this also occurs in the same underlying service context, so no additional acquisition of resources (e.g. as reported through the DAVIC resource management API) need take place.

Z.4.4 Considerations for standalone stored services

A standalone stored service contains only applications, and no A/V content. Further, because it is stored, no tuner is required. Thus, when a service context is presenting a standalone stored service, it is not required to be bound to a tuner or an audio or video decoder. However, the same service context may in the future be used to select a service that does include audio/video context, or that is a broadcast service received over a tuner. If such a service is selected, it is currently unspecified whether the tuner and A/V decoders remain bound to the service context during the presentation of the standalone stored service, or whether they are released and re-acquired. If an application has registered for `ResourceStatusEvent` notifications, it may or may not receive them, depending on the underlying implementation choice.

Z.5 Multiple service contexts in an MHP platform

The MHP specification allows the platform to have any number of service contexts, although the platform may choose to limit the number it can produce, possibly even to one. Each service context can present a different service, completely independently of the other service contexts. Operations carried out on one service context will not affect another (unless they cause tuning which prevents the contents of a service in another service context from being presented). It is even possible to display the same service in several service contexts simultaneously - this may not be very useful, but it is allowed. This may result in several instances of the same application running in at the same time in different service contexts. In practice, this is most likely to happen in future MHP terminals with multiple independent video output channels.

Z.6 How does the platform know which services are available?

In order to select a new service, an application (or the platform) has to know three things about the service it wants to start: the original network ID, the transport stream ID and the service ID for the service in question. In the case of an application, those values may be hard-wired into the application by the developer, but this not required. The application can find out about a service in the same way that the platform can - using service information.

The platform can not know the details of every available service when it started for the first time, and so it must use another method to find out about what services it can receive. A set-top box may do the following to find this out, for instance:

a) Scan the input (satellite, cable or some other input) to find out which transport streams are available and the physical parameters it needs to tune to them successfully.

b) For every transport stream:

- Tune to it.
- Use the service information API to access the service description table (SDT) and network information table (NIT) for that transport stream.
- Use these tables to find what services are in the transport stream and the values needed to select those services.
- In the case of the platform performing an initial scan, write this information to non-volatile memory.

c) When the application has found the service it wants (or in the case of the platform performing a scan, once every transport stream has been scanned in this way), a service can be selected.

At this point, the platform has all the information it needs to start presenting services to the user. It is important to realize that this is not the only way of finding this information - other ways may be possible, depending on the MHP implementation.

Annex AA (normative): DVB-HTML 1.0 DTD

AA.1 DVB-HTML 1.0 DTD

AA.1.1 DVB-HTML DTD driver

This clause contains the driver for the DVB-HTML 1.0 document type implementation as an XML DTD. It relies upon XHTML module implementations defined in Modularization [94] and in this annex. This driver is the DTD that shall be referenced by conformant DVB-HTML 1.0 documents.

```
<!-- ....................................................................... -->
<!--                          DVB-HTML 1.0 DTD                             -->
<!-- ....................................................................... -->
<!-- file: dvbhtml-1-0.dtd                                                 -->
<!-- ....................................................................... -->

<!--      This is the DTD driver for DVB-HTML 1.0.

     The following formal public identifier shall be used to identify it:
                "-//DVB//DTD XHTML DVB-HTML 1.0//EN"

   The following URL may be used to reference this file :
      "http://www.dvb.org/mhp/dtd/dvbhtml-1-0.dtd"                 -->

<!-- ....................................................................... -->
<!--                        XHTML Driver Parameters                        -->
<!-- ....................................................................... -->

<!ENTITY % XHTML.version "-//DVB//DTD XHTML DVB-HTML 1.0//EN" >
<!-- reserved for use with document profiles      -->
<!ENTITY % XHTML.profile "" >

<!-- ....................................................................... -->
<!--                               Framework                               -->
<!-- ....................................................................... -->

<!-- Tell the XHTML Framework module to use the DVB-HTML Qualified Names     -->
<!-- module as an extra qname driver      -->
<!ENTITY % xhtml-qname-extra.mod
   PUBLIC "-//DVB//ENTITIES DVB-HTML Qualified Names 1.0//EN"
   "dvb-qname-1.mod" >

<!-- Define the Content Model for the framework to use -->
<!ENTITY % xhtml-model.mod
   PUBLIC "-//DVB//ENTITIES DVB-HTML Content Model 1.0//EN"
   "dvbhtml-model-1-0.mod" >

<!-- Include bidirectional text support -->
<!ENTITY % XHTML.bidi "INCLUDE" >

<!-- Comment : Needed for tool verification purpose -->
<!ENTITY % iframe.qname "iframe" >

<!-- XHTML Inline Style Module  ..................................... -->
<!-- needs to be included prior to the XHTML Modular Framework to be taken  -->
<!-- into account                 -->
<!ENTITY % xhtml-inlstyle.module "INCLUDE">
<![%xhtml-inlstyle.module;[
    !ENTITY % xhtml-inlstyle.mod
    PUBLIC "-//W3C//ENTITIES XHTML Inline Style 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-inlstyle-1.mod" >
%xhtml-inlstyle.mod;]]>


<!-- Bring in the XHTML Framework module -->
<!ENTITY % xhtml-framework.mod
   PUBLIC "-//W3C//ENTITIES XHTML Modular Framework 1.0//EN"
   "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-framework-1.mod"  >
```

```
%xhtml-framework.mod;

<!-- Using tables, so we need to declare this. Is also present on the Content Model -->
<!ENTITY % Table.class "| %table.qname;">

<!-- instantiate the DVB Character Entities module (for the VK_* codes).      -->
<!--
   NOTE 1: The content of this module is not defined in this specification
   since the mappings of those DVB character entities to the character
   set are implementation specific

   NOTE 2: The DVB-HTML Character Entities Module is referenced from the
   DVB-HTML DTDs using a local URL (see <xref AA.1.1 "DVB-HTML DTD Driver").
   Hence the location from which the DTD is fetched will affect the
   values given to the "VK_*" entities defined for use with the HTML
   "accesskey" attribute, described in <xref to 8.5.3.1.8 "Accesskey
   attribute">.  Implementations may therefore choose to store these DTDs
   locally and access them in an implementation-defined manner.
                                        -->
<!ENTITY % dvb-charent.module "INCLUDE" >
<![%dvb-charent.module;[
<!ENTITY % dvb-charent.mod
   SYSTEM "dvb-charent-1.mod" >
%dvb-charent.mod;]]>

<!-- ..................................................................... -->
<!--                          Modules List                                 -->
<!-- ..................................................................... -->

<!-- This DTD will accept both frameset and body elements as root element childs -->
<!ENTITY % html.content  "( %head.qname;, (%frameset.qname; | %body.qname; ))" >

<!-- XHTML Document Structure Module ..................................... -->
<!ENTITY % xhtml-struct.module "INCLUDE">
<![%xhtml-struct.module;[
<!ENTITY % xhtml-struct.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Document Structure 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-struct-1.mod" >
%xhtml-struct.mod;]]>

<!-- XHTML Text Module ................................................... -->
<!-- Fix up the blockquote content model -->
<!ENTITY % blockquote-fixed.element "INCLUDE">
<![%blockquote-fixed.element;[
<!ENTITY % blockquote.content
     "( #PCDATA | %Block.mix;)*"
>
<!ENTITY % blockquote.qname  "blockquote" >
<!ELEMENT %blockquote.qname;  %blockquote.content; >
<!-- end of blockquote.element -->]]>
<!ENTITY % xhtml-text.module "INCLUDE">
<![%xhtml-text.module;[
<!ENTITY % xhtml-text.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Text 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-text-1.mod" >
%xhtml-text.mod;]]>

<!-- XHTML Hypertext Module ............................... -->
<!ENTITY % xhtml-hypertext.module "INCLUDE">
<![%xhtml-hypertext.module;[
<!ENTITY % xhtml-hypertext.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Hypertext 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-hypertext-1.mod" >
%xhtml-hypertext.mod;]]>

<!-- XHTML Lists Module ................................... -->
<!ENTITY % xhtml-list.module "INCLUDE">
<![%xhtml-list.module;[
<!ENTITY % xhtml-list.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Lists 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-list-1.mod" >
```

```
%xhtml-list.mod;]]>

<!-- XHTML Presentation Module  ..................................... -->
<!ENTITY % xhtml-pres.module "INCLUDE">
<![%xhtml-pres.module;[
<!ENTITY % xhtml-pres.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Presentation 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-pres-1.mod" >
%xhtml-pres.mod;]]>

<!-- XHTML BDO Element Module  ..................................... -->
<!ENTITY % xhtml-bdo.module "INCLUDE">
<![%xhtml-bdo.module;[
<!ENTITY % xhtml-bdo.mod
    PUBLIC "-//W3C//ELEMENTS XHTML BDO Element 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-bdo-1.mod" >
%xhtml-bdo.mod;]]>

<!-- XHTML Forms Module  ..................................... -->
<!ENTITY % xhtml-form.module "INCLUDE">
<![%xhtml-form.module;[
<!ENTITY % xhtml-form.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Forms 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-form-1.mod" >
%xhtml-form.mod;]]>

<!-- XHTML Basic Tables Module  ..................................... -->
<!ENTITY % xhtml-basic-table.module "INCLUDE">
<![%xhtml-basic-table.module;[
<!ENTITY % xhtml-basic-table.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Basic Tables 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-basic-table-1.mod">
%xhtml-basic-table.mod;]]>

<!-- XHTML Images module ....................................... -->
<!ENTITY % xhtml-image.module "INCLUDE">
<![%xhtml-image.module;[
<!ENTITY % xhtml-image.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Images 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-image-1.mod" >
%xhtml-image.mod;]]>

<!-- XHTML Client Side Image Map module ........................... -->
<!ENTITY % xhtml-csismap.module "INCLUDE">
<![%xhtml-csismap.module;[
<!ENTITY % xhtml-csismap.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Client Side Image Maps 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-csismap-1.mod" >
%xhtml-csismap.mod;]]>

<!-- XHTML Embedded Object module ....................................... -->
<!ENTITY % xhtml-object.module "INCLUDE">
<![%xhtml-object.module;[
<!ENTITY % xhtml-object.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Embedded Object 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-object-1.mod" >
%xhtml-object.mod;]]>

<!-- XHTML Frames module ..................................................-->
<!ENTITY % xhtml-frames.module "INCLUDE">
<![%xhtml-frames.module;[
<!ENTITY % xhtml-frames.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Frames 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-frames-1.mod" >
%xhtml-frames.mod;]]>

<!-- XHTML Target module ....................................... -->
<!ENTITY % xhtml-target.module "INCLUDE">
<![%xhtml-target.module;[
<!ENTITY % xhtml-target.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Target 1.0//EN"
```

```
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-target-1.mod" >
%xhtml-target.mod;]]>

<!-- XHTML IFrame module ..................................... -->
<!ENTITY % xhtml-iframe.module "INCLUDE">
<![%xhtml-iframe.module;[
<!ENTITY % xhtml-iframe.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Inline Frame Element 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-iframe-1.mod" >
%xhtml-iframe.mod;]]>

<!-- DVB-HTML Intrinsic Events Module ............................. -->
<!ENTITY % dvbhtml-events.module "INCLUDE" >
<![%dvbhtml-events.module;[
<!ENTITY % dvbhtml-events.mod
    PUBLIC "-//DVB//ENTITIES DVB-HTML Intrinsic Events 1.0//EN"
    "http://www.dvb.org/mhp/dtd/dvbhtml-events-1.mod" >
%dvbhtml-events.mod;]]>

<!-- XHTML Document Metainformation Module ........................... -->
<!ENTITY % xhtml-meta.module "INCLUDE">
<![%xhtml-meta.module;[
<!ENTITY % xhtml-meta.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Metainformation 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-meta-1.mod" >
%xhtml-meta.mod;]]>

<!-- XHTML Document Scripting Module  ................................. -->
<!ENTITY % xhtml-script.module "INCLUDE">
<![%xhtml-script.module;[
<!ENTITY % xhtml-script.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Scripting 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-script-1.mod" >
%xhtml-script.mod;]]>

<!-- XHTML Document Stylesheet Module  ................................ -->
<!ENTITY % xhtml-style.module "INCLUDE">
<![%xhtml-style.module;[
<!ENTITY % xhtml-style.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Stylesheets 1.0//EN"
    "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-style-1.mod" >
%xhtml-style.mod;]]>

<!-- XHTML Link Element Module  ................................... -->
<!ENTITY % xhtml-link.module "INCLUDE">
<![%xhtml-link.module;[
<!ENTITY % xhtml-link.mod
PUBLIC "-//W3C//ELEMENTS XHTML Link Element 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-link-1.mod" >
%xhtml-link.mod;]]>

<!-- XHTML Base Element Module  ................................... -->
<!ENTITY % xhtml-base.module "INCLUDE">
<![%xhtml-base.module;[
    !ENTITY % xhtml-base.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Base Element 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-base-1.mod" >
%xhtml-base.mod;]]>

<!-- ..................................................................... -->
<!-- XHTML Modularization modules ignored in DVB-HTML 1.0 DTD.............. -->
<!-- ..................................................................... -->

<!-- XHTML Java Applet Module  ................................... -->
<!ENTITY % xhtml-applet.module "IGNORE">
<![%xhtml-applet.module;[
    !ENTITY % xhtml-applet.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Java Applets 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-applet-1.mod" >
%xhtml-applet.mod;]]>
```

```
<!-- XHTML Edit Module  ................................... -->
<!ENTITY % xhtml-edit.module "IGNORE">
<![%xhtml-edit.module;[
    !ENTITY % xhtml-edit.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Editing Markup 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-edit-1.mod" >
%xhtml-edit.mod;]]>

<!-- XHTML Basic Forms Module  ................................... -->
<!ENTITY % xhtml-basic-form.module "IGNORE">
<![%xhtml-basic-form.module;[
    !ENTITY % xhtml-basic-form.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Basic Forms 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-basic-form-1.mod" >
%xhtml-basic-form.mod;]]>

<!-- XHTML Table Module  ................................... -->
<!ENTITY % xhtml-table.module "IGNORE">
<![%xhtml-table.module;[
    !ENTITY % xhtml-table.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Tables 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-table-1.mod" >
%xhtml-table.mod;]]>

<!-- XHTML Server Side Image Map Module  ................................... -->
<!ENTITY % xhtml-ssismap.module "IGNORE">
<![%xhtml-ssismap.module;[
    !ENTITY % xhtml-ssismap.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Server-side Image Maps 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-ssismap-1.mod" >
%xhtml-ssismap.mod;]]>

<!-- XHTML Intrinsic Events Module  ................................... -->
<!ENTITY % xhtml-events.module "IGNORE">
<![%xhtml-events.module;[
    !ENTITY % xhtml-events.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Intrinsic Events 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-events-1.mod" >
%xhtml-events.mod;]]>

<!-- XHTML Name Identification Module  ................................... -->
<!ENTITY % xhtml-nameident.module "IGNORE">
<![%xhtml-nameident.module;[
    !ENTITY % xhtml-nameident.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Name Identifier 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-nameident-1.mod" >
%xhtml-nameident.mod;]]>

<!-- XHTML Legacy Markup Module  ................................... -->
<!ENTITY % xhtml-legacy.module "IGNORE">
<![%xhtml-legacy.module;[
    !ENTITY % xhtml-legacy.mod
    PUBLIC "-//W3C//ELEMENTS XHTML Legacy Markup 1.0//EN"
"http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-legacy-1.mod" >
%xhtml-legacy.mod;]]>


<!-- end of DVB-HTML 1.0 DTD  ..................................... -->
<!-- ..................................................................... -->
```

AA.1.2 DVB-HTML DVB Intrinsic Events module

This DVB defined module adds some event attributes to the <body> and <frame> element.

```
<!-- ..................................................................... -->
<!--        DVB-HTML Intrinsic Events 1.0 Module     -->
<!-- ..................................................................... -->
<!-- file: dvbhtml-events-1.mod    -->
<!-- ..................................................................... -->
```

```
<!--  This is the DTD module for the DVB-HTML defined events.

      The following formal public identifier shall be used to identify it:
       "-//DVB//ENTITIES DVB-HTML Intrinsic Events 1.0//EN"

   The following URL may be used to reference this file :
      "http://www.dvb.org/mhp/dtd/dvbhtml-events-1.mod"

   The namespace and the default prefix of this module are respectively
      xmlns:dvbhtml="http://www.dvb.org/mhp/"
                                                                              -->

<!-- Declare PEs for the DVB Intrinsic events attributes on the body element -->
<!ENTITY % dvbhtml.body.onload.qname "%dvbhtml.pfx;onload" >
<!ENTITY % dvbhtml.body.onunload.qname "%dvbhtml.pfx;onunload" >
<!ENTITY % dvbhtml.body.ondvbdomstable.qname "%dvbhtml.pfx;ondvbdomstable" >

<!-- Declare PEs for the DVB-HTML Intrinsic events attributes on the     -->
<!-- frameset element (only used in the DVB-HTML Frameset DTD)             -->
<!ENTITY % dvbhtml.frameset.onload.qname "%dvbhtml.pfx;onload" >
<!ENTITY % dvbhtml.frameset.onunload.qname "%dvbhtml.pfx;onunload" >
<!ENTITY % dvbhtml.frameset.ondvbdomstable.qname "%dvbhtml.pfx;ondvbdomstable" >


<!-- additional attributes on body element -->
<!ATTLIST %body.qname;
    %dvbhtml.body.onload.qname       %Script.datatype;      #IMPLIED
    %dvbhtml.body.onunload.qname     %Script.datatype;      #IMPLIED
    %dvbhtml.body.ondvbdomstable.qname  %Script.datatype;      #IMPLIED
>

<!-- end of dvbhtml-events-1.mod ..................................... -->
<!-- ................................................................. -->
```

AA.1.3 DVB-HTML Qualified Names module

This DVB-defined module is declared in the DVB-HTML DTD driver and instantiated through the XHTML Modular Framework. It defines parameter entities to support namespace-qualified names. In particular, it defines namespace declarations and name prefixing rules. The actual namespace defined by this module is provided by the following URI: `"http://www.dvb.org/mhp/"` and the default prefix by the string `"dvbhtml"`.

It is defined below:

```
<!-- ................................................................. -->
<!--        DVB-HTML 1.0 Qname Module        -->
<!-- ................................................................. -->
<!-- file: dvbhtml-qname-1.mod    -->
<!-- ................................................................. -->

<!--
     The following formal public identifier shall be used to identify it:
       "-//DVB//ENTITIES DVB-HTML Qualified Names 1.0//EN"

   The following URL may be used to reference this file :
      "http://www.dvb.org/mhp/dtd/dvbhtml-qname-1.mod"          -->


<!-- Bring in the XHTML datatypes, since the URI.datatype parameter entity  -->
<!-- is used for declaring the xmlns attributes.             -->
<!ENTITY % dvb-datatypes.mod
   PUBLIC "-//W3C//ENTITIES XHTML Datatypes 1.0//EN"
   "http://www.w3.org/TR/xhtml-modularization/DTD/xhtml-datatypes-1.mod" >
%dvb-datatypes.mod;

<!-- Declare the default value for prefixing of this module's attributes    -->
<!-- Note that the NS.prefixed will get overridden by the XHTML Framework   -->
<!-- or by a document instance.             -->
```

```
<!ENTITY % NS.prefixed "IGNORE" >
<!ENTITY % dvbhtml.prefixed "%NS.prefixed;" >

<!-- Declare the actual namespace of this module -->
<!ENTITY % dvbhtml.xmlns "http://www.dvb.org/mhp/" >

<!-- Declare the default prefix for this module -->
<!ENTITY % dvbhtml.prefix "dvbhtml" >

<!-- Declare the prefix and any prefixed namespaces that are required by    -->
<!-- this module. -->
<![%dvbhtml.prefixed;[
<!ENTITY % dvbhtml.pfx "%dvbhtml.prefix;:" >
<!ENTITY % dvbhtml.xmlns.extra.attrib
   "xmlns:%dvbhtml.prefix; %URI.datatype; #FIXED '%dvbhtml.xmlns;'" >
]]>
<!ENTITY % dvbhtml.pfx "" >

<!-- Declare a Parameter Entity (PE) that defines any external namespaces  -->
<!-- that are used by this module            -->
<!ENTITY % dvbhtml.xmlns.extra.attrib "" >

<!-- Declare a PE that defines the xmlns attributes for use by dvbhtml.    -->
<![%dvbhtml.prefixed;[
<!ENTITY % dvbhtml.xmlns.attrib
   "xmlns:%dvbhtml.prefix; %URI.datatype; #FIXED í%dvbhtml.xmlns;í
   %dvbhtml.xmlns.extra.attrib;"
>
]]>
<!ENTITY % dvbhtml.xmlns.attrib
   "xmlns %URI.datatype; #FIXED í%dvbhtml.xmlns;í
   %dvbhtml.xmlns.extra.attrib;"
>
<!-- Make sure that the dvbhtml namespace attributes are included on the   -->
<!-- XHTML attribute set    -->
<![%NS.prefixed;[
<!ENTITY % XHTML.xmlns.extra.attrib
   "%dvbhtml.xmlns.attrib;" >
]]>
<!ENTITY % XHTML.xmlns.extra.attrib "" >

<!-- end of dvbhtml-qname-1.mod ..................................... -->
<!-- ................................................................ -->
```

AA.1.4 DVB-HTML Content Model module

The DVB-HTML content model module works together with the DVB-HTML 1.0 DTD driver to customize the XHTML module implementations to the document type's specific requirements. This module is instantiated by the XHTML modular framework module.

It is defined below:

```
<!-- ................................................................ -->
<!--     DVB-HTML 1.0 Document Model Module       -->
<!-- ................................................................ -->
<!-- file: dvbhtml-model-1-0.mod     -->
<!-- ................................................................ -->

<!--  This is the DTD module for the DVB-HTML Document Model.

      The following formal public identifier shall be used to identify it:
             PUBLIC "-//DVB//ENTITIES DVB-HTML Document Model 1.0//EN"

   The following URL may be used to reference this file :
      "http://www.dvb.org/mhp/dtd/dvbhtml-model-1-0.mod"     -->

<!-- Document Model
```

```
       This module describes the groupings of elements that make up
       common content models for DVB-HTML elements.                         -->

<!-- ..............  Optional Elements in head  .................. -->

<!ENTITY % HeadOpts.mix   "(        %script.qname;
                                  | %style.qname;
                                  | %meta.qname;
                                  | %link.qname;
                                  | %object.qname;)*" >

<!-- .................  Miscellaneous Elements  .................. -->

<!-- script and noscript are used to contain scripts -->

<!ENTITY % Misc.extra           " | %script.qname;
                                  | %noscript.qname; " >

<!-- These elements are neither block nor inline, and can
              essentially be used anywhere in the document body. -->
<!ENTITY % Misc.class            " %Misc.extra; "  >

<!-- ....................  Inline Elements  ...................... -->

<!ENTITY % InlStruct.class      "   %br.qname;
                                  | %span.qname; " >

<!ENTITY % InlPhras.class       " | %em.qname;
                                  | %strong.qname;
                                  | %dfn.qname;
                                  | %code.qname;
                                  | %samp.qname;
                                  | %kbd.qname;
                                  | %var.qname;
                                  | %cite.qname;
                                  | %abbr.qname;
                                  | %acronym.qname;
                                  | %q.qname; " >

<!ENTITY % InlPres.class        " | %tt.qname;
                                  | %i.qname;
                                  | %b.qname;
                                  | %big.qname;
                                  | %small.qname;
                                  | %sub.qname;
                                  | %sup.qname; " >

<!ENTITY % I18n.class           " | %bdo.qname; " >

<!ENTITY % Anchor.class         " | %a.qname; " >

<!ENTITY % InlSpecial.class     " | %img.qname;
                                  | %map.qname;
                                  | %object.qname; " >

<!ENTITY % Control.class        " | %input.qname;
                                  | %select.qname;
                                  | %textarea.qname;
                                  | %label.qname;
                                  | %button.qname; " >


<!ENTITY % Inline.extra         " | %iframe.qname; " >


<!-- %Inline.class; includes all inline elements, used as a component in mixes -->
<!ENTITY % Inline.class           " %InlStruct.class;
                                    %InlPhras.class;
                                    %InlPres.class;
                                    %I18n.class;
```

```
                %Control.class;
                                %Anchor.class;
                                %InlSpecial.class;
                                %Inline.extra;" >

<!-- %InlNoAnchor.class; includes all non-anchor inline elements,
used as a component in mixes -->

<!ENTITY % InlNoAnchor.class      " %InlStruct.class;
                                  %InlPhras.class;
                                  %InlPres.class;
                                  %I18n.class;
                %Control.class;
                                  %InlSpecial.class;
                                  %Inline.extra;" >

<!-- %Inline-noa.mix; includes all non-anchor inlines -->
<!ENTITY % InlNoAnchor.mix        " %InlNoAnchor.class;
                                  %Misc.class;">

<!-- %Inline.mix; includes all inline elements, including %Misc.class; -->
<!ENTITY % Inline.mix             " %Inline.class;
                                  %Misc.class;" >


<!-- .....................  Block Elements  ...................... -->

<!ENTITY % Heading.class          " %h1.qname;
                                  | %h2.qname;
                                  | %h3.qname;
                                  | %h4.qname;
                                  | %h5.qname;
                                  | %h6.qname; " >

<!ENTITY % List.class             " %ul.qname;
                                  | %ol.qname;
                                  | %dl.qname; " >

<!ENTITY % BlkStruct.class        " %p.qname;
                                  | %div.qname; " >

<!ENTITY % BlkPhras.class       " | %pre.qname;
                                  | %blockquote.qname;
                                  | %address.qname; " >

<!ENTITY % BlkPres.class         "| %hr.qname; " >

<!ENTITY % BlkNoTable.extra      "| %form.qname;
                                  | %fieldset.qname; " >

<!ENTITY % Table.class     "| %table.qname; " >


<!ENTITY % Block.extra             "%Table.class;
                                  | %form.qname;
                                  | %fieldset.qname; " >

<!ENTITY % BlkNoTable.class        "%BlkStruct.class;
                                   %BlkPhras.class;
                                   %BlkPres.class;
                                   %BlkNoTable.extra;" >


<!-- %Block.class; includes all block elements, used as a component in mixes -->
<!ENTITY % Block.class             "%BlkStruct.class;
                                   %BlkPhras.class;
                                   %BlkPres.class;
                                   %Block.extra;" >

<!-- %Block.mix; includes all block elements plus %Misc.class; -->
<!ENTITY % Block.mix               "%Heading.class;
```

```
                                  | %List.class;
                                  | %Block.class;
                                    %Misc.class;" >

<!-- ................  All Content Elements  .................. -->

<!ENTITY % FlowNoTable.mix         "%Heading.class;
                                  | %List.class;
                                  | %BlkNoTable.class;
                                  | %Inline.class;
                                    %Misc.class;" >


<!-- %Flow.mix; includes all text content, block and inline -->
<!ENTITY % Flow.mix                "%Heading.class;
                                  | %List.class;
                                  | %Block.class;
                                  | %Inline.class;
                                    %Misc.class;" >

<!-- ..................................................................... -->
<!-- end of dvbhtml-model-1-0.mod                                         -->
<!-- ..................................................................... -->
```

Annex AB (normative): DVB HTML StyleSheet

In the absence of any other styling information for a page, the support application shall render using the following default stylesheet:

```
/*
  * Since MHP implementations may add element types, this rule prevents
  * any such elements from being displayed by default.  The following
  * rule restores the default "inline" value to HTML element types which
  * should be displayed inline.
  */
*               { display: none }
style, meta, link,
script, noscript,
br, span,
em, strong, dfn,
code, samp, kbd,
var, cite, abbr,
acronym, q,
tt, i, d, big,
small, sub, sup,
bdo, a,
img, map, object,
input, select,
textarea, label,
button          { display: inline }

address,
blockquote,
body, dd, div,
dl, dt, fieldset,
form, frame,
frameset, h1, h2,
h3, h4, h5, h6,
hr, noframes, ol,
p, pre, ul      { display: block }
object          { display: inline }
li              { display: list-item }
head            { display: none }
table           { display: table }
tr              { display: table-row }

/*
* NOTE: Removed for DVB-HTML, as these elements and these values of display
* property are not supported.
*
* thead          { display: table-header-group }
* tbody          { display: table-row-group }
* tfoot          { display: table-footer-group }
* col            { display: table-column }
* colgroup       { display: table-column-group }
*/
td, th          { display: table-cell }
caption         { display: table-caption }
th              { font-weight: bolder; text-align: center }
caption         { text-align: center }

/*
* NOTE: The padding here and the initial block below (in the @viewport
* rule) is defined such that the initial block matches the "Safe Action
* Area" and the content area of the BODY matches the "Safe Title Area".
* The Safe Action Area is the centre 90% of the screen; the Safe Title
* Area is the centre 80%. Percentages are not used to specify the body
* padding because both axes are interpreted with respect to the *width*
* of the containing block. Therefore the padding below is in pixels.
*
* NOTE: The sample HTML 4.0 stylesheet in the CSS2 specification, derived
* from a survey of existing User Agents, has "line-height: 1.33". However,
* the errata (as of 19980512) reduce this to 1.12em.
```

```
*/
body             { font-family: Tiresias; font-size: 26pt;
                padding: 29px 36px; line-height: 1.12em;
                opacity: 0;
                background-color: rgb(0, 0, 0);
                color: rgb(255, 255, 255); }

/*
* NOTE: The margins here are chosen to be 26pt/18px (according to the
* information on Tiresias in TAM232r16). They are
* expressed in "em" units so overriding stylesheets can change just the
* font-size and have the margins scaled.
*/
h6, h4, h2       { text-transform: uppercase }
h6               { font-size: 24pt; margin: 1.08em 0 }
h5, h4           { font-size: 26pt; margin: 1em 0 }
h3, h2           { font-size: 31pt; margin: 0.84em 0 }
h1               { font-size: 36pt; margin: 0.72em 0 }

/*
* NOTE: The vertical margin here is left at 1.33em despite the CSS 2 errata
* mentioned above.
*/
blockquote, dl, fieldset, form, ol, p, ul { margin: 1.33em 0 }
h1, h2, h3, h4, h5, h6,
strong           { font-weight: bolder }
blockquote       { margin-left: 1.5em; margin-right: 1.5em }
address, cite,
em, i, var       { font-style: italic }
pre, code, kbd,
samp             { font-family: monospace }
pre              { white-space: pre }
big              { font-size: larger }
small, sub, sup  { font-size: smaller }
sub              { vertical-align: sub }
sup              { vertical-align: super }
hr               { border: 1px solid }
ol, ul, dd       { margin-left: 1.5em }
ol               { list-style-type: decimal }
ol ul, ul ol,
ul ul, ol ol     { margin-top: 0; margin-bottom: 0 }

br:before        { content: "\A" }

abbr, acronym    { letter-spacing: 0.1em }

:link            { color: rgb(0, 127, 255) } /* opaque blue */
:focus           { color: rgb(0, 127, 255); /* opaque blue */
                   outline: 2px solid rgb(255, 0, 127) } /* opaque blue */
:active          { color: rgb(255, 31, 0); /* opaque red */
                   outline: 2px solid rgb(255, 31, 0) } /* opaque red */
:visited         { color: rgb(191, 0, 127) } /* opaque violet */

/* Begin bidirectionality settings (do not change) */
bdo[dir="ltr"]   { direction: ltr; unicode-bidi: bidi-override }
bdo[dir="rtl"]   { direction: rtl; unicode-bidi: bidi-override }

*[dir="ltr"]     { direction: ltr; unicode-bidi: embed }
*[dir="rtl"]     { direction: rtl; unicode-bidi: embed }

/* Elements that are block-level in HTML4 */
/*
* NOTE: Removed for DVB-HTML, as these elements and these values of display
* property are not supported: thead, tbody, tfoot, col, colgroup
*/
address, blockquote, body, dd, div, dl, dt, fieldset,
form, frame, frameset, h1, h2, h3, h4, h5, h6, iframe,
noscript, noframes, object, ol, p, ul,
hr, pre, li, table, tr, td, th, caption { unicode-bidi: embed }
/* End bidi settings */
```

```
@viewport {
  /* scene: defaults to rect(0%, 0%, 100%, 100%), full screen */
  /* horizontal-resolution: defaults to 720px; */
  /* vertical-resolution: 576px; */
  /* By default, stay within Safe Action Area (centre 90%) */
  /* initial: (36px, 29px, 648px, 518px); */
  initial: rect(10%, 10%, 90%, 90%);
  type: none;
  background: rgb(0, 0, 0);
  area: screen;
}
```

Annex AC (normative): ECMAScript Binding

This appendix contains the complete ECMA-262 [95] binding for the DVB HTML Document Object Model ECMAScript Language Binding.

AC.1 ECMAScript language binding

Since ECMAScript is a prototype-based language, the DOM implementation using this language can add mechanisms which can't be defined using the IDL language. This clause defines two sets of functionalities that an ECMAScript DOM DVB implementation shall support.

For other considerations concerning the ECMAScript language binding, please refer to the appendix D of HTML 4 [104].

AC.1.1 Shortcuts to access objects

The IDL interfaces defined in clause 8.9.4.6 "DVB-HTML element related interfaces" on page 146 provide access to some objects using DVB HTML collections. For example, the third form element of a document can be accessed by using the following instruction, where `document` is the name of the object representing the DVB HTML document :

```
document.forms[2]
```

In this perspective, each object shall add a new property for each object that it encapsulates. The name of the property shall be the identifier of the corresponding encapsulated object (i.e. the value of the `id` attribute inherited by the `DVBHTMLElement` interface). The document will fail to parse if the id of an element would rename a property of the host object. Setting a property on the ECMAScript GlobalObject will override the shortcut of the same name.

This property only exists if the element has an id attribute. This shall be applied for the following interfaces:

- `DVBHTMLAnchorElement`,
- `DVBHTMLMapElement`,
- `DVBHTMLAreaElement`,
- `DVBHTMLButtonElement`,
- `DVBHTMLFrameElement`,
- `DVBHTMLFramesetElement`,
- `DVBHTMLImageElement`,
- `DVBHTMLInputElement`,
- `DVBHTMLOptionElement`,
- `DVBHTMLSelectElement`,
- `DVBHTMLTextareaElement`.

For example, if a document contains a form whose identifier is `myForm`, the form can be accessed using the following equivalent instructions :

```
document.myForm
document["myForm"]
myForm // since document is the global object
```

Subsequently, if the form contains a button identified by the `myButton` string, the button can be accessed using :

```
document.myForm.myButton
```

AC.1.2 Grouping the objects of a form

In DVB HTML, the following elements of a form may belong to different groups: button, input, select, textarea. The `name` attribute of those elements identifies this group. The `DVBHTMLFormElement` interface doesn't represent this relation. Instead, all the elements included in the form are accessed by the `elements` collection. To determine the elements belonging to the same group, an application can list all the elements, looking for the ones with the `name` attribute equals to a particular group name.

A DOM DVB HTML implementation shall provide an easier access by integrating a property in a form element for each group included in this form. The property is a table containing all the elements of the group. The name of the property shall be the `name` attribute of the elements which corresponds to the name of the group. For example, if the DVB HTML document contains a form identified by `myForm`, with two elements having their name attribute set to `myGroup`, these buttons will be accessed using the following instructions :

```
document.myForm.myGroup[0]
document.myForm.myGroup[1]
```

The rule defined in the previous clause also applies. Thus, if the two elements are respectively identified by `myInput1`, and `myInput2`, they can also be accessed by the following instructions :

```
document.myForm.myInput1
document.myForm.myInput2
```

Methods that attempt to set read-only attributes shall cause the DOMException with the error code NO_ MODIFICATION_ALLOWED_ERR to be raised.

AC.2 The DVB-HTML host objects

AC.2.1 Object DVBHTMLCollection

The DVBHTMLCollection object has the following properties:

length: This read-only property is of type Number.

The DVBHTMLCollection object has the following methods:

item(index): This method returns a Node object.

The **index** parameter is of type Number.

NOTE 1: This object can also be dereferenced using square bracket notation (e.g. obj[1]).

Dereferencing with an integer index is equivalent to invoking the item method with that index.

namedItem(name): This method returns a Node object.

The **name** parameter is of type String.

NOTE 2: This object can also be dereferenced using square bracket notation (e.g. obj["foo"]).Dereferencing using a string index is equivalent to invoking the namedItem method with that name.

NOTE 3: In DVB HTML names are not used for identification purposes, so only Nodes with id attributes will appear in a DVBHTMLCollection object.

See:

- clause 8.9.4.5.1 "DVB-HTMLCollection Interface" on page 144

AC.2.2 Object DVBHTMLDocument

DVBHTMLDocument has the all the properties and methods of the Document object as well as the properties and methods defined below.

The DVBHTMLDocument object has the following properties:

title: This property is of type String.

referrer: This read-only property is of type String.

domain: This read-only property is of type String.

URL: This read-only property is of type String.

body: This property is a DVBHTMLElement object.

images: This read-only property is a DVBHTMLCollection object.

links: This read-only property is a DVBHTMLCollection object.

forms: This read-only property is a DVBHTMLCollection object.

anchors: This read-only property is a DVBHTMLCollection object.

cookie: This property is of type String.

The DVBHTMLDocument object has the following methods:

open(): This method has no return value. The ECMAScript context which opened the new document cannot be destroyed until it calls document.close().

close(): This method has no return value. Deletes the ECMAScript context that opened the document.

write(text): This method has no return value.

The **text** parameter is of type String.

writeln(text): This method has no return value.

The **text** parameter is of type String.

See:

- clause 8.9.4.5.2 "DVBHTMLDocument Interface" on page 144

AC.2.3 Object DVBHTMLElement

DVBHTMLElement has the all the properties and methods of the Element object as well as the properties and methods defined below.

The DVBHTMLElement object has the following properties:

id: This property is of type String.

title: This property is of type String.

lang: This property is of type String; This property can raise a DOMException on setting.

dir: This property is of type String; This property can raise a DOMException on setting.

className: This property is of type String.

AC.2.4 Object DVBHTMLFormElement

DVBHTMLFormElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLFormElement object has the following properties:

elements: This read-only property is a DVBHTMLCollection object.

length: This read-only property is of type Number.

acceptCharset: This property is of type String.

action: This property is of type String.

enctype: This property is of type String.

method: This property is of type String; This property can raise a DOMException on setting.

target: This property is of type String.

The DVBHTMLFormElement object has the following methods:

submit(): This method has no return value.

reset(): This method has no return value.

See:

- clause 8.9.4.6.6 "DVBHTMLFormElement Interface" on page 149

AC.2.5 Object DVBHTMLSelectElement

DVBHTMLSelectElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLSelectElement object has the following properties:

type: This read-only property is of type String.

selectedIndex: This property is a long object.

value: This property is of type String.

length: This read-only property is of type Number

form: This read-only property is a DVBHTMLFormElement object.

options: This read-only property is a DVBHTMLCollection object.

disabled: This property is of type Boolean.

multiple: This read-only property is of type Boolean.

name: This property is of type String.

size: This property is of type Number.

The DVBHTMLSelectElement object has the following methods:

add(element, before): This method has no return value.

The **element** parameter is a DVBHTMLElement object.

The **before** parameter is a DVBHTMLElement object.

This method can raise a **DOMException** object.

remove(index): This method has no return value.

The **index** parameter is of type Number.

blur(): This method has no return value.

focus(): This method has no return value.

See:

- clause 8.9.4.6.14 "DVBHTMLSelectElement Interface" on page 156

AC.2.6 Object DVBHTMLOptionElement

DVBHTMLOptionElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLOptionElement object has the following properties:

form: This read-only property is a DVBHTMLFormElement object.

defaultSelected: This property is of type Boolean.

text: This read-only property is of type String.

index: This read-only property is of type Number.

disabled: This property is of type Boolean.

label: This property is of type String.

selected: This property is of type Boolean.

value: This property is of type String.

See:

- clause 8.9.4.6.13 "DVBHTMLOptionElement Interface" on page 155

AC.2.7 Object DVBHTMLInputElement

DVBHTMLInputElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLInputElement object has the following properties:

defaultValue: This property is of type String.

defaultChecked: This property is of type Boolean.

form: This read-only property is a DVBHTMLFormElement object.

accept: This property is of type String.

accessKey: This property is of type String.

alt: This property is of type String.

checked: This property is of type Boolean.

disabled: This property is of type Boolean.

maxLength: This property is of type Number.

name: This property is of type String.

readOnly: This property is of type Boolean.

size: This property is of type String.

src: This property is of type String.

type: This read-only property is of type String.

useMap: This read-only property is of type String.

value: This property is of type String.

The DVBHTMLInputElement object has the following methods:

blur(): This method has no return value.

focus(): This method has no return value.

select(): This method has no return value.

click(): This method has no return value.

See:

- clause 8.9.4.6.12 "DVBHTMLInputElement Interface" on page 153

AC.2.8 Object DVBHTMLTextAreaElement

DVBHTMLTextAreaElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLTextAreaElement object has the following properties:

defaultValue: This property is of type String.

form: This read-only property is a DVBHTMLFormElement object.

accessKey: This property is of type String.

cols: This read-only property is a long object.

disabled: This property is of type Boolean.

name: This property is of type String.

readOnly: This property is of type Boolean.

rows: This property is a long object.

type: This read-only property is of type String.

value: This property is of type String.

The DVBHTMLTextAreaElement object has the following methods:

blur(): This method has no return value.

focus(): This method has no return value.

select(): This method has no return value.

See:

- clause 8.9.4.6.15 "DVBHTMLTextAreaElement Interface" on page 157

AC.2.9 Object DVBHTMLButtonElement

DVBHTMLButtonElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLButtonElement object has the following properties:

form: This read-only property is a DVBHTMLFormElement object.

accessKey: This property is of type String.

disabled: This property is of type Boolean.

name: This property is of type String.

type: This read-only property is of type String.

value: This property is of type String.

See:

- clause 8.9.4.6.5 "DVBHTMLButtonElement Interface" on page 148

AC.2.10 Object DVBHTMLAnchorElement

DVBHTMLAnchorElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLAnchorElement object has the following properties:

accessKey: This property is of type String.

charset: This property is of type String.

href: This property is of type String.

hreflang: This property is of type String.

target: This property is of type String.

type: This property is of type String.

The DVBHTMLAnchorElement object has the following methods:

blur(): This method has no return value.

focus(): This method has no return value.

See:

- clause 8.9.4.6.2 "DVBHTMLAnchorElement Interface" on page 147

AC.2.11 Object DVBHTMLImageElement

DVBHTMLImageElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLImageElement object has the following properties:

lowSrc: This property is of type String.

alt: This property is of type String.

height: This property is of type String.

longDesc: This property is of type String.

src: This property is of type String.

useMap: This read-only property is of type String.

width: This property is of type String.

See:

- clause 8.9.4.6.10 "DVBHTMLImageElement Interface" on page 151

AC.2.12 Object DVBHTMLObjectElement

DVBHTMLObjectElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLObjectElement object has the following properties:

form: This read-only property is a DVBHTMLFormElement object.

code: This property is of type String.

archive: This property is of type String.

codeBase: This property is of type String.

codeType: This property is of type String.

data: This property is of type String.

declare: This property is of type Boolean.

height: This property is of type String.

standby: This property is of type String.

tabIndex: This property is a long object.

type: This property is of type String.

useMap: This read-only property is of type String.

width: This property is of type String.

contentDocument: This read-only property is a Document object.

See:

- clause 8.9.4.6.11 "DVBHTMLObjectElement Interface" on page 152

AC.2.13 Object DVBHTMLMapElement

DVBHTMLMapElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLMapElement object has the following properties:

areas: This read-only property is a DVBHTMLCollection object.

See:

- clause 8.9.4.6.3 "DVBHTMLMapElement Interface" on page 147

AC.2.14 Object DVBHTMLAreaElement

DVBHTMLAreaElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLAreaElement object has the following properties:

accessKey: This property is of type String.

alt: This property is of type String.

href: This property is of type String.

noHref: This property is of type Boolean.

target: This property is of type String.

See:

- clause 8.9.4.6.4 "DVBHTMLAreaElement Interface" on page 148

AC.2.15 Object DVBHTMLFrameSetElement

DVBHTMLFrameSetElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLFrameSetElement object has the following properties:

cols: This read-only property is of type String.

rows: This read-only property is of type String.

See:

- clause 8.9.4.6.8 "DVBHTMLFrameSetElement Interface" on page 151

AC.2.16 Object DVBHTMLFrameElement

DVBHTMLFrameElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLFrameElement object has the following properties:

frameBorder: This read-only property is of type String.

longDesc: This property is of type String.

marginHeight: This read-only property is of type String.

marginWidth: This read-only property is of type String.

scrolling: This read-only property is of type String.

src: This property is of type String.

contentDocument: This read-only property is a Document object.

See:

- clause 8.9.4.6.7 "DVBHTMLFrameElement Interface" on page 150

AC.2.17 Object DVBHTMLIFrameElement

DVBHTMLIFrameElement has the all the properties and methods of the DVBHTMLElement object as well as the properties and methods defined below.

The DVBHTMLIFrameElement object has the following properties:

frameBorder: This read-only property is of type String.

longDesc: This property is of type String.

marginHeight: This read-only property is of type String.

marginWidth: This read-only property is of type String.

scrolling: This read-only property is of type String.

src: This property is of type String.

contentDocument: This read-only property is a Document object.

See:

- clause 8.9.4.6.9 "DVBHTMLIFrameElement Interface" on page 151

AC.3 DVB-HTML event host objects

AC.3.1 Object DVBLifecycleEvent

DVBLifecycleEvent has the all the properties and methods of the DOMEvent object as well as the properties and methods defined below.

The DVBLifecycleEvent object has the following properties:

detail : this readonly property is of type Number

The DVBHTMLAnchorElement object has the following methods:

initDVBLifecycleEvent(typeArg, canBubbleArg, cancelableArg, detailArg): This method has no return value.

The **typeArg** parameter is of type String

The **canBubbleArg** parameter is of type Boolean

The **cancelableArg** parameter is of type Boolean

The **detailArg** parameter is of type Number

See:

- clause 8.9.2.2.1 "Interface DVBLifecycleEvent" on page 136

AC.4 DVB-HTML environment host objects

AC.4.1 Navigator Object

appCodeName: this read-only property is of type String ;

appName: this read-only property is of type String ;

appVersion: this read-only property is of type String ;

userAgent: this read-only property is of type String ;

See:

- clause 8.9.7.2.1 "Navigator Object" on page 160

AC.4.2 Window Object

Window object has the all the properties and methods defined below.

The Window object has the following properties:

document: this read-only property is of type DVBHTMLDocument ;

DOMImplementation: this read-only property is of type DVBDOMImplementation ;

frames: this read-only property is of type DVBHTMLCollection ;

length: this read-only property is of type Number

location: this property is of type Location ;

name: this read-only property is of type String ;

navigator: this read-only property is of type Navigator

parent: this read-only property is of type Window ;

window: this read-only property is of type Window

self: this read-only property is of type Window ;

status: this property is of type String ;

defaultStatus: this property is of type String ;

top: this read-only property is of type Window

The Window object has the following methods:

clearTimeout(timerId): This method has no return value

The parameter **timerId** is of type Number

open(url, name, features): This method returns a Window object

The parameter **url** is of type String

The parameter **name** is of type String

The parameter **features** is of type String

setTimeout(statement, delay): This method returns a Number

The **statement** parameter is of type String

The **delay** parameter is of type Number

See:

- clause 8.9.7.2.2 "Window object" on page 160

AC.4.3 Location object

:Location has the all the properties and methods defined below.

The Location object has the following properties:

hash; This property is of type String

host; This property is of type String

hostname; This property is of type String

href; This property is of type String

pathname; This property is of type String

port; This property is of type String

protocol; This property is of type String

search: This property is of type String

See:

- clause 8.9.7.2.3 "Location object." on page 163

AC.5 DVB-HTML CSS host objects

AC.5.1 DVBInlineStyle

The DVBElement object for elements supporting the 'style' attribute has the additional properties:

style: This read-only property is of type CSS2Properties

See:

- clause 8.9.8.1.1 "DVBCSSInlineStyle" on page 164

AC.5.2 DVBCSSStyle

The DVBElement object for the root element in a top level document has the additional properties:

viewport: This read-only property is of type DVBCSSViewportRule

See:

- clause 8.9.8.1.2 "DVBCSSStyle" on page 164

AC.5.3 DVBCSSViewportRule

DVBCSSviewportRule has the all the properties and methods of the CSSRule object as well as the properties and methods defined below.

style: This read-only property is of type DVBCSSViewportProperties

See:

- clause 8.9.8.1.3 "DVBCSSViewportRule" on page 165

AC.5.4 DVBCSSViewportProperties

DVBCSSViewportProperties has the following properties:

pseudoClass: This property is of type String

area: This property is of type String

backgroundVideoTransform: This property is of type Array of String

backgroundVideo: This property is of type Array of String

backgroundVideoPreserveAspect: This property is of type Array of String

backgroundVideoClip: This property is of type Array of String

backgroundVideoRectangle: This property is of type Array of String

background: This property is of type String

backgroundImageRectangle: This property is of type String

initial: This property is of type String

verticalResolution: This property is of type Number

horizontalResolution: This property is of type Number

scene: This property is of type String"

See:

- clause 8.9.8.1.4 "DVBCSSViewportProperties" on page 165

Annex AD (normative): Support for DVB-HTML

AD.1 Java bindings to DVB extensions

AD.1.1 The org.dvb.dom.dvbhtml package

All of these are in the package `org.dvb.dom.dvbhtml`.

AD.1.1.1 DVBHTMLButtonElement

```
public interface DVBHTMLButtonElement
   extends DVBHTMLElement {
   public String getAccessKey();
   public void setAccessKey(String key);
   public boolean getDisabled();
   public void setDisabled(boolean disabled)
   public DVBHTMLFormElement getForm();
   public String getName();
   public void setName(String name);
   public String getType();
   public void setValue(String value);
   public String getValue();
   public void blur();
   public void focus();
};
```

AD.1.1.2 DVBHTMLCollection

See:

- clause 8.9.4.5.1 "DVB-HTMLCollection Interface" on page 144
- clause AC.2.1 "Object DVBHTMLCollection" on page 987

```
public interface DVBHTMLCollection {
//Methods
   public Node getIdentifiedItem(String name)
   public Node getItem(Number index)
   public Number getLength()
}
```

AD.1.1.3 DVBHTMLDocument

See:

- clause 8.9.4.5.2 "DVBHTMLDocument Interface" on page 144
- clause AC.2.2 "Object DVBHTMLDocument" on page 987

```
public interface DVBHTMLDocument
   extends Document {
//Methods
   public DVBHTMLCollection getAnchors()
   public DVBHTMLElement getBody()
   public String getCookie()
   public String getDomain()
   public DVBHTMLCollection getForms()
   public DVBHTMLCollection getImages()
   public DVBHTMLCollection getLinks()
   public String getReference()
   public String getTitle()
   public void setTitle(String title)
   public String getURL()
   public void open()
```

```
      throws IllegalStateException
   public void close()
      throws IllegalStateException
   public void write(String text)
      throws IllegalStateException
   public void writeIn(String text)
      throws IllegalStateException
}
```

AD.1.1.4 DVBHTMLElement

See:

- clause 8.9.4.6.1 "DVBHTMLElement Interface" on page 146
- clause AC.2.3 "Object DVBHTMLElement" on page 988

```
public interface DVBHTMLElement
   extends Element {
   public String getClassName()
   public void setClassName()
   public String getDir()
   public void setDir()
   public String getId()
   public void setId(String id)
   public String getLang()
   public void setLang(String lang)
   public String getTitle()
   public void setTitle(String)
}
```

AD.1.1.5 DVBHTMLFormElement

See:

- clause 8.9.4.6.6 "DVBHTMLFormElement Interface" on page 149
- clause AC.2.4 "Object DVBHTMLFormElement" on page 989

```
public interface DVBHTMLFormElement
   extends DVBHTMLElement {
   public String getAction()
   public void setAction(String action)
   public String getCharSet()
   public void setCharSet(String charset)
   public DVBHTMLCollection getElements()
   public String getEncType()
   public void setEncType(String action)
   public long getLength()
   public String getMethod()
   public void setMethod(String action)
   public String getTarget()
   public void setTarget(String action)
   public void submit()
   public void reset()
}
```

AD.1.1.6 DVBHTMLSelectElement

See:

- clause 8.9.4.6.14 "DVBHTMLSelectElement Interface" on page 156
- clause AC.2.5 "Object DVBHTMLSelectElement" on page 989

```
public interface DVBHTMLSelectElement
   extends DVBHTMLElement {
   public String getType()
```

```
   public long getSelectedIndex()
   public void setSelectedIndex(long index)
   public String getValue()
   public void setvalue(String value)
   public long getLength()
   public DVBHTMLFormElement getForm()
   public DVBHTMLCollection getOptions()
   public boolean isDisabled()
   public void setDisabled(Boolean disabled)
   public boolean isMultiple()
   public String getName()
   public void setName(String name)
   public long getSize()
   public void setSize(long index)
   public long getTabIndex()
   public void setTabIndex(long index)
   public void add(DVBHTMLElement element, DVBHTMLElement before)
      throws DOMException
   public void remove(long index)
   public void blur()
   public void focus()
}
```

AD.1.1.7 DVBHTMLOptionElement

See:

- clause 8.9.4.6.13 "DVBHTMLOptionElement Interface" on page 155
- clause AC.2.6 "Object DVBHTMLOptionElement" on page 990

```
public interface DVBHTMLOptionElement
   extends DVBHTMLElement {
   public boolean isDefaultSelected()
   public void setDefaultSelected(boolean defaultselected)
   public boolean isSelected()
   public void setSelected(boolean selected)
   public boolean isDisabled()
   public void setDisabled(boolean disabled)
   public DVBHTMLFormElement getForm()
   public long getIndex()
   public String getLabel()
   public void setLabel(String Lable)
   public String getText()
   public void setText(String text)
   public String getValue()
   public void setValue(String value)
}
```

AD.1.1.8 DVBHTMLInputElement

See:

- clause 8.9.4.6.12 "DVBHTMLInputElement Interface" on page 153
- clause AC.2.7 "Object DVBHTMLInputElement" on page 990

```
public interface DVBHTMLInputElement
   extends DVBHTMLElement {
   public boolean isChecked()
   public void setChecked(boolean checked)
   public boolean isDefaultChecked()
   public void setDefaultChecked(boolean defaultchecked)
   public boolean isDisabled()
   public void setDisabled(boolean disabled)
   public boolean isReadOnly()
   public void setReadOnly(boolean readonly)
   public String getAccept()
   public void setAccept(String accept)
```

```
   public String getAccessKey()
   public void setAccessKey(String accesskey)
   public String getAlt()
   public void setAlt(String alt)
   public String getDefaultValue()
   public void setDefaultValue(String value)
   public DVBHTMLFormElement getForm()
   public long getMaxLength()
   public void setMaxLength(long length)
   public String getName()
   public void setName(String name)
   public String getSize()
   public void setSize(String size)
   public String getSrc()
   public void setSrc(String src)
   public String getType()
   public void setType(String type)
   public String getUseMap()
   public String getValue()
   public void setValue(String value)
   public void blur()
   public void click()
   public void focus()
   public void select()
}
```

AD.1.1.9 DVBHTMLTextAreaElement

See:

- clause 8.9.4.6.15 "DVBHTMLTextAreaElement Interface" on page 157
- clause AC.2.8 "Object DVBHTMLTextAreaElement" on page 991

```
public interface DVBHTMLTextAreaElement
   extends DVBHTMLElement {
   public boolean isDisabled()
   public void setDisabled(boolean disabled)
   public String getAccessKey()
   public void setAccessKey(String accesskey)
   public String getDefaultValue()
   public void setDefaultValue(String value)
   public DVBHTMLFormElement getForm()
   public String getName()
   public void setName(String name)
   public String getType()
   public void setType(String type)
   public String getValue()
   public void setValue(String value)
}
```

AD.1.1.10 DVBHTMLAnchorElement

See:

- clause 8.9.4.6.2 "DVBHTMLAnchorElement Interface" on page 147
- clause AC.2.10 "Object DVBHTMLAnchorElement" on page 992

```
public interface DVBHTMLAnchorElement
   extends DVBHTMLElement {
   public String getAccessKey()
   public void setAccessKey(String accesskey)
   public String getCharSet()
   public void setCharSet(String charset)
   public String getHRef()
   public void setHRef(String href)
   public String getHRefLang()
   public void setHRefLang(String hreflang)
```

```
    public String getTarget()
    public void setTarget(String target)
    public String getType()
    public void setType(String type)
    public void blur()
    public void focus()
}
```

AD.1.1.11 DVBHTMLImageElement

See:

- clause 8.9.4.6.10 "DVBHTMLImageElement Interface" on page 151
- clause AC.2.11 "Object DVBHTMLImageElement" on page 993

```
public interface DVBHTMLImageElement
    extends DVBHTMLElement {
    public String getLOwSrc()
    public void setLowSrc(String lowsrc)
    public String getAlt()
    public void setAlt(String alt)
    public String getHeight()
    public void setHeight(String height)
    public String getLongDesc()
    public void setLongDesc(String longdesc)
    public String getArc()
    public void setArc(String arc)
    public String getUsemap()
    public void setUseMap(String usemap)
    public String getWidth()
    public void setWidth(String width)
}
```

AD.1.1.12 DVBHTMLObjectElement

See:

- clause 8.9.4.6.11 "DVBHTMLObjectElement Interface" on page 152
- clause AC.2.12 "Object DVBHTMLObjectElement" on page 993

```
public interface DVBHTMLObjectElement
    extends DVBHTMLElement {
    public boolean isDeclare()
    public void setDeclare(boolean declare)
    public DVBHTMLFormElement getForm()
    public String getCode()
    public void setCode(String code)
    public String getArchive()
    public void setArchive(String archive)
    public String getCodeBase()
    public void setCodeBase(String codebase)
    public String getCodeType()
    public void setCodeType(String codetype)
    public String getData()
    public void setData(String data)
    public String getHeight()
    public void setHeight(String height)
    public String getStandby()
    public void setStandby(String standby)
    public long getTabIndex()
    public void setTabIndex(String index)
    public String getType()
    public void setType(String type)
    public String getUseMap()
    public void setUseMap(String usemap)
    public String getWidth()
    public void setWidth(String width)
```

```
   public Document getContentDocument()
}
```

AD.1.1.13 DVBHTMLMapElement

See:

- clause 8.9.4.6.3 "DVBHTMLMapElement Interface" on page 147
- clause AC.2.13 "Object DVBHTMLMapElement" on page 994

```
public interface DVBHTMLMapElement
   extends DVBHTMLElement {
   public DVBHTMLCollection getAreas()
}
```

AD.1.1.14 DVBHTMLAreaElement

See:

- clause 8.9.4.6.4 "DVBHTMLAreaElement Interface" on page 148
- clause AC.2.14 "Object DVBHTMLAreaElement" on page 994

```
public interface DVBHTMLAreaElement
   extends DVBHTMLElement {
   public boolean isNoHRef()
   public void setNoHRef(boolean nohref)
   public String getAccessKey()
   public void setAccessKey(String accesskey)
   public String getAlt()
   public void setAlt(String alt)
   public String getHRef()
   public void setHRef(String href)
   public String getTarget()
   public void setTarget(String target)
}
```

AD.1.1.15 DVBHTMLFrameSetElement

See:

- clause 8.9.4.6.8 "DVBHTMLFrameSetElement Interface" on page 151
- clause AC.2.15 "Object DVBHTMLFrameSetElement" on page 994

```
public interface DVBHTMLFrameSetElement
   extends DVBHTMLElement {
   public String getCols()
   public void setCols(String cols)
   public String getRows()
   public void setRows(String rows)
}
```

AD.1.1.16 DVBHTMLFrameElement

See:

- clause 8.9.4.6.7 "DVBHTMLFrameElement Interface" on page 150
- clause AC.2.16 "Object DVBHTMLFrameElement" on page 994

```
public interface DVBHTMLFrameElement
   extends DVBHTMLElement {
   public Document getContentDocument()
   public String getFrameBorder()
```

```
   public void setFraneBorder(String border)
   public String getLongDesc()
   public void setLongDesc(String longdesc)
   public String getMarginHeight()
   public void setMarginHeight(String marginheight)
   public String getMarginWidth()
   public void setMarginWidth(String marginwidth)
   public String getScrolling()
   public void setScrolling(String scrolling)
   public String getSrc()
   public void setSrc(String src)
}
```

AD.1.1.17 DVBHTMLIFrameElement

See:

- clause 8.9.4.6.9 "DVBHTMLIFrameElement Interface" on page 151
- clause AC.2.17 "Object DVBHTMLIFrameElement" on page 995

```
public interface DVBHTMLIFrameElement
   extends DVBHTMLElement {
   public String getAlign()
   public void setAlign(String align)
   public Document getContentDocument()
   public String getFrameBorder()
   public void setFraneBorder(String border)
   public String getHeight()
   public void setHeight(String height)
   public String getLongDesc()
   public void setLongDesc(String longdesc)
   public String getMarginHeight()
   public void setMargineHeight(String marginheight)
   public String getMarginWidth()
   public void setMarginWidth(String marginwidth)
   public String getName()
   public void setName(String name)
   public String getScrolling()
   public void setScrolling(String scrolling)
   public String getSrc()
   public void setSrc(String src)
   public String getWidth()
   public void setWidth(String width)
}
```

AD.1.2 The org.dvb.dom.css package

All of these are in the package `org.dvb.dom.css`.

AD.1.2.1 DVBInlineStyle

This interface shall be implemented by objects that implement the `org.w3c.dom.Element` interface and which represent elements that support the style attribute.

```
public interface DVBCSSInlineStyle {
   public CSS2Properties getStyle();
};
```

See:

- clause 8.9.8.1.1 "DVBCSSInlineStyle" on page 164
- clause AC.5.1 "DVBInlineStyle" on page 997

AD.1.2.2 DVBCSSStyle

This interface shall be implemented by objects that implement the `org.w3c.dom.Element` interface that represent the root element of a document.

```
public interface DVBCSSStyle {
   public DVBCSSViewportRule getViewport();
};
```

See:

- clause 8.9.8.1.2 "DVBCSSStyle" on page 164
- clause AC.5.2 "DVBCSSStyle" on page 997

AD.1.2.3 DVBCSSViewportRule

```
public interface DVBCSSViewportRule extends org.w3c.dom.CSSRule {
   public DVBCSSViewportProperties getStyle();
};
```

See:

- clause 8.9.8.1.3 "DVBCSSViewportRule" on page 165
- clause AC.5.3 "DVBCSSViewportRule" on page 998

AD.1.2.4 DVBCSSViewportProperties

```
public interface DVBCSSViewportProperties {
   public String getPseudoClass();
   public String getArea();
   public void setArea(String area);
   public String[] getBackgroundVideoTransform();
   public void setBackgroundVideoTransform(String transform[]);
   public String[] getBackgroundVideo();
   public void setBackgroundVideo(String video[]);
   public String[] getBackgroundVideoPreserveAspect();
   public void setBackgroundVideoPreserveAspect(String aspect[]);
   public String[] getBackgroundVideoClip();
   public void setBackgroundVideoClip(String clip[]);
   public String[] getBackgroundVideoRectangle()
   public void setBackgroundVideoRectangle(String rectangle[]);
   public String getBackground();
   public void setBackground(String background);
   public String getBackgroundImageRectangle();
   public void setBackgroundImageRectangle(String rect);
   public String getInitial();
   public void setInitial(String initial);
   public int getVerticalResolution();
   public void setVerticalResolution(int res);
   public int getHorizontalResolution();
   public void setHorizontalResolution(int res);
   public String getScene();
   public void setScene(String scene);
};
```

See:

- clause 8.9.8.1.4 "DVBCSSViewportProperties" on page 165
- clause AC.5.4 "DVBCSSViewportProperties" on page 998

AD.1.3 The org.dvb.dom.environment package

All of these are in the package org.dvb.dom.environment.

AD.1.3.1 Navigator

See:

- clause 8.9.7.2.1 "Navigator Object" on page 160
- clause AC.4.1 "Navigator Object" on page 996

```
public class Navigator
   extends java.lang.Object {
   public Navigator()
   public Navigator(String appname, String appcodename,
      String appversion, String useragent)
   public String getAppCodeName()
   public String getAppName()
   public String getAppVersion()
   public String getUserAgent()
}
```

AD.1.3.2 Window

See:

- clause 8.9.7.2.2 "Window object" on page 160
- clause AC.4.2 "Window Object" on page 996

```
public class Window
   extends java.lang.Object {
   public Window()
   public Window(DVBHTMLDocument document, DVBDOMImpl impl,
      DVBHTMLCollection frames, long length, Navigator navigator,
      Window parent, Window window, Window top)
   public String getDefaultStatus()
   public void setDefaultStatus(String defaultstatus)
   public DVBHTMLDocument getDocument()
   public DVBDOMImpl getDVBDOMImpl()
   public DVBHTMLCollection getFranes()
   public long getLength()
   public Location getLocation()
   public void setLocation(Location location)
   public String getName()
   public void setName(String name)
   public Navigator getNavigator()
   public Window getParent()
   public Window getWindow()
   public Window getSelf()
   public String getStatus()
   public void setStatus(String status)
   public Window getTop()
   public void open(String url, String name, String features)
}
```

AD.1.3.3 Location

See:

- clause 8.9.7.2.3 "Location object." on page 163
- clause AC.4.3 "Location object" on page 997

```
public class Location
   extends java.lang.Object {
   public Location()
```

```
   public String getNash()
   public void setHash(String hash)
   public String getHost()
   public void setHost(String host)
   public String getHostName()
   public void setHostName(String hostname)
   public String getHRef()
   public void setHRef(String href)
   public String getPathName()
   public void setPathName(String pathname)
   public String getPort()
   public void setPort(String port)
   public String getProtocol()
   public void setProtocol(String protocol)
   public String getSearch()
   public void setSearch(String search)
}
```

AD.1.4 The org.dvb.dom.event package

All of these are in the package org.dvb.dom.event.

AD.1.4.1 DVBLifecycleEvent

See:

- clause 8.9.2.2.1 "Interface DVBLifecycleEvent" on page 136
- clause AC.3.1 "Object DVBLifecycleEvent" on page 995

```
public class DVBLifecycleEvent
   extends java.util.event {
   public DVBLifecycleEvent()
   public DVBLifecycleEvent(String typearg, boolean canbubblearg,
      boolean candisablearg, long detailarg)
   public long getDetail()
}
```

Package
org.dvb.dom.bootstrap

Description
Provides the entry point to the W3C DOM APIs for Java applications.

Class Summary	
Interfaces	
DocumentAction	DocumentAction is used for an action that modifies a W3C Document.
DocumentFactory	DocumentFactory contains bootstrap methods for applications embedded in a document to access the document object model of the document in which they are contained.
MultipleDocumentsAction	MultipleDocumentAction is used for an action that modifies zero or more W3C Document instances.

org.dvb.dom.bootstrap
DocumentAction

Declaration

```
public interface DocumentAction
```

Description

DocumentAction is used for an action that modifies a W3C Document. When an application wishes to access a Document, it creates an instance of a class that implements DocumentAction, and passes this instance to the system. The system then calls back to the user code via the DocumentAction interface.

See Also:

MultipleDocumentsAction, DocumentFactory

Methods

---

run(Document)

```
public void run(org.w3c.dom.Document doc)
```

Access and/or modify a W3C DOM Document. All modifications must take place during this callback. The results of retaining and using DOM references outside the context of this callback are undefined.

Parameters:

doc - the DOM document to modify

org.dvb.dom.bootstrap
DocumentFactory

Declaration
```
public interface DocumentFactory
```

Description
DocumentFactory contains bootstrap methods for applications embedded in a document to access the document object model of the document in which they are contained.

Since:
MHP 1.1

Fields

DOM

```
public static final java.lang.String DOM
```

The property string to use with `XletContext.getXletProperty` in order to obtain the DocumentFactory for this Xlet (if one exists).

Methods

---

performAction(DocumentAction)

```
public void performAction(org.dvb.dom.bootstrap.DocumentAction act)
```

Perform an action on the document that contains the Xlet controlled by the given XletContext.

Parameters:

`act` - The action to perform. It will be called by the system either synchronously, or on a system thread.

---

performActionOnFrames(String[], MultipleDocumentsAction)

```
public void performActionOnFrames(java.lang.String[] names,
            org.dvb.dom.bootstrap.MultipleDocumentsAction act)
```

Perform an action on a set of documents, each contained in a frame that is a part of the same application as the Xlet controlled by the given XletContext.

Parameters:

`names` - The names of the desired frames.

`act` - The action to perform. It will be called by the system either synchronously, or on a system thread.

performActionReadOnly(DocumentAction)

```
public void performActionReadOnly(org.dvb.dom.bootstrap.DocumentAction act)
```

Perform an action on the document that contains the Xlet controlled by the given XletContext. The action is called without any ability to modify the DOM.

Parameters:

`act` - The action to perform. It will be called by the system either synchronously, or on a system thread. Attempts by this action to modify the DOM shall fail.

org.dvb.dom.bootstrap
MultipleDocumentsAction

Declaration

```
public interface MultipleDocumentsAction
```

Description

MultipleDocumentAction is used for an action that modifies zero or more W3C Document instances. When an application wishes to access a number of Documents simultaneously, it creates an instance of a class that implements MultipleDocumentAction, and passes this instance to the system. The system then calls back to the user code via the MultipleDocumentAction interface.

See Also:

DocumentAction, DocumentFactory

Methods

---

run(Document[])

```
public void run(org.w3c.dom.Document[] docs)
```

Access and/or modify a set of W3C DOM Documents. All modifications must take place during this callback. The results of retaining and using DOM references outside the context of this callback are undefined.

Parameters:

`docs` - The array of documents on which to operate. If a requested document is not found, the corresponding entry in this array will be null.

Package
org.dvb.dom.inner

Description

Provides support for embedding DVB-HTML applications within the user interface of a DVB-J application.

Class Summary	
Classes	
HTMLApplication	Encapsulates the information needed to define a DVB-HTML application.
HTMLInnerApplication-Container	Represents embedding of an DVB-HTML inner application within the user interface of a DVB-J application.

org.dvb.dom.inner
HTMLApplication

Declaration

```
public class HTMLApplication extends org.dvb.application.inner.InnerApplication

java.lang.Object
  |
  +--org.dvb.application.inner.InnerApplication
        |
        +--org.dvb.dom.inner.HTMLApplication
```

Description

Encapsulates the information needed to define a DVB-HTML application.

Constructors

HTMLApplication(URL, String, String)

```
public HTMLApplication(java.net.URL physicalRoot, java.lang.String initialPathBytes,
            java.lang.String parameters)
```

Constructor for instances of the class. The semantics of these shall be as defined in the main body of the present document for the equivalent information when provided through an AIT.

Parameters:

`physicalRoot` - the physical root of the application entry point.

`initialPathBytes` - a string specifying the URL path component to the entry point document. This path is relative to the root defined in the physicalRoots parameter.

`parameters` - the string that is appended to the application initial path as parameters

---

HTMLApplication(URL, String, String, String[], String[])

```
public HTMLApplication(java.net.URL physicalRoot, java.lang.String initialPathBytes,
            java.lang.String parameters, java.lang.String[] label,
            java.lang.String[] regex)
```

Constructor for instances of the class. The semantics of these shall be as defined in the main body of the present document for the equivalent information when provided through an AIT.

Parameters:

`physicalRoot` - the physical root of the application entry point.

`initialPathBytes` - a string specifying the URL path component to the entry point document. This path is relative to the root defined in the physicalRoots parameter.

`parameters` - the string that is appended to the application initial path as parameters

`label` - an array of one or more strings specifying a label that is associated with the set of data identified by the regular expression. This label can be used for pre-fetching in a transport specific manner.

`regex` - an array of one or more strings specifying a regular expressions that can generate all URLs that are in the domain of the application.

Throws:

`java.lang.IllegalArgumentException` - if either the regex or label parameters are an array of length zero or if the lengths of these two arrays are not the same

org.dvb.dom.inner
HTMLInnerApplicationContainer

Declaration

```
public class HTMLInnerApplicationContainer extends
    org.dvb.application.inner.InnerApplicationContainer

java.lang.Object
  |
  +--java.awt.Component
        |
        +--org.havi.ui.HComponent
              |
              +--org.dvb.application.inner.InnerApplicationContainer
                    |
                    +--org.dvb.dom.inner.HTMLInnerApplicationContainer
```

All Implemented Interfaces:

`org.havi.ui.HMatteLayer`, `org.havi.ui.HNavigable`, `org.havi.ui.HNavigationInputPreferred`, `java.awt.image.ImageObserver`, `java.io.Serializable`, `org.dvb.ui.TestOpacity`

Description

Represents embedding of an DVB-HTML inner application within the user interface of a DVB-J application.

Constructors

HTMLInnerApplicationContainer(HTMLApplication)

```
public HTMLInnerApplicationContainer(org.dvb.dom.inner.HTMLApplication a)
            throws IOException
```

Construct an instance of this class with a DVB-HTML application as its content. The instance is initialized to present the entry point document of the application.

Parameters:

`a` - the DVB-HTML application

Throws:

`java.io.IOException` - if an error occurred while reading the code or data for the inner application

Methods

performAction(DocumentAction)

```
public void performAction(org.dvb.dom.bootstrap.DocumentAction act)
```

Perform an action on the DVB-HTML document.

Parameters:

`act` - The action to perform. It will be called by the system either synchronously, or on a system thread.

Annex AE (normative): Inner Applications

Package org.dvb.application.inner

Description

Provides support for embedding other interactive applications within the user interface of a DVB-J application.

Class Summary	
Interfaces	
DVBScene	Represents various features which are common to the top level Container of applications whether running stand-alone or embedded in a DVB-HTML application.
InnerApplicationListener	Listener for events related to inner applications
Classes	
InnerApplication	Encapsulates the information needed to define an inner application.
InnerApplicationContainer	Represents embedding of an inner application within the user interface of a DVB-J application.
InnerApplicationEvent	InnerApplicationEvent is used to notify applications which have registered interest in events coming from inner applications that such an event has happened.

org.dvb.application.inner
DVBScene

Declaration

```
public interface DVBScene
```

Description

Represents various features which are common to the top level Container of applications whether running stand-alone or embedded in a DVB-HTML application. All integer constants used in this class are those defined in the class org.havi.ui.HScene.

Methods

---

addShortcut(int, HActionable)

```
public boolean addShortcut(int keyCode, org.havi.ui.HActionable comp)
```

Adds a shortcut key to action the specified `HActionable` . Generating the defined java.awt.KeyEvent or `HRcEvent` keycode causes the specified component to become actioned —— potentially any keyCode may have a shortcut associated with it. The shortcut will only be added if the `HActionable` component is a child component in the container hierarchy of which the `HScene` is the root container. If this is not the case this method shall return false.

Note that a maximum of one `HActionable` may be associated with a given keyCode. An `HActionable` can have at most one associated shortcut keycode. Calling `addShortcut` repeatedly with the same `HActionable` will result in the previous short cut being removed. A short cut can be set on an invisible `HActionable` and therefore it is possible to provide short-cuts that have no user representation.

If the relevant keyCode is received by the `HScene` , then the `HActionable` will be actioned by the `HScene` sending it an `ACTION_PERFORMED` . Note that it is the responsibility of the application to ensure that the keyCode used is included in the set registered with the setKeyEvents method and is one which the platform can generate, i.e. where the method HRcCapabilities.isSupported() returns true.

Parameters:

`keyCode` - the keycode that represents the short cut. If keycode is java.awt.event.KeyEvent#VK_UNDEFINED, then the shortcut will not be added, any existing shortcut for this component will not be changed and this method shall return false.

`comp` - The actionable component that will be actioned.

Returns:

true if the shortcut was added, false otherwise.

---

addWindowListener(WindowListener)

```
public void addWindowListener(java.awt.event.WindowListener wl)
```

Add a listener to receive any java.awt.event.WindowEvents sent from this `DVBScene` . If the listener has already been added further calls will add further references to the listener, which will then receive multiple copies of a single event.

Parameters:
`wl` - The java.awt.event.WindowListener to be notified of any java.awt.event.WindowEvents.

---

enableShortcuts(boolean)

```
public void enableShortcuts(boolean enable)
```

Enables or disables all short cuts that are currently set on the Scene. To enable or disable a single shortcut use `addShortcut` or `removeShortcut` .

Note `enableShortcuts(false)` does not remove existing added `DVBScene` shortcuts - they are merely disabled and may be subsequently re-enabled with `enableShortcuts(true)` .

Parameters:
`enable` - a value of true indicates all shortcuts are to be enabled, and a value of false indicates all shortcuts are to be disabled.

---

getAllShortcutKeycodes()

```
public int[] getAllShortcutKeycodes()
```

Returns all keycodes added in the DVBScene as shortcuts.

Returns:
all keycodes added in the DVBScene as shortcuts, there are no ordering guarantees.

---

getBackgroundImage()

```
public java.awt.Image getBackgroundImage()
```

Retrieve any image used as a background for this `DVBScene` .

Returns:
an image used as a background, or `null` if no image is set. Note that depending on the current render mode any image set may not actually be rendered.

See Also:
`setRenderMode(int)`

---

getBackgroundMode()

```
public int getBackgroundMode()
```

Get the background mode of this `DVBScene` . The return value specifies whether the paint method should draw the background (i.e. a rectangle filling the bounds of the `DVBScene`).

Returns:
one of `NO_BACKGROUND_FILL` or `BACKGROUND_FILL` .

---

getFocusOwner()

```
public java.awt.Component getFocusOwner()
```

Returns the child component of this `DVBScene` which has focus if and only if this `DVBScene` is active.

Returns:
the component with focus, or null if no children have focus assigned to them.

getRenderMode()

```
public int getRenderMode()
```

Get the rendering mode of any background image associated with this DVBScene .

Returns:
the rendering mode, one of IMAGE_NONE , IMAGE_STRETCH , IMAGE_CENTER or IMAGE_TILE .

getShortcutComponent(int)

```
public org.havi.ui.HActionable getShortcutComponent(int keyCode)
```

Retrieve the HActionable associated with the specified shortcut key.

Parameters:
keyCode - the shortcut key code to be queried for an associated HActionable .

Returns:
the HActionable associated with the specified key if keyCode is a valid shortcut key for this DVBScene , null otherwise.

getShortcutKeycode(HActionable)

```
public int getShortcutKeycode(org.havi.ui.HActionable comp)
```

Returns the keycode associated with the specified HActionable component.

Parameters:
comp - the HActionable to return the keycode that it is associated with.

Returns:
the keycode associated with the specified HActionable component, if it is currently a valid shortcut “target”, otherwise return java.awt.event.KeyEvent#VK_UNDEFINED.

isDoubleBuffered()

```
public boolean isDoubleBuffered()
```

Returns true if all the drawing done during the update and paint methods for this specific DVBScene object is automatically double buffered.

Returns:
true if all the drawing done during the update and paint methods for this specific DVBScene object is automatically double buffered, or false if drawing is not double buffered. The default value for the double buffering setting is platform-specific.

isEnableShortcuts()

```
public boolean isEnableShortcuts()
```

Returns the status of all short cuts that are currently set on the DVBScene.

Returns:
true if shortcuts are enabled, false otherwise.

See Also:
enableShortcuts(boolean)

isOpaque()

```
public boolean isOpaque()
```

Returns true if the entire DVBScene area, as given by the java.awt.Component#getBounds method, is fully opaque, i.e. its paint method (or surrogate methods) guarantee that all pixels are painted in an opaque Color.

By default, the return value depends on the value of the current background mode, as set by the setBackgroundMode method. The return value should be overridden by subclasses that can guarantee full opacity. The consequences of an invalid overridden value are implementation specific.

Returns:

true if all the pixels within the area given by the java.awt.Component#getBounds method are fully opaque, i.e. its paint method (or surrogate methods) guarantee that all pixels are painted in an opaque Color, otherwise false.

isVisible()

```
public boolean isVisible()
```

Determines if the DVBScene (or more properly its added child components) is Visible. Initially an DVBScene is invisible.

Returns:

true if the DVBScene is visible; false otherwise.

removeShortcut(int)

```
public void removeShortcut(int keyCode)
```

Removes the specified short-cut key. if the specified short-cut key is not registered, the method has no effect

Parameters:

keyCode - The keycode that represents the short cut

removeWindowListener(WindowListener)

```
public void removeWindowListener(java.awt.event.WindowListener wl)
```

Remove a listener so that it no longer receives any java.awt.event.WindowEvents. If the specified listener is not registered, the method has no effect. If multiple references to a single listener have been registered it should be noted that this method will only remove one reference per call.

Parameters:

wl - The java.awt.event.WindowListener to be removed from notification of any java.awt.event.WindowEvents.

setBackgroundImage(Image)

```
public void setBackgroundImage(java.awt.Image image)
```

Set an image which shall be painted in the background of the DVBScene , after the background has been drawn according to the current mode set with setBackgroundMode , but before any children are drawn. The image is rendered according to the current render mode set with setRenderMode .

Note that the use of a background image in this way may affect the return value of the isOpaque method, depending on the image and the current rendering mode.

Parameters:

`image` - the image to be used as a background. If this parameter is `null` any current image is removed. Note that depending on the current render mode any image set may not actually be rendered.

See Also:

`setRenderMode(int)`

---

setBackgroundMode(int)

```
public void setBackgroundMode(int mode)
```

Set the background mode of this `DVBScene` . The value specifies whether the paint method should draw the background (i.e. a rectangle filling the bounds of the `DVBScene`).

Note that the background mode will affect the return value of the `isOpaque` method, depending on the value of the `mode` parameter. A fill mode of `BACKGROUND_FILL` implies that `isOpaque` must return `true`.

Parameters:

`mode` - one of `NO_BACKGROUND_FILL` or `BACKGROUND_FILL` . If mode is not a valid value, an IllegalArgumentException will be thrown.

---

setRenderMode(int)

```
public boolean setRenderMode(int mode)
```

Set the rendering mode of any background image associated with this `DVBScene` .

Note that the minimum requirement is to support only the `IMAGE_NONE` mode. Support of the other modes is platform and implementation specific.

Parameters:

`mode` - the rendering mode, one of `IMAGE_NONE` , `IMAGE_STRETCH` , `IMAGE_CENTER` or `IMAGE_TILE` .

Returns:

`true` if the mode was set successfully, `false` if the mode is not supported by the platform.

org.dvb.application.inner
InnerApplication

Declaration

```
public abstract class InnerApplication

java.lang.Object
  |
  +--org.dvb.application.inner.InnerApplication
```

Direct Known Subclasses:

org.dvb.dom.inner.HTMLApplication

Description

Encapsulates the information needed to define an inner application.

Constructors

InnerApplication()

```
protected InnerApplication()
```

A protected constructor. This shall not be used by inter-operable applications.

org.dvb.application.inner
InnerApplicationContainer

Declaration

```
public abstract class InnerApplicationContainer extends org.havi.ui.HComponent implements
    org.havi.ui.HNavigable

java.lang.Object
  |
  +--java.awt.Component
        |
        +--org.havi.ui.HComponent
              |
              +--org.dvb.application.inner.InnerApplicationContainer
```

All Implemented Interfaces:

`org.havi.ui.HMatteLayer`, `org.havi.ui.HNavigable`, `org.havi.ui.HNavigationInputPreferred`, `java.awt.image.ImageObserver`, `java.io.Serializable`, `org.dvb.ui.TestOpacity`

Direct Known Subclasses:

`org.dvb.dom.inner.HTMLInnerApplicationContainer`

Description

Represents embedding of an inner application within the user interface of a DVB-J application. The inner application shall be started when the object of this class is constructed. The behaviour of instances of this class when an inner application exits is either implementation or inner application format dependent.

When an instance of this class gains input focus,shall gain the input focus. The meaning of this is specific to the format of the inner application concerned. Inner applications are allowed to consume the events VK_UP, VK_DOWN, VK_LEFT and VK_RIGHT. While this is happening, the HNavigable focus management shall be disabled and the actions defined by `setFocusTraversal` shall not happen. The mechanisms by which inner applications start and stop consuming these events are specific to the content format of the inner application.

Constructors

InnerApplicationContainer(InnerApplication)

```
protected InnerApplicationContainer(org.dvb.application.inner.InnerApplication a)
            throws IOException
```

Construct an instance of this class with a particular inner application as its content. This shall not be used by inter-operable applications.

Parameters:

`a` - the inner application

Throws:

`java.io.IOException` - if an error occurred while reading the code or data for the inner application

Methods

---

addHFocusListener(HFocusListener)

```
public void addHFocusListener(org.havi.ui.event.HFocusListener l)
```

Adds the specified `HFocusListener` to receive `HFocusEvent` events sent from this `HNavigable`. If the listener has already been added further calls will add further references to the listener, which will then receive multiple copies of a single event.

Specified By:
`addHFocusListener` in interface `HNavigable`

Parameters:
`l` - the HFocusListener to add

---

addInnerApplicationListener(InnerApplicationListener)

```
public void addInnerApplicationListener(org.dvb.application.inner.InnerApplicationListener
            l)
```

Add a listener for events when the inner application exits.

Parameters:
`l` - the listener to be notified when the inner application exits

---

getGainFocusSound()

```
public org.havi.ui.HSound getGainFocusSound()
```

Get the sound associated with the gain focus event.

Specified By:
`getGainFocusSound` in interface `HNavigable`

Returns:
The sound played when the component gains focus. If no sound is associated with gaining focus, then null shall be returned.

---

getLoseFocusSound()

```
public org.havi.ui.HSound getLoseFocusSound()
```

Get the sound associated with the lost focus event.

Specified By:
`getLoseFocusSound` in interface `HNavigable`

Returns:
The sound played when the component loses focus. If no sound is associated with losing focus, then null shall be returned.

---

getMove(int)

```
public org.havi.ui.HNavigable getMove(int keyCode)
```

Provides the `HNavigable` object that is navigated to when a particular key is pressed.

Specified By:
`getMove` in interface `HNavigable`

Parameters:
`keyCode` - The key code of the pressed key.

Returns:

Returns the HNavigable object, or if no HNavigable is associated with the keyCode then returns null.

---

getNavigationKeys()

```
public int[] getNavigationKeys()
```

Retrieve the set of key codes which this component maps to navigation targets.

Specified By:
getNavigationKeys in interface HNavigationInputPreferred

Returns:
an array of key codes, or null if no navigation targets are set on this component.

---

isSelected()

```
public boolean isSelected()
```

Indicates if this component has focus.

Specified By:
isSelected in interface HNavigable

Returns:
true if the component has focus, otherwise returns false.

---

processHFocusEvent(HFocusEvent)

```
public void processHFocusEvent(org.havi.ui.event.HFocusEvent evt)
```

Process an HFocusEvent sent to this HNavigationInputPreferred.

Specified By:
processHFocusEvent in interface HNavigationInputPreferred

Parameters:
evt - the HFocusEvent to process.

---

removeHFocusListener(HFocusListener)

```
public void removeHFocusListener(org.havi.ui.event.HFocusListener l)
```

Removes the specified HFocusListener so that it no longer receives HFocusEvent events from this HNavigable. If the specified listener is not registered, the method has no effect. If multiple references to a single listener have been registered it should be noted that this method will only remove one reference per call.

Specified By:
removeHFocusListener in interface HNavigable

Parameters:
l - the HFocusListener to remove

---

removeInnerApplicationListener(InnerApplicationListener)

```
public void
            removeInnerApplicationListener(org.dvb.application.inner.InnerApplicationListe
            ner l)
```

Remove a listener for events when the inner application exits.

Parameters:
`l` - the listener to be removed

---

setFocusTraversal(HNavigable, HNavigable, HNavigable, HNavigable)

```
public void setFocusTraversal(org.havi.ui.HNavigable up, org.havi.ui.HNavigable down,
            org.havi.ui.HNavigable left, org.havi.ui.HNavigable right)
```

Set the focus control for an `HNavigable` component. Note `setFocusTraversal` is a convenience function for application programmers where a standard up, down, left and right focus traversal between components is required.

Note `setFocusTraversal` is equivalent to multiple calls to `setMove` , where the key codes VK_UP, VK_DOWN, VK_LEFT, VK_RIGHT are used.

Note that this API does not prevent the creation of "isolated" `HNavigable` components ——- authors should endeavor to avoid confusing the user.

Specified By:
`setFocusTraversal` in interface `HNavigable`

Parameters:
`up` - The `HNavigable` component to move to, when the user generates a VK_UP KeyEvent. If there is no `HNavigable` component to move "up" to, then null should be specified.

`down` - The `HNavigable` component to move to, when the user generates a VK_DOWN KeyEvent. If there is no `HNavigable` component to move "down" to, then null should be specified.

`left` - The `HNavigable` component to move to, when the user generates a VK_LEFT KeyEvent. If there is no `HNavigable` component to move "left" to, then null should be specified.

`right` - The `HNavigable` component to move to, when the user generates a VK_RIGHT KeyEvent. If there is no `HNavigable` component to move "right" to, then null should be specified.

---

setGainFocusSound(HSound)

```
public void setGainFocusSound(org.havi.ui.HSound sound)
```

Associate a sound with gaining focus, i.e. when the `HNavigable` receives a `java.awt.event.FocusEvent` event of type `FOCUS_GAINED`. This sound will start to be played when an object implementing this interface gains focus. It is not guaranteed to be played to completion. If the object implementing this interface loses focus before the audio completes playing, the audio will be truncated. Applications wishing to ensure the audio is always played to completion must implement special logic to slow down the focus transitions.

By default, an `HNavigable` object does not have any gain focus sound associated with it.

Note that the ordering of playing sounds is dependent on the order of the focus lost, gained events.

Specified By:
`setGainFocusSound` in interface `HNavigable`

Parameters:
`sound` - the sound to be played, when the component gains focus. If sound content is already set, the original content is replaced. To remove the sound specify a null `HSound` .

---

setLoseFocusSound(HSound)

```
public void setLoseFocusSound(org.havi.ui.HSound sound)
```

Associate a sound with losing focus, i.e. when the HNavigable receives a java.awt.event.FocusEvent event of type FOCUS_LOST. This sound will start to be played when an object implementing this interface loses focus. It is not guaranteed to be played to completion. It is implementation dependent whether and when this sound will be truncated by any gain focus sound played by the next object to gain focus.

By default, an HNavigable object does not have any lose focus sound associated with it.

Note that the ordering of playing sounds is dependent on the order of the focus lost, gained events.

Specified By:

setLoseFocusSound in interface HNavigable

Parameters:

sound - the sound to be played, when the component loses focus. If sound content is already set, the original content is replaced. To remove the sound specify a null HSound .

---

setMove(int, HNavigable)

```
public void setMove(int keyCode, org.havi.ui.HNavigable target)
```

Defines the navigation path from the current HNavigable to another HNavigable when a particular key is pressed.

Note that setFocusTraversal is equivalent to multiple calls to setMove , where the key codes VK_UP, VK_DOWN, VK_LEFT, VK_RIGHT are used.

Specified By:

setMove in interface HNavigable

Parameters:

keyCode - The key code of the pressed key. Any numerical keycode is allowed, but the platform may not be able to generate all keycodes. Application authors should only use keys for which HRcCapabilities.isSupported() or HKeyCapabilities.isSupported() returns true.

target - The target HNavigable object that should be navigated to. If a target is to be removed from a particular navigation path, then null should be specified.

org.dvb.application.inner
InnerApplicationEvent

Declaration

```
public class InnerApplicationEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.application.inner.InnerApplicationEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

InnerApplicationEvent is used to notify applications which have registered interest in events coming from inner applications that such an event has happened.

Constructors

InnerApplicationEvent(InnerApplicationContainer)

```
public InnerApplicationEvent(org.dvb.application.inner.InnerApplicationContainer source)
```

Constructor for an event.

Parameters:

source - the InnerApplicationContainer which generated the event.

org.dvb.application.inner
InnerApplicationListener

Declaration
```
public interface InnerApplicationListener
```

Description
Listener for events related to inner applications

Methods

InnerApplicationExited(InnerApplicationEvent)

```
public void InnerApplicationExited(org.dvb.application.inner.InnerApplicationEvent e)
```

Called when an inner application exits.

Parameters:

`e` - an event object encapsulating what happened

Annex AF (normative): Plug-in APIs

Package org.dvb.application.plugins

Description

Provides support for inter-operable plug-ins in the MHP specification. The following classes and interfaces are intended for generic plug-ins and are not specific to any particular content format.

- InvalidApplicationException
- Plugin
- ApplicationSecurityContext

The following classes are intended specifically for DVB-HTML plug-ins.

- XletContainer
- XletSystemCall

Class Summary

Interfaces	
Plugin	This interface allows an application or service manager to control the lifecycle of applications being executed by an inter-operable plug-in.
Classes	
ApplicationSecurityContext	This class represents the security context for an application whose permissions are defined by the MHP security model, in particular a permission request file.
XletContainer	This class provides a container that can be embedded in a widget hierarchy, and can provide a container that can safely be used as the top-level container of an embedded Xlet.
XletSystemCall	This class permits user code to intercept certain system calls initiated by an embedded Xlet that need to be serviced by a support application.
Exceptions	
InvalidApplicationException	Thrown if an application is not valid for execution by a plug-in.

org.dvb.application.plugins
ApplicationSecurityContext

Declaration

```
public class ApplicationSecurityContext

java.lang.Object
  |
  +--org.dvb.application.plugins.ApplicationSecurityContext
```

Description

This class represents the security context for an application whose permissions are defined by the MHP security model, in particular a permission request file. One example of this is DVB-HTML applications managed by a plug-in application. This would also apply to applications in other content format where the permissions for that content format are signalled with MHP mechanisms and governed by the MHP security model.

Constructors

ApplicationSecurityContext(URL[], URL, AppID)

```
public ApplicationSecurityContext(java.net.URL[] path, java.net.URL entryPoint,
            org.dvb.application.AppID appID)
            throws IOException
```

Creates a new security context for an application whose code can be found on the path supplied, and whose entry point directory is as given. Under no circumstances will an application managed by a plug-in be given access to resources not available to the plug-in itself. This policy is reflected in the permissions granted to the ApplicationSecurityContext, as well as the permissions granted to any classes loaded by any class loaders managed by a security context.

If there is a permission request file in the directory identified by the entryPoint, it will be processed in the same way as the permission request file of a DVB-J application. i.e. reading it in, parsing it and taking account of the access rights granted by the user as defined under “General principles” in the main body of the present document.

Parameters:

`path` - The search path for locating resources within the application.

`entryPoint` - The directory containing the permission request file to use

`appID` - the application ID which the application is to run under

Throws:

IOException - when there is an IO error reading in the permission request file or attempting to read in the permission request file or attempting to discover the existence of a permission request file.

`java.lang.NullPointerException` - if entryPoint is null, if path is null, or if any element of path is null.

`java.lang.IllegalArgumentException` - if path.length < 1

`java.io.IOException`

Methods

checkPermission(Permission)

```
public void checkPermission(java.security.Permission p)
```

Throws a `SecurityException` if the requested access, specified by the given permission, is not permitted to the application or sub-application represented by this application security context object. The set of permissions granted to an entity is be a function of receiver policy, possibly influenced by user settings, application signer, and permission request file.

Parameters:

`p` - A permission object representing the resource for which access is being checked.

Throws:

`java.lang.NullPointerException` - if p is null

`java.lang.SecurityException` - if this application has not been granted access to the resource represented by p.

createEmbeddedContext(URL[], URL)

```
public org.dvb.application.plugins.ApplicationSecurityContext
            createEmbeddedContext(java.net.URL[] path, java.net.URL entryPoint)
```

Creates a context for an embedded part of an application, e.g. an Xlet embedded within a DVB-HTML page. The set of permissions granted to the application will be the same as the parent ApplicationSecurityContext.

Parameters:

`path` - The search path for locating resources within the application.

`entryPoint` - The resource of the entry point of this application.

Returns:

a context for the part of the application concerned

Throws:

`java.lang.NullPointerException` - if entryPoint is null, if path is null, or if any element of path is null.

`java.lang.IllegalArgumentException` - if path.length < 1

doPrivileged(PrivilegedAction)

```
public java.lang.Object doPrivileged(java.security.PrivilegedAction action)
```

Performs the specified PrivilegedAction with privileges enabled and restricted by the specified AccessControlContext. The action is performed with the intersection of the permissions possessed by the caller's protection domain, and those possessed by the domains represented by the specified AccessControlContext. If the action's run method throws an (unchecked) exception, it will propagate through this method.

Parameters:

`action` - the action to be performed.

Returns:

the value returned by the action's run method.

getClassLoader(String[])

```
public java.lang.ClassLoader getClassLoader(java.lang.String[] forbiddenPackages)
```

Get a classloader that is appropriate for loading classes for the application (or sub-application) represented by this application security context object. If this method is called more than once, the same instance will be returned.

It is important that embedded DVB-J code be prevented from accessing classes that implement the plug-in application. To this end, the plug-in may specify a list of forbidden packages. Classes loaded by the returned classloader will be forbidden from loading or accessing classes in the named packages.

Parameters:

`forbiddenPackages` - a list of forbidden package names, e.g. `{ "de.tu-bs.ing.ifn.plugin.impl" }`.

Returns:

A class loader that is appropriate for loading and DVB-J classes that are a part of this application or sub-application.

---

getResource(String, boolean)

```
public java.net.URL getResource(java.lang.String name, boolean sameSigner)
```

Get a locator to the named resource, within the search path for this application. Will return null if a resource with the given name that is appropriately signed (if necessary) cannot be found.

Note (informative): This method can be used, for example, by an interoperable plug-in that needs to fetch part of an application that is not loaded by a classloader. For example, it could be used to get a locator to an HTML page, if and only if that page is appropriately signed.

Parameters:

`name` - The name of the resource (e.g. com/foo/MyPage.html)

`sameSigner` - True if this is code, or any other resource for which the signer must be the same as the signer of the entry point.

Returns:

URL to the named resource, or null.

org.dvb.application.plugins
InvalidApplicationException

Declaration

```
public class InvalidApplicationException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.plugins.InvalidApplicationException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown if an application is not valid for execution by a plug-in.

Since:

MHP1.1

Constructors

InvalidApplicationException()

```
public InvalidApplicationException()
```

Construct a InvalidApplicationException with no detail message

---

InvalidApplicationException(String)

```
public InvalidApplicationException(java.lang.String s)
```

Construct a InvalidApplicationException with a detail message

Parameters:

s - detail message

org.dvb.application.plugins
Plugin

Declaration

```
public interface Plugin
```

Description

This interface allows an application or service manager to control the lifecycle of applications being executed by an inter-operable plug-in. It shall be implemented by inter-operable plug-ins and shall be called by implementation of the application manager in an MHP terminal. It shall not be called by MHP applications. The usage model for this interface is the reuse of the `javax.tv.xlet.Xlet` interface to represent applications in formats other than DVB-J. It is the responsibility of the plug-in to provide implementations of the methods in that interface and to perform the translation between the semantics specified for DVB-J applications and the semantics of the application format which the plug-in supports. The plug-in is initialized by the application manager calling the no-argument constructor of the object implementing this interface. Plug-ins are not expected to perform any time consuming activities or hold any scarce resources in this call.

Methods

---

initApplication(AppAttributes)

```
public javax.tv.xlet.Xlet initApplication(org.dvb.application.AppAttributes app)
            throws InvalidApplicationException
```

Request the plug-in to prepare for executing an instance of an application in a format which it supports. If the application cannot be prepared then null shall be returned. While the plug-in is in the terminated state then this method shall always return null. The application shall only be considered to be started when the application manager calls the methods on the Xlet interface returned by this method.

Parameters:

`app` - an instance of `AppAttributes` for the application which is to be started.

Returns:

an object implementing the Xlet interface or null if the application cannot be started.

Throws:

`InvalidApplicationException` - if the application to be started is not valid for this plug-in

---

initApplication(InnerApplication)

```
public javax.tv.xlet.Xlet initApplication(org.dvb.application.inner.InnerApplication app)
            throws InvalidApplicationException
```

Request the plug-in to prepare for executing an instance of an application in a format which it supports.If the application cannot be prepared then null shall be returned. While the plug-in is in the terminated state then this method shall always return null. The application shall only be considered to be started when the application manager calls the methods on the Xlet interface returned by this method.

Parameters:

`app` - an instance of InnerApplication for the application which is to be started

Returns:

an object implementing the Xlet interface or null if the application cannot be started

Throws:
`InvalidApplicationException` - if the application to be started is not valid for this plug-in

---

initPlugin()

```
public boolean initPlugin()
```

initialize the plug-in. Any time consuming initializations should be performed during this method call. This method shall be called after the no-argument constructor of the object implementing this interface and before any calls to the `startApplication`. It may also be called after a call to `terminatePlugin` if a plug-in was not removed from the virtual machine where it was executing. The behaviour of an application manager should a plug-in fail to initialize is intentionally unspecified.

Returns:
true if the plug-in initialized successfully otherwise false

---

isSupported(AppAttributes)

```
public boolean isSupported(org.dvb.application.AppAttributes app)
```

Test whether this plug-in is able to support a particular application. This method shall work regardless of whether the plug-in has been initialized or not.

Parameters:
`app` - an instance of `AppAttributes` for the application which is to be started.

Returns:
true if the plug-in can support this application otherwise false

---

terminatePlugin()

```
public void terminatePlugin()
```

Terminate the plug-in. This method shall only be called after all applications being executed by this plug-in have been terminated. The implementation of this method shall release all resources held by the plug-in. Once this method has returned, the plug-in shall either be unloaded from the virtual machine where it was executing or the `initPlugin` method shall be called again to put the plug-in again in an initialized condition. A plug-in may not refuse to terminate and throwing a runtime exception or error from this method shall result in the plug-in being removed from the virtual machine where it was executing.

org.dvb.application.plugins
XletContainer

Declaration

```
public class XletContainer extends java.awt.Container

java.lang.Object
  |
  +--java.awt.Component
        |
        +--java.awt.Container
              |
              +--org.dvb.application.plugins.XletContainer
```

All Implemented Interfaces:

java.awt.image.ImageObserver, java.io.Serializable

Description

This class provides a container that can be embedded in a widget hierarchy, and can provide a container that can safely be used as the top-level container of an embedded Xlet. This solves the problem of an embedded Xlet being able to call getParent() to discover the widget hierarchy in which it is embedded.

Since:

MHP 1.1

Constructors

XletContainer(Container)

```
public XletContainer(java.awt.Container parent)
```

Construct a new XletContainer as a child of Parent. The XletContainer contains exactly one widget: A child container. The child container is constrained to be at the same location and the same size as the parent XletContainer.

Parameters:

parent - The widget that is to have an Xlet embedded within it.

Throws:

java.lang.NullPointerException - if parent is null

See Also:

getXletContainer()

Methods

---

getXletContainer()

```
public java.awt.Container getXletContainer()
```

Get the only child of the XletContainer. This container can safely be used as the top-level container of an Xlet, e.g. an Xlet embedded in a DVB-HTML page. Calling getParent() on this container from

client code will return null, unless the caller has been granted special access via a platform-dependent mechanism.

If this method is invoked more than once for the same instance of XletContainer, it will return the same instance.

Returns:
The child of this XletContainer.

org.dvb.application.plugins
XletSystemCall

Declaration

```
public abstract class XletSystemCall

java.lang.Object
  |
  +--org.dvb.application.plugins.XletSystemCall
```

Description

This class permits user code to intercept certain system calls initiated by an embedded Xlet that need to be serviced by a support application. For example, a DVB-HTML plug-in application needs to service requests that are made by an embedded Xlet, typically via static method calls.

Since:

MHP1.1

Constructors

XletSystemCall()

```
protected XletSystemCall()
```

Create a new XletSystemCall

Methods

---

getRootContainer(XletContext)

```
public abstract java.awt.Container getRootContainer(javax.tv.xlet.XletContext ctx)
```

Called when the Xlet calls javax.tv.graphics.TVContainer.getRootContainer().

Parameters:

`ctx` - The context of the Xlet making the request; it shall be identical to the XletContext used to create this instance of XletSystemCall.

Returns:

a container object to be returned to the embedded xlet

See Also:

`javax.tv.graphics.TVContainer.getRootContainer(XletContext)`

---

register(Plugin, XletContext)

```
public final void register(org.dvb.application.plugins.Plugin p,
            javax.tv.xlet.XletContext ctx)
```

Register this instance of XletSystemCall with the system.

Parameters:

`p` - The Plugin that services calls made by the xlet, i.e. the Plugin of which this instance of XletSystemCall is a part.

`ctx` - The XletContext of the Xlet making the calls

Throws:

`java.lang.NullPointerException` - if p or ctx is null

See Also:

`unregister(Plugin, XletContext)`

---

unregister(Plugin, XletContext)

```
public final void unregister(org.dvb.application.plugins.Plugin p,
            javax.tv.xlet.XletContext ctx)
```

Unregister this instance of XletSystemCall with the system. When an interoperable Plugin terminates, of an Xlet managed by a Plugin is asked to terminate, the Plugin must unregister any relevant XletSystemCall instances.

Parameters:

`p` - The Plugin that services calls made by the xlet, i.e. the Plugin of which this instance of XletSystemCall is a part.

`ctx` - The XletContext of the Xlet making the calls

Throws:

`java.lang.NullPointerException` - if p or ctx is null

See Also:

`register(Plugin, XletContext)`

Annex AG (normative): Stored application APIs

Package org.dvb.application.storage

Description

Provides support for storage of applications.

Class Summary	
Interfaces	
ApplicationStorageController	Defines the methods for storing, listing and removing applications to and from a service.
ApplicationStorageListener	Listener to receive reports on progress of application storage operations.
ExtendedAppAttributes	The `ExtendedAppAttributes` interface provides additional attributes that are useful when application can be stored in the MHP terminal.
StoredApplicationService	Defines the information about a stored application service.
Classes	
ApplicationCache	A cache to store applications so that they may be started faster when signalled in broadcast.
ApplicationStoragePermission	This class represents a permission to manage applications stored in the MHP terminal.
StoredApplicationServiceFactory	This factory creates new Service objects representing stand-alone stored application services.
StoredApplicationServiceType	The service type used for stored application services.
Exceptions	
ApplicationDownloadException	Thrown if the downloading of the application failed.
InvalidApplicationException	When an application is being installed into a service, this is thrown when: The application does not include an application_storage_descriptor.
InvalidDescriptionFileException	Thrown when an application descriptio file is invalid.
NotEnoughResourcesException	Thrown if the MHP terminal does not have enough resources to install the application.
ServiceAlreadyExistsException	Thrown if a StoredApplicationService already exists with the identifiers the application tried to create a new one.
UserRejectedInstallException	Thrown if the end user rejects the request to install or remove an application.

org.dvb.application.storage
ApplicationCache

Declaration

```
public abstract class ApplicationCache

java.lang.Object
  |
  +--org.dvb.application.storage.ApplicationCache
```

Description

A cache to store applications so that they may be started faster when signalled in broadcast.

Applications stored via this mechanism cannot be started directly, only via an AIT entry in a broadcast service.

Note that applications are globally uniquely identified by a combination of organisation ID, application ID, and version number. Application authors should ensure that their storable applications are consistently broadcast.

Each instance of ApplicationCache can store only a single version of an application - i.e. within an `ApplicationCache`, an organisation ID and application ID pair can uniquely identify an application. Successfully storing a different version of a cached application than the current one in an ApplicationCache shall result in the current one being removed from that ApplicationCache instance. If the call to store fails then the current version shall not be removed.

A single MHP terminal will support many instances of `ApplicationCache`. These shall share a single underlying application store, and that underlying store shall use reference-counting or similar techniques to allow several stored services and `ApplicationCache` instances to contain the same application without wasting storage space by storing the same application multiple times. Space permitting, the underlying application store shall support storing several different versions of a single application (i.e. same organisation ID and application ID but different version numbers) where these are stored via different `ApplicationCache` instances or form part of different stored services. The underlying application store shall manage the removal of versions of stored applications which are not used in any stored services or application caches.

If an application is already cached in one `ApplicationCache`, storing the same version of the same application in a different `ApplicationCache` shall not fail due to insufficient disk space, and if all files in the ADF are labelled as critical, it shall not fail due to inability to download files listed in the ADF and shall complete quickly (without waiting for the files listed in the ADF to be broadcast).

Since:

MHP1.1.2

Constructors

ApplicationCache()

```
protected ApplicationCache()
```

Interoperable applications shall not call this constructor.

Since:

MHP1.1.2

Methods

getDefaultCache()

```
public static org.dvb.application.storage.ApplicationCache getDefaultCache()
```

Get the default cache that this application can use. Note that in MHP 1.1, applications cannot access any cache other than the default one.

The object returned depends on the organisation_id of the calling application. Applications with the same organisation_id shall recieve the same `ApplicationCache`. Applications with different organisation_id shall recieve different, independent instances of `ApplicationCache`. (I.e. if one application stores an application or removes a stored application, that operation shall be visible to another application via the methods on this class if and only if the other application has the same organisation_id as the first application).

Returns:
An `ApplicationCache` instance.

Throws:
`java.lang.SecurityException` - Thrown if the application calling this method does not have an `ApplicationStoragePermission` with action “manageCache” for it’s own organisation_id.

Since:
MHP1.1.2

getStoredAppIDs()

```
public abstract org.dvb.application.AppID[] getStoredAppIDs()
```

Lists the `AppID`s of the applications that are stored within this cache.

Returns:
an array of `AppID` objects representing the stored applications

Since:
MHP1.1.2

getVersionNumber(AppID)

```
public abstract int getVersionNumber(org.dvb.application.AppID appId)
```

Return the version number of the stored application whose `AppID` is given as a parameter.

Parameters:
`appId` - the `AppID` of the application whose version is queried

Returns:
the version number of the stored application, returns -1 if the application given as a parameter is not stored as part of this cache.

Since:
MHP1.1.2

remove(AppID)

```
public abstract void remove(org.dvb.application.AppID appId)
```

Requests the MHP terminal to initiate the removal of an application stored in the MHP terminal from this cache.

The platform is not expected to consult the end user of the MHP terminal for the permission to remove the application.

This specification does not prevent a terminal keeping an application in cache even after all references to it have been removed via this API.

If the application identified by the AppID passed in as a parameter is not installed in this cache, the method shall fail silently.

If the application is already stored elsewhere (e.g. in another ApplicationCache, or in a StoredApplicationService) then those caches and stored services shall not be affected by calling this method.

Parameters:

`appId` - `AppID` of the application to be removed

Throws:

`java.lang.SecurityException` - thrown if the application calling this method does not have an `ApplicationStoragePermission` with action "removeCache" for the organisation_id of the application to be removed and an ApplicationStoragePermission with action "manageCache"

Since:

MHP1.1.2

---

store(AppProxy, boolean)

```
public abstract void store(org.dvb.application.AppProxy app, boolean canPrompt)
            throws InvalidApplicationException, NotEnoughResourcesException, InvalidDescri
            ptionFileException, ApplicationDownloadException
```

Store an application in the MHP terminal.

MHP terminals may prompt the user for permission to free up resources if and only if all of the following conditions hold:

- `canPrompt` is true
- the caller has the necessary permissions (i.e. the `SecurityException` will not be thrown)
- the application is valid (i.e. the `InvalidApplicationException` will not be thrown)
- the application description file is valid (i.e. the `InvalidDescriptionFileException` will not be thrown)
- the MHP terminal determines that there are insufficient resources to store the application, and it cannot or will not silently free up enough resources (i.e. the `NotEnoughResourcesException` would be thrown)
- the MHP terminal determines that it could free up sufficient resources to store the application (i.e. to ensure the `NotEnoughResourcesException` would not be thrown) if it had the user's consent

Prompting the end-user for permission is not required however applications setting canPrompt to true should be prepared for the possibility of it happening. Note that if the user decides not to allow the terminal to free up resources, the NotEnoughResourcesException will be thrown (as if the terminal had not asked the user at all).

Note: This method is synchronous and will block until the storing is either completed or fails.

Storing (the same version of) an application that is already stored elsewhere (e.g. in another ApplicationCache, or in a StoredApplicationService) shall use the already-stored files.

Parameters:

`app` - an AppProxy representing the application to be installed

`canPrompt` - If `true`, the terminal is allowed to prompt the user for permission to free up space in order to store this application. If `false`, the terminal shall not prompt the user for permission to cache this application.

Throws:

`InvalidApplicationException` - thrown if the specified application is not signalled as capable of being stored, or if the specified application is not signalled as part of the same service as the calling application.

NotEnoughResourcesException - thrown if the MHP terminal does not have enough resources, e.g. storage space, available for the application

InvalidDescriptionFileException - thrown if the application description file is missing, invalid or otherwise not conformant to the specification

ApplicationDownloadException - thrown if the downloading of the application files was not successful (e.g. a carousel error, a file in the application description file is missing in the carousel, if the application was removed from the AIT or from its transport mechanism while installation is in progress, etc).

java.lang.SecurityException - Thrown if the application calling this method does not have an ApplicationStoragePermission with action “storeCache” or “*” for the organisation_id of the application to be stored.

Since:

MHP1.1.2

org.dvb.application.storage
ApplicationDownloadException

Declaration

```
public class ApplicationDownloadException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.ApplicationDownloadException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown if the downloading of the application failed. E.g. a carousel error, a file in the application description file is missing in the carousel, the application was being authenticated as part of downloading and this failed, the application was specified as being stored from another service and that service is not currently reachable (e.g. requires tuning), etc

Since:

MHP1.1

Constructors

ApplicationDownloadException()

```
public ApplicationDownloadException()
```

Constructs an ApplicationDownloadException with no detail message.

ApplicationDownloadException(String)

```
public ApplicationDownloadException(java.lang.String s)
```

Constructs an ApplicationDownloadException with a detail message

Parameters:

s - detail message

org.dvb.application.storage
ApplicationStorageController

Declaration
`public interface` **`ApplicationStorageController`**

All Known Subinterfaces:
`StoredApplicationService`

Description
Defines the methods for storing, listing and removing applications to and from a service.

Since:
MHP1.1.3

Methods

---

getStoredAppIDs()

`public org.dvb.application.AppID[]` **`getStoredAppIDs`**`()`

Lists the `AppID`s of the applications that are stored within this service.

Returns:
an array of `AppID` object representing the stored application

Throws:
`java.lang.SecurityException` - Thrown if the application calling this method does not have an `ApplicationStoragePermission` with action “manageService” for the organisation_id of this service.

Since:
MHP1.1.2

---

getVersionNumber(AppID)

`public int` **`getVersionNumber`**`(org.dvb.application.AppID appId)`

Return the version number of the stored application whose `AppID` is given as a parameter.

Parameters:
`appId` - the `AppID` of the application whose version is queried

Returns:
the version number of the stored application, returns -1 if the application given as a parameter is not stored

Throws:
`java.lang.SecurityException` - Thrown if the application calling this method does not have an `ApplicationStoragePermission` with action “manageService” for the organisation_id of this service.

Since:
MHP1.1.2

remove(AppID)

```
public void remove(org.dvb.application.AppID appId)
            throws UserRejectedInstallException
```

Removes a stored application from this service.

Applications should be prepared for the platform consulting the end user of the MHP terminal for the permission to remove the application

If the application identified by the `AppID` passed in as a parameter is not installed in this service, and the caller has the permissions that would be needed to remove the application if it was installed, the method shall fail silently.

Successfully removing an application from a stored service that is currently being presented shall cause the terminal to send an `AppsDatabaseEvent.APP_DELETED` event to registered listeners, and if the application is Loaded, Active or Paused then it shall be destroyed as if it had been signalled as KILL in the AIT. (Note that there is no special-case for if an application removes itself from a stored service - this is not an error and shall be handled normally).

Parameters:

`appId` - `AppID` of the application to be removed

Throws:

`UserRejectedInstallException` - If the user chose not to remove the application.

`java.lang.SecurityException` - Thrown if the application calling this method does not have an `ApplicationStoragePermission` with action “removeService” for the organisation_id of the application to be removed, and an `ApplicationStoragePermission` with action “manageService” for the organisation_id of this service.

Since:

MHP1.1.2

remove(AppID[])

```
public void remove(org.dvb.application.AppID[] appIds)
            throws UserRejectedInstallException
```

Removes multiple stored applications from this service.

Applications should be prepared for the platform consulting the end user of the MHP terminal for permission to remove the applications

If an application identified by the `AppID`s passed in as a parameter is not installed in this service, and the caller has the permissions that would be needed to remove the application if it was installed, then this method shall ignore that `AppID`.

This method either succeeds or fails completely. It will never remove some installed applications but not other installed applications.

Successfully removing application(s) from a stored service that is currently being presented shall cause the terminal to send an `AppsDatabaseEvent.APP_DELETED` event for each application to registered listeners, and if any of the removed applications are Loaded, Active or Paused then they shall be destroyed as if they had been signalled as KILL in the AIT. (Note that there is no special-case for if an application removes itself from a stored service - this is not an error and shall be handled normally).

Parameters:

`appIds` - `AppID`s of the applications to be removed

Throws:

`java.lang.IllegalArgumentException` - If the array passed to this method has length zero.

java.lang.SecurityException - thrown if the application calling this method does not have ApplicationStoragePermission s with action “removeService” for the organisation_ids of all the applications to be removed, and an ApplicationStoragePermission with action “manageService” for the organisation_id of this service.

UserRejectedInstallException - If the user chose not to remove the application.

Since:

MHP1.1.2

---

store(AppProxy[], boolean[], String[][])

```
public void store(org.dvb.application.AppProxy[] apps, boolean[] autoStart,
            java.lang.String[][] args)
            throws InvalidApplicationException, UserRejectedInstallException, NotEnoughRes
            ourcesException, InvalidDescriptionFileException, ApplicationDownloadException
```

Installs several applications into this stored service.

Applications should be prepared for the platform consulting the end user of the MHP terminal for the permission to install the applications.

Note: This method is synchronous and will block until the installation is either completed or fails.

This method either succeeds or fails completely. It will never install some applications but not others.

For each specified application, if that application is already installed in the service (whether the same version or a different version, then the rules specified in the store() method that stores a single application shall apply regarding updating the application and/or the stored representation of the AIT for that application. Note that the preceeding statement that this method either completely succeeds or completely fails still applies.

If this service is being presented, then on success the rules in the store() method that stores a single application regarding sending AppsDatabaseEvents and starting and killing applications shall apply.

Parameters:

apps - an array of AppProxys representing the applications to be installed. May not be null or zero-length.

autoStart - An array that is the same length as apps where each element is true, if the corresponding application in apps becomes an autostart application in the stored application service; or false, if the application becomes a normal present (non-autostart) application. May not be null.

args - parameters to be available to the applications when started. May be null, indicating all applications take no parameters. Otherwise it is an array that is the same length as apps, where each element is the arguments for the corresponding application in apps. If the element is either null or a subarray of size zero, that indicates no parameters are to be available. These parameters shall be available to applications when running as part of the stored application service using the Xlet property “dvb.installer.parameters”.

Throws:

java.lang.IllegalArgumentException - If the arrays passed to this method have different lengths, or if they have length zero.

InvalidApplicationException - thrown if any of the applications do not include an application_storage_descriptor, or if any of the applications are not identified as able to run stand-alone in their application_storage_desciptor.

InvalidDescriptionFileException - thrown if one of the application description files is missing, invalid or otherwise not conformant to the specification

NotEnoughResourcesException - thrown if the MHP terminal does not have enough resources, e.g. storage space, available for the applications

UserRejectedInstallException - thrown if the end user rejects the installation

ApplicationDownloadException - thrown if the downloading of the application files was notsuccessful (e.g. a carousel error, a file in the application description file is missing in the carousel, if the application was removed from the AIT or from its transport mechanism while installation is in progress, etc) or if the application failed authentication while being downloaded

java.lang.SecurityException - thrown if the application calling this method does not have ApplicationStoragePermission s with action "storeService" for the organisation_ids of all the applications to be stored, and an ApplicationStoragePermission with action "manageService" for the organisation_id of this service.

Since:

MHP1.1.2

---

store(AppProxy[], boolean[], String[][], ApplicationStorageListener)

```
public void store(org.dvb.application.AppProxy[] apps, boolean[] autoStart,
            java.lang.String[][] args,
            org.dvb.application.storage.ApplicationStorageListener listener)
```

Installs several applications into this stored service.

Applications should be prepared for the platform consulting the end user of the MHP terminal for the permission to install the applications.

This method is asynchronous with completion reported via the ApplicationStorageListener.

This method either succeeds or fails completely. It will never install some applications but not others.

For each specified application, if that application is already installed in the service (whether the same version or a different version, then the rules specified in the store() method that stores a single application shall apply regarding updating the application and/or the stored representation of the AIT for that application. Note that the preceeding statement that this method either completely succeeds or completely fails still applies.

If this service is being presented, then on success the rules in the store() method that stores a single application regarding sending AppsDatabaseEvents and starting and killing applications shall apply.

Parameters:

apps - an array of AppProxys representing the applications to be installed. May not be null or zero-length.

autoStart - An array that is the same length as apps where each element is true, if the corresponding application in apps becomes an autostart application in the stored application service; or false, if the application becomes a normal present (non-autostart) application. May not be null.

args - parameters to be available to the applications when started. May be null, indicating all applications take no parameters. Otherwise it is an array that is the same length as apps, where each element is the arguments for the corresponding application in apps. If the element is either null or a subarray of size zero, that indicates no parameters are to be available. These parameters shall be available to applications when running as part of the stored application service using the Xlet property "dvb.installer.parameters".

listener - the listener to be notified of the success or failure of this installation.

Throws:

java.lang.IllegalArgumentException - If the arrays passed to this method have different lengths, or if they have length zero.

java.lang.SecurityException - thrown if the application calling this method does not have ApplicationStoragePermission s with action "storeService" for the organisation_ids of all the applications to be stored, and an ApplicationStoragePermission with action "manageService" for the organisation_id of this service.

Since:
MHP1.1.3

---

store(AppProxy, boolean, String[])

```
public void store(org.dvb.application.AppProxy app, boolean autoStart,
            java.lang.String[] args)
            throws InvalidApplicationException, UserRejectedInstallException, NotEnoughRes
            ourcesException, InvalidDescriptionFileException, ApplicationDownloadException
```

Installs an application into this stored service.

Applications should be prepared for the platform consulting the end user of the MHP terminal for the permission to install the application

Note: This method is synchronous and will block until the installation is either completed or fails.

Successfully adding an application to a stored service that is currently being presented shall cause the terminal to behave as if the application was added to the AIT - i.e. it will send an org.dvb.application.AppsDatabaseEvent.APP_ADDED event to registered listeners, and if the autoStart parameter is true then the application shall be started.

If the same version of the same application is already installed in this stored service, then (if the caller has sufficient permissions to install the application) this method shall update the stored representation of the AIT from the autoStart and args parameters, and return without throwing an exception. Terminals shall not store the application again. Terminals are not expected (but are allowed) to prompt the user for permission in this case. If the stored service is currently being presented, and the autostart setting is changed, then:

- an org.dvb.application.AppsDatabaseEvent.APP_CHANGED event shall be sent as usual to registered listeners
- If the autostart setting is changed to true, then the application shall be started as usual. (Note that the opposite is not true: setting autostart to false shall not cause the application to be killed if it is running).

Note that calling this method with a new value for the args parameter shall not have any effect on an existing instance of an application.

If a different version of the same application is already installed in this stored service, then this method shall install the new version of the application as normal. (Note that for the purposes of this method description, "new" and "old" versions refer to the version specified by the AppProxy passed to this method and the version currently installed in the service, respectively. They do not refer to numeric comparison of version numbers). On success, the old version shall be removed from the service. On failure, the old version of the application shall remain as it was before this method was called. If the stored service is currently being presented, then on success:

- an org.dvb.application.AppsDatabaseEvent.APP_CHANGED event shall be sent as usual to registered listeners
- If the old version of the application is running (or paused) then it shall be terminated as if it had been signalled as KILL in the AIT.
- If the new version is signalled as autostart, then the new version shall be started as usual, once the old version has terminated.

Parameters:
app - an AppProxy representing the application to be installed

autoStart - true, if the application becomes an autostart application in the stored application service; false, if the application becomes a normal present (non-autostart) application in the stored application service.

args - parameters to be available to the application when started. Passing in either null or an array of size zero indicates no parameters are to be available. These parameters shall be available to applications when running as part of the stored application service using the Xlet property “dvb.installer.parameters”.

Throws:

InvalidApplicationException - thrown if the application does not include an application_storage_descriptor, or if the application is not identified as able to run stand-alone in it’s application_storage_desciptor.

InvalidDescriptionFileException - thrown if the application description file is missing, invalid or otherwise not conformant to the specification

NotEnoughResourcesException - thrown if the MHP terminal does not have enough resources, e.g. storage space, available for the application

UserRejectedInstallException - thrown if the end user rejects the installation

ApplicationDownloadException - thrown if the downloading of the application files was notsuccessful (e.g. a carousel error, a file in the application description file is missing in the carousel, if the application was removed from the AIT or from its transport mechanism while installation is in progress, etc) or if the application failed authentication while being downloaded

java.lang.SecurityException - thrown if the application calling this method does not have an ApplicationStoragePermission with action “storeService” for the organisation_id of the application to be stored, and an ApplicationStoragePermission with action “manageService” for the organisation_id of this service.

Since:

MHP1.1.2

---

store(Locator, AppID[], boolean[], String[][], ApplicationStorageListener)

```
public void store(org.davic.net.Locator locator, org.dvb.application.AppID[] apps,
            boolean[] autoStart, java.lang.String[][] args,
            org.dvb.application.storage.ApplicationStorageListener listener)
```

Installs several applications into this stored service. The applications are from a service which need not be selected.

Applications should be prepared for the platform consulting the end user of the MHP terminal for the permission to install the applications.

This method is asynchronous with completion reported via the ApplicationStorageListener

This method either succeeds or fails completely. It will never install some applications but not others.

For each specified application, if that application is already installed in the service (whether the same version or a different version, then the rules specified in the store() method that stores a single application shall apply regarding updating the application and/or the stored representation of the AIT for that application. Note that the preceeding statement that this method either completely succeeds or completely fails still applies.

If this service is being presented, then on success the rules in the store() method that stores a single application regarding sending AppsDatabaseEvents and starting and killing applications shall apply.

Parameters:

locator - the locator of the service from which the applications are to be stored

apps - an array of application ids identifying the applications to be stored

`autoStart` - An array that is the same length as `apps` where each element is `true`, if the corresponding application in `apps` becomes an autostart application in the stored application service; or `false`, if the application becomes a normal present (non-autostart) application. May not be `null`.

`args` - parameters to be available to the applications when started. May be `null`, indicating all applications take no parameters. Otherwise it is an array that is the same length as `apps`, where each element is the arguments for the corresponding application in `apps`. If the element is either null or a subarray of size zero, that indicates no parameters are to be available. These parameters shall be available to applications when running as part of the stored application service using the Xlet property “dvb.installer.parameters”.

`listener` - the listener to be notified of the success or failure of this installation.

Throws:

`java.lang.IllegalArgumentException` - If the arrays passed to this method have different lengths, or if they have length zero.

`java.lang.SecurityException` - thrown if the application calling this method does not have `ApplicationStoragePermission` s with action “storeService” for the organisation_ids of all the applications to be stored, and an `ApplicationStoragePermission with action "manageService" for the organisation_id of this service.`

Since:

MHP1.1.3

org.dvb.application.storage
ApplicationStorageListener

Declaration

```
public interface ApplicationStorageListener
```

Description

Listener to receive reports on progress of application storage operations. When multiple applications are being stored, calls to this listener shall be generated for each individual application.

Methods

---

storageCompleted(AppID)

```
public void storageCompleted(org.dvb.application.AppID id)
```

Called when a storage operation is successfully completed.

Parameters:

`id` - the application which is now successfully stored

---

storageFailed(AppID, Exception)

```
public void storageFailed(org.dvb.application.AppID id, java.lang.Exception failureMode)
```

Called if a storage operation fails.

Parameters:

`id` - the application whose storage failed

`failureMode` - the reason for the failure as would be reported by one of the checked exceptions thrown by the method StoredApplicationService.store.

---

storageUpdate(AppID, byte, int)

```
public void storageUpdate(org.dvb.application.AppID id, byte completion, int size)
```

Called at 1 second intervals after a storage operation starts until it completes. The precise definition of completeness is implementation dependent however it would typically reflect the extent to which the data of the application has been downloaded. In implementations where an application is first downloaded and then stored, assuming the storage phase takes much less time than the downloading phase, the storage phase can be ignored when reporting completeness. If an application is (already) downloaded and stored before the first call to this method becomes due, this method may never be called.

Parameters:

`id` - the application being stored

`size` - the size in bytes of the application to be stored, as calculated by adding the size attributes in the application description file of the application

`completion` - the extent to which the storage operation is complete, 0 being not complete and 255 being almost complete.

org.dvb.application.storage
ApplicationStoragePermission

Declaration

```
public class ApplicationStoragePermission extends java.security.Permission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--org.dvb.application.storage.ApplicationStoragePermission
```

All Implemented Interfaces:

java.security.Guard, java.io.Serializable

Description

This class represents a permission to manage applications stored in the MHP terminal. An ApplicationStoragePermission contains a name representing the organisation_id whose applications can be managed and an actions list representing the permitted actions, e.g. store and/or remove applications.

The name of the permission contains the organisation_id represented in hexadecimal form as defined in the section "Text encoding of application identifiers" in the main body of this specification. Valid organization ids must be in the range "1" to "ffffffff" inclusive. Alternatively, the value "*" indicates all organization ids.

The actions string shall be a comma-separated list of one or more of the following :-

- "manageService", representing permission to query what applications are stored in a stored application service with the given organisation ID. This permission is also necessary (but not sufficient) to store applications into and remove applications from a stored application service, where the stored application service has the given organisation ID.
- "storeService", representing permission to store an application in a stored application service, where the application has the given organisation ID.
- "removeService", representing permission to remove an application from a stored application service, where the application has the given organisation ID.
- "createService", representing permission to create a stored application service with a given organisation ID.
- "deleteService", representing permission to remove a stored application service with a given organisation ID.
- "manageCache", representing permission to query what applications are stored in an application cache with the given organisation ID. This permission is also necessary (but not sufficient) to store applications into and remove applications from an application cache, where the application cache has the given organisation ID.
- "storeCache", representing permission to store an application in a cache.
- "removeCache", representing permission to remove an application from a cache.

Since:

MHP1.1

Constructors

ApplicationStoragePermission(String, String)

```
public ApplicationStoragePermission(java.lang.String name, java.lang.String actions)
```

Creates a new ApplicationStoragePermission object with the specified name and actions string. The name contains the organisation_id of the applications that can be managed and the actions String shall be a comma-separated list of actions as defined above. Permission objects constructed with incorrectly encoded parameters do not represent any permission and are ignored by the platform.

Parameters:

name - the organisation_id whose applications can be managed. This is encoded in hexadecimal representation as if by java.lang.Integer.toHexString(int) , and must be in the range "1" to "ffffffff" inclusive. Alternatively, the value "*" indicates all organization ids.

actions - Shall conform to the syntax described above.

Methods

---

equals(Object)

```
public boolean equals(java.lang.Object obj)
```

Checks two permission objects for equality.

Do not use the equals method for making access control decisions; use the implies method.

If X is an ApplicationStoragePermission, and Y is any Object, then X.equals(Y) returns true if and only if all of the following hold:

- Y is not null
- Y is an instance of ApplicationStoragePermission
- X and Y have the same run-time type (i.e. X.getClass() == Y.getClass())
- X and Y were both constructed with correctly encoded parameters
- X and Y both have the same organization ID, or both have organization ID "*".
- X has the same actions as Y. The order of the comma-separated actions list does not affect the results of this check.

Overrides:

equals in class Permission

Parameters:

obj - the object we are testing for equality with this object.

Returns:

true if both ApplicationStoragePermission objects are equivalent.

---

getActions()

```
public java.lang.String getActions()
```

Returns the actions as a String. Must always return actions in canonical form.

Permission objects constructed with an incorrectly encoded action parameter shall return an empty string.

Permission objects constructed with a correctly encoded action parameter shall return a comma-separated list of actions, with the actions sorted in the order given by java.lang.String.compareTo(String) .

Overrides:

getActions in class Permission

Returns:

the actions of this Permission.

hashCode()

```
public int hashCode()
```

Returns the hash code value for this ApplicationStoragePermission object.

The required hashCode behavior for ApplicationStoragePermission objects is the following:

- Whenever it is invoked on the same ApplicationStoragePermission object more than once during an execution of a Java application, the hashCode method must consistently return the same integer. This integer need not remain consistent from one execution of an application to another execution of the same application.
- If two ApplicationStoragePermission objects are equal according to the equals(Object) method, then calling the hashCode method on each of the two Permission objects must produce the same integer result.

Overrides:
hashCode in class Permission

Returns:
a hash code value for this object.

implies(Permission)

```
public boolean implies(java.security.Permission permission)
```

Checks if the specified permission's actions are "implied by" this object's actions.

If X is an ApplicationStoragePermission, and Y is any Permission, then X.implies(Y) returns true if and only if all of the following hold:

- Y is an instance of ApplicationStoragePermission
- X and Y have the same run-time type (i.e. X.getClass() == Y.getClass())
- X and Y were both constructed with correctly encoded parameters
- X and Y both have the same organization ID, or X has the organization ID "*"
- X contains all the actions requested by Y. The order of the comma-separated actions list does not affect the results of this check.

Overrides:
implies in class Permission

Parameters:
permission - the permission to check against.

Returns:
true if the specified permission is implied by this object, false if not.

newPermissionCollection()

```
public java.security.PermissionCollection newPermissionCollection()
```

Returns an empty PermissionCollection for ApplicationStoragePermission objects.

Overrides:
newPermissionCollection in class Permission

Returns:
a new PermissionCollection object for ApplicationStoragePermissions.

org.dvb.application.storage
ExtendedAppAttributes

Declaration

```
public interface ExtendedAppAttributes extends org.dvb.application.AppAttributes
```

All Superinterfaces:

org.dvb.application.AppAttributes

Description

The ExtendedAppAttributes interface provides additional attributes that are useful when application can be stored in the MHP terminal.

org.dvb.application.AppAttributes objects that are returned from the org.dvb.application.AppsDatabase shall implement this interface if and only if the terminal supports storing applications and the total amount of memory for stored services and/or cached applications is greater than zero.

Since:

MHP1.1

Methods

---

canAddToStoredService()

```
public boolean canAddToStoredService()
```

Returns true if this application is signalled as capable of being added to a stored service. I.e. if this application could be added to a stored service without the InvalidApplicationException being thrown.

For broadcast applications, returns true if and only if this application is signalled as being storable and as capable of running stand alone. For applications that are part of a stored service, this function returns true.

Returns:

true if this application is signalled as capable of being added to a stored service.

Since:

MHP1.1.2

---

canCache()

```
public boolean canCache()
```

Returns true if this application is signalled as capable of being cached. I.e. if this application could be added to a cache without the InvalidApplicationException being thrown.

For broadcast applications, returns true if and only if this application is signalled as being storable. For applications that are part of a stored service, this function returns true.

Returns:

true if this application is signalled as capable of being cached.

Since:
MHP1.1.2

---

getCurrentVersionNumber()

```
public int getCurrentVersionNumber()
```

Returns the optional version number currently signalled for this application. (E.g. in the AIT). If no version number is signalled, -1 shall be returned.

Returns:
the version number signalled for this application.

Since:
MHP1.1

---

isStartable()

```
public boolean isStartable()
```

This method determines whether the application is startable or not. An Application is not startable if any of the following apply.

- The application is transmitted on a remote connection, and either does not have an application storage descriptor, is not cached, or is not signalled as launchable completely from cache.
- The caller of the method does not have the Permissions to start it.
- if the application is signalled with a control code which is neither AUTOSTART nor PRESENT.
- if the application is signalled with an application storage descriptor where not_launchable_from_broadcast is "1", and the application is not stored or cached.

If none of the above apply, then the application is startable.

The value returned by this method does not depend on whether the application is actually running or not.

Overrides:
`isStartable` in interface `AppAttributes`

Returns:
true if an application is startable, false otherwise.

Since:
MHP1.0

---

isStorageRequired()

```
public boolean isStorageRequired()
```

Returns `true` if this application is signalled as not launchable from broadcast. I.e. for a broadcast application this method will return `true` if and only if the application is signalled with an application storage descriptor where not_launchable_from_broadcast is "1". If this application is part of a stored service, this function returns `true`.

Note that the return value of this method does not depend on whether or not the application is currently stored or cached.

Returns:
`true` if and only if this application is signalled as not launchable from broadcast.

Since:
MHP1.1.2

isStored()

```
public boolean isStored()
```

Returns `true` if this application is currently stored or cached on the terminal. Returns `true` if and only if the application is signalled as being storable and all the files signalled as having critical priority have been stored or cached by the terminal.

Returns:
`true` if this application is currently stored or cached.

Since:
MHP1.1.2

org.dvb.application.storage
InvalidApplicationException

Declaration

```
public class InvalidApplicationException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.InvalidApplicationException
```

All Implemented Interfaces:

java.io.Serializable

Description

When an application is being installed into a service, this is thrown when:

- The application does not include an application_storage_descriptor.
- The application is not identified as able to run stand-alone in it's application_storage_descriptor.

When an application is being stored in a cache this is thrown when

- The application does not include an application_storage_descriptor.
- The application is not signalled as part of the same service as the calling application

Since:

MHP1.1

Constructors

InvalidApplicationException()

```
public InvalidApplicationException()
```

Constructs an InvalidApplicationException with no detail message.

InvalidApplicationException(String)

```
public InvalidApplicationException(java.lang.String s)
```

Construct a InvalidApplicationException with a detail message

Parameters:

s - detail message

org.dvb.application.storage
InvalidDescriptionFileException

Declaration

```
public class InvalidDescriptionFileException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.InvalidDescriptionFileException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when an application descriptio file is invalid.

Constructors

InvalidDescriptionFileException()

```
public InvalidDescriptionFileException()
```

Creates a new instance of InvalidDescriptionFileException without detail message.

InvalidDescriptionFileException(String)

```
public InvalidDescriptionFileException(java.lang.String msg)
```

Constructs an instance of InvalidDescriptionFileException with the specified detail message.

Parameters:

msg - the detail message.

org.dvb.application.storage
NotEnoughResourcesException

Declaration

```
public class NotEnoughResourcesException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.NotEnoughResourcesException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown if the MHP terminal does not have enough resources to install the application. E.g. not enough storage space.

Since:

MHP1.1

Constructors

NotEnoughResourcesException()

```
public NotEnoughResourcesException()
```

Constructs a NotEnoughResourcesException with no detail message.

NotEnoughResourcesException(String)

```
public NotEnoughResourcesException(java.lang.String s)
```

Constructs a NotEnoughResourcesException with a detail message

Parameters:

s - detail message

org.dvb.application.storage
ServiceAlreadyExistsException

Declaration

```
public class ServiceAlreadyExistsException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.ServiceAlreadyExistsException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown if a StoredApplicationService already exists with the identifiers the application tried to create a new one.

Since:

MHP1.1

Constructors

ServiceAlreadyExistsException()

```
public ServiceAlreadyExistsException()
```

Constructs a ServiceAlreadyExistsException with no detail message.

ServiceAlreadyExistsException(String)

```
public ServiceAlreadyExistsException(java.lang.String s)
```

Constructs a ServiceAlreadyExistsException with a detail message

Parameters:

s - detail message

org.dvb.application.storage
StoredApplicationService

Declaration

```
public interface StoredApplicationService extends javax.tv.service.Service,
    ApplicationStorageController
```

All Superinterfaces:

ApplicationStorageController, javax.tv.service.Service

Description

Defines the information about a stored application service.

Stored application services can be created by applications that have a permission to store applications for an organisation_id.

Stored application services are uniquely identified within the terminal by the combination of the organisation_id and service_id.

Since:

MHP1.1

Methods

---

getLocator()

```
public javax.tv.locator.Locator getLocator()
```

Gets the locator for this stored application service. This locator is opaque and platform specific. It shall be an instance of `org.davic.net.Locator` or a subclass. It is not required to be an instance of any other public locator class in the platform (e.g. `org.davic.net.dvb.DvbLocator`).

Overrides:

`getLocator` in interface `Service`

Returns:

a locator for this stored application service

---

getName()

```
public java.lang.String getName()
```

Returns the name of the stored application service as defined when the stored application service was created.

Overrides:

`getName` in interface `Service`

Returns:

the name of the stored application service

getOrganisationId()

```
public int getOrganisationId()
```

Return the organisation id of this stored application service

Returns:
the organisation id of this stored application service

getServiceId()

```
public int getServiceId()
```

Return the service id of this stored application service

Returns:
the service id of this stored application service

getServiceInformationType()

```
public javax.tv.service.ServiceInformationType getServiceInformationType()
```

Returns the service information format of this object. This shall always return `ServiceInformationType.UNKNOWN`.

Returns:
the service information format

getServiceType()

```
public javax.tv.service.ServiceType getServiceType()
```

Returns the type of this service. For stored application services, this method shall always return `StoredApplicationServiceType.STORED_APPLICATION_SERVICE`.

Overrides:
`getServiceType` in interface `Service`

Returns:
service type of this service

hasMultipleInstances()

```
public boolean hasMultipleInstances()
```

Indicates whether the service represented by this Service is available on multiple transports. For stored application services, this shall always return false.

Overrides:
`hasMultipleInstances` in interface `Service`

Returns:
false

isSelectable()

```
public boolean isSelectable()
```

Test whether this service is selectable. StoredApplicationServices are selectable if they contain at least one autostart application and are not selectable if they do not contain any autostart applications. Applications which offer the end-user a choice of services to select should not include services which are not selectable in that list.

Returns:
false if the service is not selectable otherwise true

Since:
MHP 1.1.3

---

removeService()

```
public void removeService()
            throws UserRejectedInstallException
```

Remove the whole stored application service from the terminal. Removal of the service results in the removal of all the applications from within that service.

If there are any applications installed in the stored application service, then the application calling this method should be prepared for the platform consulting the end user of the MHP terminal for permission to remove the stored service.

The platform shall not prompt the user for permission if no applications are installed in the service.

If the end user is asked and does not give permission to remove the service, none of the applications in the service shall be removed.

Throws:
`java.lang.SecurityException` - if the caller does not have an `ApplicationStoragePermission` with action “deleteService” and an organisation_id which matches that of this service. Also thrown if the caller does not have ApplicationStoragePermission with action “removeService” for the organisation IDs of every application installed in this service.

`UserRejectedInstallException` - If the user chose not to remove the applications in the service.

---

retrieveDetails(SIRequestor)

```
public javax.tv.service.SIRequest retrieveDetails(javax.tv.service.SIRequestor requestor)
```

This method retrieves additional information about the service. This shall result in failure with the `SIRequestFailureType` `DATA_UNAVAILABLE`.

Overrides:
`retrieveDetails` in interface `Service`

Parameters:
`requestor` - The SIRequestor to be notified when this operation completes.

Returns:
A SIRequest object identifying this request.

org.dvb.application.storage
StoredApplicationServiceFactory

Declaration

```
public abstract class StoredApplicationServiceFactory

java.lang.Object
  |
  +--org.dvb.application.storage.StoredApplicationServiceFactory
```

Description

This factory creates new Service objects representing stand-alone stored application services. Services thus created shall appear in the list of services maintained by the SIManager until removed using `StoredApplicationService.remove` or some MHP terminal specific mechanism. i.e. they shall be returned by `filterServices` both when passed an instance of `ServiceTypeFilter` constructed with the type `StoredApplicationServiceType.STORED_APPLICATION_SERVICE` and when passed null to list all known services.

Since:

MHP1.1.2

Constructors

StoredApplicationServiceFactory()

```
protected StoredApplicationServiceFactory()
```

This constructor is provided for the use of implementations and specifications which extend the present document. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

createStoredApplicationService(int, int, String)

```
public abstract org.dvb.application.storage.StoredApplicationService
            createStoredApplicationService(int organisation_id, int service_id,
            java.lang.String serviceName)
            throws ServiceAlreadyExistsException
```

Creates a new stored application service.

Parameters:

`organisation_id` - the organisation_id of the organisation to whom this service belongs to

`service_id` - unique identifier for this service within the organisation

`serviceName` - a name for the service that can be displayed to the end user to identify this service

Returns:

the stored application service created

Throws:

`ServiceAlreadyExistsException` - thrown if a stored application service with the same organisation_id and service_id already exists in the terminal

`java.lang.SecurityException` - thrown if the application calling this method does not have an ApplicationStoragePermission with action “createService” for the organisation_id passed in as the parameter.

---

getInstance()

`public static org.dvb.application.storage.StoredApplicationServiceFactory getInstance()`

Get the singleton instance of this class, or null if and only if this MHP implementation does not support stand-alone stored applications.

Returns:

a factory

org.dvb.application.storage
StoredApplicationServiceType

Declaration

```
public class StoredApplicationServiceType extends javax.tv.service.ServiceType

java.lang.Object
  |
  +--javax.tv.service.ServiceType
        |
        +--org.dvb.application.storage.StoredApplicationServiceType
```

Description

The service type used for stored application services.

Since:

MHP 1.1.2

See Also:

`javax.tv.service.navigation.ServiceTypeFilter`

Fields

STORED_APPLICATION_SERVICE

```
public static final javax.tv.service.ServiceType STORED_APPLICATION_SERVICE
```

The service type for a stored application.

Since:

MHP 1.1.2

Constructors

StoredApplicationServiceType(String)

```
protected StoredApplicationServiceType(java.lang.String name)
```

Creates a new StoredServiceType object.

Parameters:

`name` - The string name of this type (e.g. “STORED_APPLICATION_SERVICE”).

Since:

MHP 1.1.2

org.dvb.application.storage
UserRejectedInstallException

Declaration

```
public class UserRejectedInstallException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.application.storage.UserRejectedInstallException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown if the end user rejects the request to install or remove an application.

Since:

MHP1.1

Constructors

UserRejectedInstallException()

```
public UserRejectedInstallException()
```

Constructs a UserRejectedInstallException with no detail message.

UserRejectedInstallException(String)

```
public UserRejectedInstallException(java.lang.String s)
```

Constructs a UserRejectedInstallException with a detail message

Parameters:

s - detail message

Annex AH (normative): Internet client APIs

Package org.dvb.internet

Description

Provides a mechanism for MHP applications to control internet clients that may be present on an MHP such as a web browser or email client.

This package provides a mechanism for MHP applications to control internet clients that may be present on an MHP such as a web browser or email client. The API makes no assumptions about whether an internet client and downloaded MHP application can run simultaneously, and in some cases starting an internet client may result in the calling application being killed.

The API consists of two main class hierarchies. `InternetClientService` and its clients provide a mechanism to get a locator for a resident internet client so that it can be started, and also provide any functionality that does not require the client to be started. This can include adding bookmarks or getting the capabilities of the clients. The second major part of the API is the `InternetClient` class and its subclasses. These provide an interface to a running instance of an internet client and support the operations that can only be carried out when the client is running.

The internet client API uses the JavaTV service navigation API for accessing resident applications. Any effect that the invocation of a resident internet client has on the lifecycle of a downloaded application is dependent on the service context in which the resident application is started (using `ServiceContext.select()`). If the internet client is started in the same service context as the downloaded application, then the downloaded application will be terminated, following the usual semantics of the service selection API. The basic concepts are introduced below and then a few scenarios are explored to illustrate combinations or broadcast application versus resident application execution.

Concepts

The first implication of resident applications is that it should be feasible for broadcast applications to isolate, browse, and select such services. The collection of `javax.tv.service.*` packages provides the framework for the solution to this requirement.

The class `ServiceType` in the `javax.tv.service` package defines various kinds of services. This is extended in this API to provide additional service types for Internet clients. The `javax.tv framework` lets a client filter the services known to a platform to create a `ServiceCollection`. The client would first create an instance of `ServiceTypeFilter`

```
public ServiceTypeFilter(ServiceType type)
```

where the `ServiceType` in the signature would be the instance for the resident service in question. The client would then filter the services known to the platform to isolate the resident services of this type. The `ServiceCollection` interface provides the filter operation.

```
public ServiceCollection createServiceCollection(ServiceFilter filter)
```

Given the `ServiceCollection`, the client can iterate over the resident services to find a specific resident service. The last step is to `select()` the resident service. The `ServiceContext` interface of the `javax.tv.service.selection` package provides the operation:

```
public void select(Service selection)
throws java.lang.SecurityException
```

The select() method is asynchronous and returns before attempting to allocate resources to execute the service.

If the implementation determines that it can not realize the service due to scarce resources, it forwards a `SelectionFailedEvent` (of the `javax.tv.service. selection` package) with the reason code `INSUFFICIENT_RESOURCES`. The `ServiceContextListener` interface fields the event:

```
public void receiveServiceContextEvent(ServiceContextEvent e)
```

Thus the client should implement an instance of the `ServiceContextListener` interface and register interest in service context events. The `ServiceContext` interface provides the mechanism:

```
public void addListener(ServiceContextListener listener)
throws java.lang.IllegalStateException
```

The semantics of a `ServiceContext` are that at most a single `Service` can execute within a `ServiceContext` at a time. Since the premise is that a broadcast service selects a resident service, there are two scenarios of interest.

The first scenario presumes that the broadcast service wants to select the resident service but not survive. It expects the selection to cause its termination. The broadcast service in this case should create an instance of `ServiceContextFactory`. The operation on `ServiceContextFactory` itself is:

```
public static ServiceContextFactory getInstance()
```

The broadcast application then requests the service contexts that are visible to the broadcast application:

```
public abstract ServiceContext getServiceContext(XletContext ctx)
```

which returns *its* `ServiceContext`. The broadcast application selects the resident application within its service context:

```
public void select(Locator selection)
throws InvalidLocatorException, java.lang.SecurityException,
java.lang.IllegalStateException
```

which causes the broadcast application to terminate.

The premise of the second scenario is that the broadcast application wants to survive the selection of the resident service. In this case the broadcast again creates a `ServiceContextFactory` but then creates a `ServiceContext` which is not its `ServiceContext`:

```
public abstract ServiceContext createServiceContext()
throws InsufficientResourcesException,
java.lang.SecurityException
```

The broadcast application selects the resident application. Since the operation is on a `ServiceContext` that is not its `ServiceContext`, the broadcast application survives the selection.

One subtle aspect of the invocation patterns is that the platform does not know whether the broadcast application will attempt to select a resident application versus another broadcast application until the broadcast application invokes the `select()` operation. For example, assume the platform supports a single broadcast application plus a single resident application. Further assume that, after the broadcast application creates a second `ServiceContext`, it selects a second broadcast application rather than a resident application. If the locator is valid, the operation succeeds, but the broadcast application then receives a `SelectionFailedEvent`.

Likewise assume the platform supports multiple broadcast applications but not (for the present) a resident application. If the broadcast application selects a resident application, and if the locator is valid, the operation succeeds, but the broadcast application then receives a `SelectionFailedEvent`. (The second case is rather improbable. If the platform does not support resident applications, it is not clear how the broadcast application could obtain a valid locator to a broadcast application. The platform would have to support resident applications in concept, but not at the instant the broadcast applications selects a resident application.)

Class Summary

Interfaces

`EmailClient`	Interface supporting the operations required on an email client.
`EmailClientService`	Service representing the resident email client
`InternetClient`	Base interface for the internet clients.
`InternetClientListener`	Interface for objects that wish to receive `InternetClientEvents`
`InternetClientService`	The base class for the interface to resident applications that are supported by the internet access profile.
`UsenetClient`	This interface supports the operations required on a Usenet news client.
`UsenetClientService`	Service representing the resident usenet news client

Class Summary	
WWWBrowser	This interface provides support for the operations required on an WWW browser.
WWWBrowserService	Service representing a resident WWW browser
Classes	
CancelledByUserEvent	Event indicating that an operation on an internet client failed because the operation was canceled by the user
HomePagePermission	This class is for permissions related to the ability for an MHP application to set the home page of a WWW browser in the internet access profile.
InternetClientEvent	Base class for all status events from internet clients.
InternetClientFailureEvent	Event indicating that an operation on an internet client failed.
InternetClientSuccessEvent	Event indicating that an operation on an internet client succeeded
InternetServiceFilter	`InternetServiceFilter` represents a service type for a particular kind of internet client.
InternetServiceType	Class representing the additional service types available in the Internet Access profile.
PermissionDeniedEvent	Event indicating that an operation on an internet client failed due to the specified URL not being accessible by the client due to access controls on the server.
URLUnavailableEvent	Event indicating that an operation on an internet client failed due to the specified URL not being available.
Exceptions	
ClientNotRunningException	Exception thrown when a method of `InternetClient` or one of its subclasses is called while the client is not running, for instance if the client has been terminated by the user.
EntryExistsException	Exception generated when an application tries to add a bookmark or address book entry that already exists

org.dvb.internet
CancelledByUserEvent

Declaration

```
public class CancelledByUserEvent extends InternetClientFailureEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
              |
              +--org.dvb.internet.InternetClientFailureEvent
                    |
                    +--org.dvb.internet.CancelledByUserEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event indicating that an operation on an internet client failed because the operation was canceled by the user

Constructors

CancelledByUserEvent(Object, URL)

`public CancelledByUserEvent(java.lang.Object source, java.net.URL url)`

Construct a new `CancelledByUserEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

org.dvb.internet
ClientNotRunningException

Declaration

```
public class ClientNotRunningException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.internet.ClientNotRunningException
```

All Implemented Interfaces:

java.io.Serializable

Description

Exception thrown when a method of InternetClient or one of its subclasses is called while the client is not running, for instance if the client has been terminated by the user.

Constructors

ClientNotRunningException()

public **ClientNotRunningException**()

Construct a ClientNotRunningException with no detail message

ClientNotRunningException(String)

public **ClientNotRunningException**(java.lang.String reason)

Construct a ClientNotRunningException with the specified detail message

Parameters:

reason - the reason why the exception was thrown

org.dvb.internet
EmailClient

Declaration

```
public interface EmailClient extends InternetClient
```

All Superinterfaces:

InternetClient, javax.tv.service.selection.ServiceContentHandler

Description

Interface supporting the operations required on an email client.

Methods

---

createMessage(String, String, String)

```
public void createMessage(java.lang.String to, java.lang.String subject,
            java.lang.String messageBody)
            throws ClientNotRunningException
```

Create a new email message. If any of the parameters are an empty string, the user will be prompted for the missing information.

This is an asynchronous operation, whose success or failure will be indicated by an InternetClientSuccessEvent or InternetClientFailureEvent or one of their subclasses.

Parameters:

to - the address to which the email should be sent.

subject - the subject for the email.

messageBody - the body of the message.

Throws:

java.lang.NullPointerException - if any of the to address, subject or message body are null.

ClientNotRunningException - if the client is not currently running.

java.lang.IllegalArgumentException - if the destination address is an empty string.

org.dvb.internet
EmailClientService

Declaration

```
public interface EmailClientService extends InternetClientService
```

All Superinterfaces:

InternetClientService, javax.tv.service.Service

Description

Service representing the resident email client

Methods

---

addToAddressBook(String, String)

```
public void addToAddressBook(java.lang.String address, java.lang.String name)
            throws EntryExistsException, IOException
```

Add an entry to the address book. As a side-effect an entry previously added by this method may be lost. Implementations may restrict the number of entries a single MHP application or source of applications may add.

Parameters:

address - the address to be added to the address book

name - the name that should be associated with that address

Throws:

EntryExistsException - if an entry with both the same name and the same address already exists in the address book.

java.lang.IllegalArgumentException - if the string passed as the email address does not conform to the internet email address format

IOException - if no more address book entries can be added due to a lack of storage space or a limitation in the client

java.io.IOException

---

getUserEmailAddress()

```
public java.lang.String getUserEmailAddress()
```

Get the email address of the user. The returned value shall be the same as that obtained by reading the value of the “User @” preference (see org.dvb.user.GeneralPreferences for details).

Returns:

the email address of the user, or null if no email address is set or the email address is not available to the client.

Throws:

java.lang.SecurityException - if the caller does not have a UserPreferencePermission with the name “read”.

setInitialMessage(String, String, String)

```
public void setInitialMessage(java.lang.String to, java.lang.String subject,
            java.lang.String messageBody)
```

Set the initial recipient, subject & message body to be used when the email client starts. This URL is specific to this instance of EmailClientService and will not impact any other instance and is only valid for the lifetime of this instance. Calling this method and then selecting the EmailClientService instance is equivalent to selecting the EmailClientService instance, obtaining the EmailClient and then calling the createMessage method there. If the application calling this method is still running when the message is sent (or fails) and has registered an InternetClientListener then the appropriate InternetClientEvent shall be sent corresponding to the success or failure of the operation to send the message.

Parameters:

`to` - the address to which the email should be sent

`subject` - the subject for the email

`messageBody` - the body of the message.

Throws:

`java.lang.NullPointerException` - if any of the to address, subject or message body are null.

`java.lang.IllegalArgumentException` - if the destination address is an empty string.

org.dvb.internet
EntryExistsException

Declaration

```
public class EntryExistsException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.internet.EntryExistsException
```

All Implemented Interfaces:

java.io.Serializable

Description

Exception generated when an application tries to add a bookmark or address book entry that already exists

Constructors

EntryExistsException()

public **EntryExistsException**()

Construct a EntryExistsException with no detail message

EntryExistsException(String)

public **EntryExistsException**(java.lang.String message)

Construct a EntryExistsException with the specified detail message

Parameters:

message - the reason why the exception was thrown

org.dvb.internet
HomePagePermission

Declaration

```
public class HomePagePermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.internet.HomePagePermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for permissions related to the ability for an MHP application to set the home page of a WWW browser in the internet access profile. If an application has this permission then shall be able to set the home page.

Constructors

HomePagePermission(String)

`public HomePagePermission(java.lang.String name)`

Creates a new `HomePagePermission`. The name parameter is not used and must be set to empty string "". Implementations of this version of the present document shall ignore the name, but it could be taken into use in future versions of the present document.

Parameters:

`name` - the name of the `HomePagePermission`. Not used, shall be "".

HomePagePermission(String, String)

`public HomePagePermission(java.lang.String name, java.lang.String actions)`

Creates a new `HomePagePermission`. The name and actions parameters are not used. Implementations of this version of the present document shall ignore the name and actions, but they could be taken into use in future versions of the present document. This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:

`name` - the name of the `HomePagePermission`. Not used, shall be "".

`actions` - Not used, shall be null.

org.dvb.internet
InternetClient

Declaration
`public interface` **`InternetClient extends javax.tv.service.selection.ServiceContentHandler`**

All Superinterfaces:
`javax.tv.service.selection.ServiceContentHandler`

All Known Subinterfaces:
`EmailClient`, `UsenetClient`, `WWWBrowser`

Description
Base interface for the internet clients. Access to those methods common to all running instances of the client (e.g. operations on bookmark lists) are all carried out through the service objects associated with the `InternetClient` object in question. These are accessed using the `getService()` method.

Methods

---

addInternetClientListener(InternetClientListener)

`public void` **`addInternetClientListener`**`(org.dvb.internet.InternetClientListener l)`

Add a listener for `InternetClientEvents`. If the listener is already registered, or the client is not running, then calls to this method have no effect.

Parameters:
`l` - the listener to be added.

---

getService()

`public org.dvb.internet.InternetClientService` **`getService`**`()`

Get the service object which matches this internet client. In the case of a web browser, for example, this would be an instance of the WWWBrowserService class.

Returns:
the service which matches the `InternetClient` object.

---

getServiceContentLocators()

`public javax.tv.locator.Locator[]` **`getServiceContentLocators`**`()`

Reports the portions of the service on which this handler operates.

Overrides:
`getServiceContentLocators` in interface `ServiceContentHandler`

Returns:
An array of length 1, containing the locator representing the internet client. This shall be the same locator returned by calls to `getService().getLocator()`.

removeInternetClientListener(InternetClientListener)

```
public void removeInternetClientListener(org.dvb.internet.InternetClientListener l)
```

Remove a listener for `InternetClientEvents`. If the listener is not registered, or the client is not running, then calls to this method have no effect.

Parameters:

`l` - the listener to be added.

org.dvb.internet
InternetClientEvent

Declaration

```
public class InternetClientEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Direct Known Subclasses:

`InternetClientFailureEvent`, `InternetClientSuccessEvent`

Description

Base class for all status events from internet clients.

Constructors

InternetClientEvent(Object, URL)

```
public InternetClientEvent(java.lang.Object source, java.net.URL url)
```

Construct a new `InternetClientEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

Methods

---

getUrl()

```
public java.net.URL getUrl()
```

Get the URL for which this event was generated. In the case that a URL was not specified when the event was constructed, null shall be returned.

Returns:

an instance of `java.net.URL` or null

org.dvb.internet
InternetClientFailureEvent

Declaration

```
public class InternetClientFailureEvent extends InternetClientEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
              |
              +--org.dvb.internet.InternetClientFailureEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Direct Known Subclasses:

`CancelledByUserEvent`, `PermissionDeniedEvent`, `URLUnavailableEvent`

Description

Event indicating that an operation on an internet client failed. Typically, internet clients will post subclasses of this event detailing the reason why the operation failed.

Constructors

InternetClientFailureEvent(Object, URL)

```
public InternetClientFailureEvent(java.lang.Object source, java.net.URL url)
```

Construct a new `InternetClientFailureEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

org.dvb.internet
InternetClientListener

Declaration
`public interface` **`InternetClientListener extends java.util.EventListener`**

All Superinterfaces:
`java.util.EventListener`

Description
Interface for objects that wish to receive `InternetClientEvents`

Methods

---

receiveInternetClientEvent(InternetClientEvent)

`public void` **`receiveInternetClientEvent`**`(org.dvb.internet.InternetClientEvent event)`

The method to be called when an `InternetClientEvent` is received.

Parameters:
`event` - the received `InternetClientEvent`

org.dvb.internet
InternetClientService

Declaration
`public interface` **`InternetClientService extends javax.tv.service.Service`**

All Superinterfaces:
`javax.tv.service.Service`

All Known Subinterfaces:
`EmailClientService`, `UsenetClientService`, `WWWBrowserService`

Description
The base class for the interface to resident applications that are supported by the internet access profile.

The lifecycle of an application which implements this interface or its subclasses is for a broadcast service. The application is started by selecting the appropriate service (using the `Locator` object returned by calls to `getLocator()`). If this service is selected in the service context which contains the executing application, any currently presented content will be stopped and the application will be destroyed before the client is launched. Calling `destroy()` or `stop()` on the service context in which the client is running will cause the client to be terminated.

Methods in this API will not affect the lifecycle of the calling application.

Methods

---

canRunApplication()

`public boolean` **`canRunApplication`**`()`

Returns true if the application can run without having to stop the downloaded MHP application.

Returns:
true if the application can be run without stopping the calling application, or false otherwise.

---

getName()

`public java.lang.String` **`getName`**`()`

Returns a short service name or an acronym. In the case of subclasses of `InternetClient`, the returned value is implementation dependent

Overrides:
`getName` in interface `Service`

Returns:
A string representing this service's short name.

---

getServiceType()

`public javax.tv.service.ServiceType` **`getServiceType`**`()`

Returns the type of this service. In the case of internet clients, one of the service types defined in the `InternetServiceType` class shall be returned.

Overrides:
`getServiceType` in interface `Service`

Returns:
The service type of this Service.

---

getSupportedClientServices()

`public org.dvb.internet.InternetClientService[] getSupportedClientServices()`

Returns all `InternetClientService`s supported by the same application as this one. This `InternetClientService` is included in the array.

Returns:
an array of `InternetClientServices`

---

hasMultipleInstances()

`public boolean hasMultipleInstances()`

This method indicates whether the service represented by this Service is available on multiple transports. This method has no effect in the case of an `InternetClient`

Overrides:
`hasMultipleInstances` in interface `Service`

Returns:
FALSE always for `InternetClient` instances

---

retrieveDetails(SIRequestor)

`public javax.tv.service.SIRequest retrieveDetails(javax.tv.service.SIRequestor requestor)`

This method will always fail when called for an `InternetClient`. The requestor will always be notified of a failure of type DATA_UNAVAILABLE.

Overrides:
`retrieveDetails` in interface `Service`

Parameters:
`requestor` - - The `SIRequestor` to be notified when this retrieval operation completes.

Returns:
An `SIRequest` object identifying the request

org.dvb.internet
InternetClientSuccessEvent

Declaration

```
public class InternetClientSuccessEvent extends InternetClientEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
              |
              +--org.dvb.internet.InternetClientSuccessEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event indicating that an operation on an internet client succeeded

Constructors

InternetClientSuccessEvent(Object, URL)

`public InternetClientSuccessEvent(java.lang.Object source, java.net.URL url)`

Construct a new `InternetClientSuccessEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

org.dvb.internet
InternetServiceFilter

Declaration

```
public final class InternetServiceFilter extends javax.tv.service.navigation.ServiceFilter

java.lang.Object
  |
  +--javax.tv.service.navigation.ServiceFilter
        |
        +--org.dvb.internet.InternetServiceFilter
```

Description

`InternetServiceFilter` represents a service type for a particular kind of internet client. A `ServiceList` resulting from this filter will include only services providing access to the specified type of internet client.

Fields

EMAIL_CLIENT

```
public static final int EMAIL_CLIENT
```

Constant identifying an email client service

NEWS_CLIENT

```
public static final int NEWS_CLIENT
```

Constant identifying a usenet news client service

WWW_CLIENT

```
public static final int WWW_CLIENT
```

Constant identifying a WWW client service

Constructors

InternetServiceFilter(int)

```
public InternetServiceFilter(int service_type)
```

Constructs the filter based on a particular type of internet client service. The types of service required are those defined by the constants in this class. Support for other values is platform dependent. Platforms not supporting services of the type specified shall return an empty `ServiceList` when instances of this class constructed using that type are used.

Parameters:

`service_type` - the type of service required

Methods

---

accept(Service)

```
public boolean accept(javax.tv.service.Service service)
```

Tests if a particular service represents an internet client of the type specified in the constructor of this instance.

Overrides:
`accept` in class `ServiceFilter`

Parameters:
`service` - A Service to be evaluated against the filtering algorithm.

Returns:
true if service satisfies the filtering algorithm; false otherwise.

org.dvb.internet
InternetServiceType

Declaration

```
public class InternetServiceType extends javax.tv.service.ServiceType
```

```
java.lang.Object
  |
  +--javax.tv.service.ServiceType
        |
        +--org.dvb.internet.InternetServiceType
```

Description

Class representing the additional service types available in the Internet Access profile. When this service type is used in a `java.tv.service.navigation.ServiceTypeFilter` for filtering available services on their type, all internet client services shall be returned. Applications wishing to obtain a specific sub-type of internet client service should use `InternetServiceFilter`.

See Also:

`InternetServiceFilter`

Fields

INTERNET_CLIENT

```
public static final javax.tv.service.ServiceType INTERNET_CLIENT
```

WWW service type

Constructors

InternetServiceType(String)

```
protected InternetServiceType(java.lang.String name)
```

This protected constructor is provided for implementation use and to enable future evolution of this or other specifications. It shall not be called by inter-operable applications.

Parameters:

`name` - the name of the service type

org.dvb.internet
PermissionDeniedEvent

Declaration

```
public class PermissionDeniedEvent extends InternetClientFailureEvent
```

```
java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
              |
              +--org.dvb.internet.InternetClientFailureEvent
                    |
                    +--org.dvb.internet.PermissionDeniedEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event indicating that an operation on an internet client failed due to the specified URL not being accessible by the client due to access controls on the server.

Constructors

PermissionDeniedEvent(Object, URL)

`public PermissionDeniedEvent(java.lang.Object source, java.net.URL url)`

Construct a new `PermissionDeniedEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

org.dvb.internet
URLUnavailableEvent

Declaration

```
public class URLUnavailableEvent extends InternetClientFailureEvent

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.internet.InternetClientEvent
              |
              +--org.dvb.internet.InternetClientFailureEvent
                    |
                    +--org.dvb.internet.URLUnavailableEvent
```

All Implemented Interfaces:

`java.io.Serializable`

Description

Event indicating that an operation on an internet client failed due to the specified URL not being available. This could be because a server is not available or because a file is not available on that server

Constructors

URLUnavailableEvent(Object, URL)

```
public URLUnavailableEvent(java.lang.Object source, java.net.URL url)
```

Construct a new `URLUnavailableEvent`

Parameters:

`source` - the source of the event

`url` - the URL to which the event relates.

org.dvb.internet
UsenetClient

Declaration

```
public interface UsenetClient extends InternetClient
```

All Superinterfaces:

InternetClient, javax.tv.service.selection.ServiceContentHandler

Description

This interface supports the operations required on a Usenet news client.

Any URLs passed to methods in this interface should correspond to the usenet news URL format specified in RFC 1738

Methods

---

selectGroup(URL)

```
public void selectGroup(java.net.URL group)
            throws ClientNotRunningException
```

Select and display messages in the specified newsgroup. If the news client is not running, then this method will not cause it to be started and the call will fail.

This is an asynchronous operation, whose success or failure will be indicated by an InternetClientSuccessEvent or InternetClientFailureEvent or one of their subclasses.

Parameters:

group - the URL of the group. This may or may not include the address of a news server.

Throws:

java.lang.SecurityException - if the caller does not have a SocketPermission for the host part of the specified URL.

java.lang.IllegalArgumentException - if the specified URL does not correspond to the Usenet news URL format specified in RFC 1738

ClientNotRunningException - if the client is not currently running.

---

selectMessage(URL)

```
public void selectMessage(java.net.URL message)
            throws ClientNotRunningException
```

Select and display a message with the given message ID. If the news client is not running, then this method will not cause it to be started and the call will fail.

This is an asynchronous operation, whose success or failure will be indicated by an InternetClientSuccessEvent or InternetClientFailureEvent or one of their subclasses.

Parameters:

message - the URL of the message. This may or may not include the address of a news server.

Throws:

`java.lang.SecurityException` - if the caller does not have a `SocketPermission` for the host part of the specified URL

`java.lang.IllegalArgumentException` - if the specified URL does not include a Usenet news message ID or does not correspond to the Usenet news URL format specified in RFC 1738

`ClientNotRunningException` - if the client is not currently running.

org.dvb.internet
UsenetClientService

Declaration

```
public interface UsenetClientService extends InternetClientService
```

All Superinterfaces:

InternetClientService, javax.tv.service.Service

Description

Service representing the resident usenet news client

Methods

---

setInitialGroup(URL)

```
public void setInitialGroup(java.net.URL group)
```

Set the initial group to be displayed when the news client starts. This URL is specific to this instance of UsenetClientService and will not impact any other instance and is only valid for the lifetime of this instance. Calling this method and then selecting the UsenetClientService instance is equivalent to selecting the UsenetClientService instance, obtaining the UsenetClient and then calling the selectMessage method there. If the application calling this method is still running when the message is sent (or fails) and has registered an InternetClientListener then the appropriate InternetClientEvent shall be sent corresponding to the success or failure of the operation to send the message. Calls to setInitialGroup shall cancel previous calls to setInitialMessage and vice-versa on the same UsenetClientService instance.

Parameters:

group - the URL of the message. This may or may not include the address of a news server

Throws:

java.lang.IllegalArgumentException - if the specified URL does not correspond to the Usenet news URL format specified in RFC 1738

---

setInitialMessage(URL)

```
public void setInitialMessage(java.net.URL message)
```

Set the initial message to be used when the news client starts. This URL is specific to this instance of UsenetClientService and will not impact any other instance and is only valid for the lifetime of this instance. Calling this method and then selecting the UsenetClientService instance is equivalent to selecting the UsenetClientService instance, obtaining the UsenetClient and then calling the selectMessage method there. If the application calling this method is still running when the message is sent (or fails) and has registered an InternetClientListener then the appropriate InternetClientEvent shall be sent corresponding to the success or failure of the operation to send the message. Calls to setInitialGroup shall cancel previous calls to setInitialMessage and vice-versa on the same UsenetClientService instance.

Parameters:

message - the URL of the message. This may or may not include the address of a news server

Throws:

`java.lang.IllegalArgumentException` - if the specified URL does not include a Usenet news message ID or does not correspond to the Usenet news URL format specified in RFC 1738

---

subscribe(String)

```
public void subscribe(java.lang.String newsgroup)
            throws IOException
```

Add a newsgroup to the list currently subscribed newsgroups. If the newsgroup is already in the list, then this method has no effect. As a side-effect a newsgroup previously subscribed to by this method may be unsubscribed. Implementations may restrict the number of newsgroups a single MHP application or source of applications may subscribe to.

Parameters:

`newsgroup` - the name of the newsgroup that should be subscribed to

Throws:

IOException - if no more newsgroups can be added due to a lack of storage space

`java.io.IOException`

org.dvb.internet
WWWBrowser

Declaration

```
public interface WWWBrowser extends InternetClient
```

All Superinterfaces:

`InternetClient`, `javax.tv.service.selection.ServiceContentHandler`

Description

This interface provides support for the operations required on an WWW browser.

Any URLs passed to methods in this interface should correspond to the HTTP or FTP URL schemes specified in RFC 1738. Other schemes or URL formats may be supported, but these are implementation-specific and additional supported schemes should be discovered by querying the capabilities of the web browser if they are required.

Methods

---

goToURL(URL)

```
public void goToURL(java.net.URL url)
            throws ClientNotRunningException
```

Direct the web browser to display the page at the specified URL. If the web browser is not already running, then this method will not cause the web browser to be started and the call will fail.

This is an asynchronous operation, whose success or failure will be indicated by an `InternetClientSuccessEvent` or `InternetClientFailureEvent` or one of their subclasses.

Parameters:

`url` - the URL to visit

Throws:

`java.lang.SecurityException` - if the caller does not have a `SocketPermission` for the host part of the specified URL

`java.lang.IllegalArgumentException` - if the URL scheme is not supported by the web browser.

`ClientNotRunningException` - if the client is not currently running.

org.dvb.internet
WWWBrowserService

Declaration

```
public interface WWWBrowserService extends InternetClientService
```

All Superinterfaces:

InternetClientService, javax.tv.service.Service

Description

Service representing a resident WWW browser

Methods

---

addBookmark(URL, String)

```
public void addBookmark(java.net.URL bookmarkUrl, java.lang.String name)
            throws EntryExistsException, IOException
```

Add a bookmark to the list of bookmarks in the current application. As a side-effect a bookmark previously added by this method may be lost. Implementations may restrict the number of bookmarks a single MHP application or source of applications may add.

Parameters:

bookmarkUrl - the URL that should be added to the bookmarks list.

name - the name that should be displayed for that URL in the bookmarks list.

Throws:

EntryExistsException - if a bookmark with both the same name and the same URL already exists in the bookmarks list.

java.lang.IllegalArgumentException - if the URL scheme is not supported by the application.

IOException - if no more bookmarks can be added due to a lack of storage space or other limitation in the client

java.io.IOException

---

areFramesSupported()

```
public boolean areFramesSupported()
```

Check whether frames are supported by the browser and enabled.

Returns:

true if the browser supports frames and frame support is enabled by the user, false otherwise.

---

getAcceptedMediaTypes()

```
public java.lang.String[] getAcceptedMediaTypes()
```

Returns an array of supported MIME types, e.g. “application/vnd.rn-realmedia” The returned MIME types shall include at least one entry with type “text/html”. Each entry of this type shall have a

'version' parameter that indicates the version of HTML that is supported, for example text/html; version = "4.0". A browser may claim to support an HTML version while only implementing a subset of the features - this is implementation-dependent. A browser that wishes to explicitly indicate support for multiple HTML versions shall return multiple entries of type "text/html" with different values for the 'version' parameter.

Returns:
an array of MIME types supported by the web browser

---

getSupportedPlugins()

```
public java.lang.String[] getSupportedPlugins()
```

Returns an array of names of installed plug-ins. The name in each string is defined by the plug-in provider

Returns:
an array of plugin names

---

getUserAgent()

```
public java.lang.String getUserAgent()
```

Returns the string used in the HTTP "User-Agent" header.

Returns:
the string identifying the user agent

---

setHomepage(URL)

```
public void setHomepage(java.net.URL defaultUrl)
```

Set the home page for the web browser.

Parameters:
`defaultUrl` - the URL to be used as the default when the application is launched with no starting URL.

Throws:
`java.lang.SecurityException` - if the caller does not have a `HomePagePermission`

`java.lang.IllegalArgumentException` - if the URL scheme is not supported by the application. Different classes which implement or extend this interface may implement different schemes.

---

setInitialURL(URL)

```
public void setInitialURL(java.net.URL initialUrl)
```

Set the initial URL to be used when the WWW browser starts. This URL is specific to this instance of WWWBrowserService and will not impact any other instance and is only valid for the lifetime of this instance. Calling this method and then selecting the WWWBrowserService instance is equivalent to selecting the WWWBrowserService instance, obtaining the WWWBrowser and then calling the goToURL method there. If the application calling this method is still running when the specified initial page is displayed (or fails) and has registered an InternetClientListener then the appropriate InternetClientEvent shall be sent corresponding to the success or failure of the operation to display the specified initial URL.

Parameters:
`initialUrl` - the URL to use

Throws:

`java.lang.IllegalArgumentException` - if the URL scheme is not supported by the application. Different classes which implement or extend this interface may implement different schemes.

`java.lang.SecurityException` - if the caller does not have a `SocketPermission` for the host part of the specified URL

Annex AI (normative): DVB Extensions for cryptography

Package org.dvb.security

Description

Enables applications to login to a PKCS11 token for non key related operations including providing PIN codes.

The AuthProvider class is needed to log into a PKCS11 token for non key related operations. In that case, there is no other way to send the PIN code. The KeyStoreBuilder class is needed to install a callback handler which is called when a PIN code is required to create a KeyStore. This is an alternative to providing the PIN code when a KeyStore is instantiated. It enables an application to log into the token for key operations without using a KeyStoreBuilder.

Class Summary	
Interfaces	
KeyStoreProtectionParameters	A marker interface for keystore protection parameters.
Classes	
AuthProvider	This class defines login and logout for a provider.
DVBKeyStore	Extends KeyStore to allow loading the keystore using protection parameters.
KeyStoreBuilder	An instance of this class encapsulates the information needed to instance and initialize a KeyStore object.
KeyStoreCallbackHandlerProtection	A protection parameter encapsulating a CallbackHandler.
Exceptions	
KeyStoreException	Generic KeyStore exception.
LoginException	Basic login exception.

org.dvb.security
AuthProvider

Declaration

```
public abstract class AuthProvider extends java.security.Provider
```

```
java.lang.Object
  |
  +--java.util.Dictionary
        |
        +--java.util.Hashtable
              |
              +--java.util.Properties
                    |
                    +--java.security.Provider
                          |
                          +--org.dvb.security.AuthProvider
```

All Implemented Interfaces:

`java.lang.Cloneable`, `java.util.Map`, `java.io.Serializable`

Direct Known Subclasses:

`org.dvb.security.pkcs11.DVBPKCS11Provider`

Description

This class defines login and logout for a provider. While callers may invoke login directly, the provider may also invoke login on behalf of callers if it determines that a login must be perfomed prior to certain operations.

Constructors

AuthProvider(String, double, String)

```
protected AuthProvider(java.lang.String name, double version, java.lang.String info)
```

Creates a new instance of AuthProvider.

Methods

---

login(Principal, CallbackHandler)

```
public abstract void login(java.security.Principal identity,
            org.dvb.auth.callback.CallbackHandler handler)
            throws LoginException
```

log in to this provider

Throws:

`LoginException`

---

logout()

```
public abstract void logout()
            throws LoginException
```

logout from this provider

Throws:

LoginException

---

setCallbackHandler(CallbackHandler)

```
public abstract void setCallbackHandler(org.dvb.auth.callback.CallbackHandler handler)
```

set a call back handler

org.dvb.security
DVBKeyStore

Declaration

```
public class DVBKeyStore extends java.security.KeyStore

java.lang.Object
  |
  +--java.security.KeyStore
        |
        +--org.dvb.security.DVBKeyStore
```

Description

Extends KeyStore to allow loading the keystore using protection parameters.

Since:

MHP 1.1.2

Constructors

DVBKeyStore(KeyStoreSpi, Provider, String)

```
protected DVBKeyStore(java.security.KeyStoreSpi keyStoreSpi,
            java.security.Provider provider, java.lang.String type)
```

Creates a KeyStore object of the given type, and encapsulates the given provider implementation (SPI object) in it.

Parameters:

`keyStoreSpi` - the provider implementation.

`provider` - the provider.

`type` - the keystore type.

Methods

---

load(KeyStoreProtectionParameters)

```
public final void load(org.dvb.security.KeyStoreProtectionParameters p)
            throws IOException, NoSuchAlgorithmException, CertificateException
```

Loads this keystore using the given protection parameters

Parameters:

`p` - protection parameters to use

Throws:

`java.lang.IllegalArgumentException` - if the parameter p is not recognized

`java.io.IOException` - if there is an I/O or format problem with the keystore data

`java.security.NoSuchAlgorithmException` - if the algorithm used to check the integrity of the keystore cannot be found

`java.security.cert.CertificateException` - if any of the certificates in the keystore could not be loaded

org.dvb.security
KeyStoreBuilder

Declaration

```
public abstract class KeyStoreBuilder

java.lang.Object
  |
  +--org.dvb.security.KeyStoreBuilder
```

Description

An instance of this class encapsulates the information needed to instance and initialize a KeyStore object. That process is triggered when the getKeyStore method is called. This makes it possible to decouple configuration from KeyStore object creation and delay password prompt until it is needed.

Constructors

KeyStoreBuilder()

```
protected KeyStoreBuilder()
```

Creates a new instance of KeyStoreBuilder

Methods

---

getKeyStore()

```
public abstract java.security.KeyStore getKeyStore()
            throws KeyStoreException
```

Returns the KeyStore described by this object.

Throws:

`KeyStoreException` - if an error occurred, e.g. if an error occurred in the constructor or the load method of the KeyStore

---

newInstance(String, Provider, KeyStoreProtectionParameters)

```
public static org.dvb.security.KeyStoreBuilder newInstance(java.lang.String type,
            java.security.Provider provider,
            org.dvb.security.KeyStoreProtectionParameters protection)
```

Returns a new builder object. Each call to the `getKeyStore` method on the returned builder will return a new org.dvb.security.DVBKeyStore object of type type. Its `load` method is invoked with the protection parameter used to construct this KeyStoreBuilder.

Parameters:

`type` - the type of the KeyStore to be constructed. The type parameter is concatenated with the string “KeyStore.” and then passed to the get method of the specified Provider in order to obtain the fully qualified name of the KeyStoreSpi implementation. For more details, see “How to Implement a Provider for the JavaTM Cryptography Architecture”

`provider` - the provider from which the keyStore is to be instantiated.

`protection` - the protection parameter securing the Keystore.

Throws:

`java.lang.IllegalArgumentException` - if protection is an application defined class

`java.lang.NullPointerException` - if type, provider or protection are null

org.dvb.security
KeyStoreCallbackHandlerProtection

Declaration

```
public class KeyStoreCallbackHandlerProtection implements KeyStoreProtectionParameters

java.lang.Object
  |
  +--org.dvb.security.KeyStoreCallbackHandlerProtection
```

All Implemented Interfaces:

KeyStoreProtectionParameters

Description

A protection parameter encapsulating a CallbackHandler.

Constructors

KeyStoreCallbackHandlerProtection(CallbackHandler)

```
public KeyStoreCallbackHandlerProtection(org.dvb.auth.callback.CallbackHandler handler)
```

Creates a new instance of KeyStoreCallbackHandlerProtection

Methods

---

getCallbackHandler()

```
public org.dvb.auth.callback.CallbackHandler getCallbackHandler()
```

Returns the callback handler.

org.dvb.security
KeyStoreException

Declaration

```
public class KeyStoreException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.security.KeyStoreException
```

All Implemented Interfaces:

java.io.Serializable

Description

Generic KeyStore exception.

Constructors

KeyStoreException()

```
public KeyStoreException()
```

Creates a new instance of `KeyStoreException` without detail message.

KeyStoreException(String)

```
public KeyStoreException(java.lang.String msg)
```

Constructs an instance of `KeyStoreException` with the specified detail message.

Parameters:

`msg` - the detail message.

org.dvb.security
KeyStoreProtectionParameters

Declaration
```
public interface KeyStoreProtectionParameters
```

All Known Implementing Classes:
KeyStoreCallbackHandlerProtection

Description
A marker interface for keystore protection parameters.

org.dvb.security
LoginException

Declaration

```
public class LoginException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.security.LoginException
```

All Implemented Interfaces:

java.io.Serializable

Description

Basic login exception.

Constructors

LoginException()

```
public LoginException()
```

Creates a new instance of LoginException without detail message.

LoginException(String)

```
public LoginException(java.lang.String msg)
```

Constructs an instance of LoginException with the specified detail message.

Parameters:

msg - the detail message.

Package org.dvb.auth.callback

Description

Enables applications to ask the end-user for PIN codes. Applications will request the PIN code by implementing the interface CallbackHandler from this package. This handler will receive a PasswordCallback object when the implementation requires the PIN code.

NOTE: In order to prevent other applications listening in, it is recommended that applications use org.dvb.event to obtain exclusive access to the number keys when asking for the PIN code.

Class Summary	
Interfaces	
Callback	Implementations of this interface are passed to a CallbackHandler, allowing underlying security services the ability to interact with a calling application to retrieve specific authentication data such as usernames and passwords, or to display certain information, such as error and warning messages.
CallbackHandler	An application implements a CallbackHandler and passes it to underlying security services so that they may interact with the application to retrieve specific authentication data, such as usernames and passwords, or to display certain information, such as error and warning messages.
Classes	
PasswordCallback	Underlying security services instantiate and pass a PasswordCallback to the handle method of a CallbackHandler to retrieve password information.
Exceptions	
UnsupportedCallback-Exception	Thrown when a callback handler is asked to handle a callback which it cannot handle.

org.dvb.auth.callback
Callback

Declaration

```
public interface Callback
```

All Known Implementing Classes:

PasswordCallback

Description

Implementations of this interface are passed to a CallbackHandler, allowing underlying security services the ability to interact with a calling application to retrieve specific authentication data such as usernames and passwords, or to display certain information, such as error and warning messages. Callback implementations do not retrieve or display the information requested by underlying security services. Callback implementations simply provide the means to pass such requests to applications, and for applications, if appropriate, to return requested information back to the underlying security services.

org.dvb.auth.callback
CallbackHandler

Declaration

```
public interface CallbackHandler
```

Description

An application implements a CallbackHandler and passes it to underlying security services so that they may interact with the application to retrieve specific authentication data, such as usernames and passwords, or to display certain information, such as error and warning messages.

Methods

---

handle(Callback[])

```
public void handle(org.dvb.auth.callback.Callback[] callbacks)
            throws IOException, UnsupportedCallbackException
```

Called when a callback needs handling.

Parameters:

`callbacks` - - an array of Callback objects provided by an underlying security service which contains the information requested to be retrieved or displayed.

Throws:

`java.io.IOException` - if an input or output error occurs when retrieving the password

`UnsupportedCallbackException` - if one of the callbacks in the array is not supported by the handler

org.dvb.auth.callback
PasswordCallback

Declaration

```
public class PasswordCallback implements Callback

java.lang.Object
  |
  +--org.dvb.auth.callback.PasswordCallback
```

All Implemented Interfaces:

Callback

Description

Underlying security services instantiate and pass a PasswordCallback to the handle method of a CallbackHandler to retrieve password information. The CallbackHandler uses this to communicate to the security services a password obtained from the end-user.

Constructors

PasswordCallback(String, boolean)

```
public PasswordCallback(java.lang.String prompt, boolean echoOn)
```

Creates a new instance of PasswordCallback.

Parameters:

`prompt` - the prompt to use

`echoOn` - true if the password should be displayed as typed otherwise false

Methods

---

clearPassord()

```
public void clearPassord()
```

Clear the retrieved password.

---

getPassword()

```
public char[] getPassword()
```

Get the retrieved password.

Returns:

the last password previously set by setPassword or null if none has been set

See Also:

setPassword(char[])

---

getPrompt()

```
public java.lang.String getPrompt()
```

Get the prompt to use.

Returns:
the prompt as passed to the constructor

---

isEchoOn()

```
public boolean isEchoOn()
```

Return whether the password should be displayed as being typed.

Returns:
true if the password should be displayed otherwise false

---

setPassword(char[])

```
public void setPassword(char[] password)
```

Set the retrieved password.

Parameters:
`password` - the password to return

See Also:
`getPassword()`

org.dvb.auth.callback
UnsupportedCallbackException

Declaration

```
public class UnsupportedCallbackException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.auth.callback.UnsupportedCallbackException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when a callback handler is asked to handle a callback which it cannot handle.

Constructors

UnsupportedCallbackException(Callback)

```
public UnsupportedCallbackException(org.dvb.auth.callback.Callback callback)
```

Creates a new instance of UnsupportedCallbackException without detail message.

Parameters:

callback - the callback which cannot be handled

UnsupportedCallbackException(Callback, String)

```
public UnsupportedCallbackException(org.dvb.auth.callback.Callback callback,
            java.lang.String msg)
```

Constructs an instance of UnsupportedCallbackException with the specified detail message.

Parameters:

callback - the callback which cannot be handled

msg - the detail message.

Methods

---

getCallback()

```
public org.dvb.auth.callback.Callback getCallback()
```

Returns the Callback passed in to the constructor.

Returns:

a callback

Package
org.dvb.net.ssl

Description

Enables applications to provide keys and certificates for SSL/TLS connections. During the SSL handshake, the SSL engine uses TrustManagers to make sure the certificate chain received from the server is trusted. If client authentication is enabled, the SSL engine will use KeyManagers to find a certificate chain and a private key according to the CertificateRequest message from the server. The CertificateRequest message gives a list of acceptable CA for the server.

The init method in DVBTrustManagerFactory and DVBKeyManagerFactory is used by applications to provide a set of KeyStoreBuilders to these factory classes. Without these two classes, applications can only provide the PIN code at the time the KeyManagerFactory is created. Hence if the token is replaced, the existing KeyManagerFactory cannot be used and the application would need to create a new instance to use with the new token.

Class Summary

Classes

DVBKeyManagerFactory	This class is used to create a KeyManagerFactory initialized with an array of KeyStoreBuilder instances.
DVBKeyManagerFactorySpi	This class defines the Service Provider Interface for the DVBKeyManagerFactory class.
DVBTrustManagerFactory	This class is used to create a KeyManagerFactory initialized with an array of KeyStoreBuilder instances.
DVBTrustManagerFactorySpi	This class defines the Service Provider Interface for the DVBTrustManagerFactory class.

org.dvb.net.ssl
DVBKeyManagerFactory

Declaration

```
public class DVBKeyManagerFactory extends javax.net.ssl.KeyManagerFactory

java.lang.Object
  |
  +--javax.net.ssl.KeyManagerFactory
        |
        +--org.dvb.net.ssl.DVBKeyManagerFactory
```

Description

This class is used to create a KeyManagerFactory initialized with an array of KeyStoreBuilder instances. The (inherited) method getInstance shall return an instance of DVBKeyManagerFactory where provider is an instance of DVBPKCS11Provider.

Constructors

DVBKeyManagerFactory(DVBKeyManagerFactorySpi, Provider, String)

```
protected DVBKeyManagerFactory(org.dvb.net.ssl.DVBKeyManagerFactorySpi factorySpi,
            java.security.Provider provider, java.lang.String algorithm)
```

Creates a new instance of DVBKeyManagerFactory

Methods

---

init(KeyStoreBuilder[])

```
public final void init(org.dvb.security.KeyStoreBuilder[] builders)
```

This method is used to initialize the factory with an array of KeyStoreBuilder instances.

Parameters:

`builders` - an array of KeyStoreBuilder instances.

org.dvb.net.ssl
DVBKeyManagerFactorySpi

Declaration

```
public abstract class DVBKeyManagerFactorySpi extends javax.net.ssl.KeyManagerFactorySpi

java.lang.Object
  |
  +--javax.net.ssl.KeyManagerFactorySpi
        |
        +--org.dvb.net.ssl.DVBKeyManagerFactorySpi
```

Description

This class defines the Service Provider Interface for the DVBKeyManagerFactory class.

Constructors

DVBKeyManagerFactorySpi()

```
public DVBKeyManagerFactorySpi()
```

Creates a new instance of DVBKeyManagerFactorySpi

Methods

---

engineInit(KeyStoreBuilder[])

```
protected abstract void engineInit(org.dvb.security.KeyStoreBuilder[] builders)
```

This method is used to initialize the factory with an array of KeyStoreBuilder instances.

Parameters:

`builders` - an array of KeyStoreBuilder.

org.dvb.net.ssl
DVBTrustManagerFactory

Declaration

```
public class DVBTrustManagerFactory extends javax.net.ssl.TrustManagerFactory

java.lang.Object
  |
  +--javax.net.ssl.TrustManagerFactory
        |
        +--org.dvb.net.ssl.DVBTrustManagerFactory
```

Description

This class is used to create a KeyManagerFactory initialized with an array of KeyStoreBuilder instances. The inherited method getInstance shall return an instance of DVBTrustManagerFactory when the provider is an instance of DVBPKCS11Provider.

Constructors

DVBTrustManagerFactory(DVBTrustManagerFactorySpi, Provider, String)

```
protected DVBTrustManagerFactory(org.dvb.net.ssl.DVBTrustManagerFactorySpi factorySpi,
            java.security.Provider provider, java.lang.String algorithm)
```

Creates a new instance of DVBTrustManagerFactory

Methods

---

init(KeyStoreBuilder[])

```
public final void init(org.dvb.security.KeyStoreBuilder[] builders)
```

This method is used to initialize the factory with an array of KeyStoreBuilder instances.

Parameters:

`builders` - an array of KeyStoreBuilder instances.

org.dvb.net.ssl
DVBTrustManagerFactorySpi

Declaration

```
public abstract class DVBTrustManagerFactorySpi extends javax.net.ssl.TrustManagerFactorySpi

java.lang.Object
  |
  +--javax.net.ssl.TrustManagerFactorySpi
        |
        +--org.dvb.net.ssl.DVBTrustManagerFactorySpi
```

Description

This class defines the Service Provider Interface for the DVBTrustManagerFactory class.

Constructors

DVBTrustManagerFactorySpi()

```
public DVBTrustManagerFactorySpi()
```

Creates a new instance of DVBTrustManagerFactorySpi

Methods

---

engineInit(KeyStoreBuilder[])

```
protected abstract void engineInit(org.dvb.security.KeyStoreBuilder[] builders)
```

This method is used to initialize the factory with an array of KeyStoreBuilder instances.

Parameters:

`builders` - an array of `KeyStoreBuilder`s.

Package
org.dvb.security.pkcs11

Description

Provides information about available slots and tokens and enables the selection of the slot to use.

PKCS11 smart card products in the market show significant variation. In practice, this variation is significant enough that a defining a default PKCS11 driver to be resident in all MHP terminals is impractical. DVBPKCS11Provider implementations will use the " Non-CA smart card API" (http://java.sun.com/products/satsa/) to communicate with the smart cards.

In this package, when PKCS#11 library functions are mentioned, it is to indicate that the call this method shall cause effect similar to the named PKCS#11 library equivalent.

The methods getSlotList and getTokenInfo of the class DVBPKCS11Provider can be used to get the list of slots and tokens available. The default slot used will be defined by the java property "dvb.security.pkcs11.defaultSlotId". If an application needs to use another slot, it should call the method DVBPKCS11Provider.setSlotId(int slotId) to change the slot used by the provider. The slot can only be changed when the provider is not logged into the token.

Class Summary	
Interfaces	
SlotInfo	This interface is used to retrieve information about a PKCS11 slot.
TokenInfo	This interface is used to get information about a PKCS11 token.
Classes	
DVBPKCS11Provider	This class implements a PKCS11 security provider.

org.dvb.security.pkcs11
DVBPKCS11Provider

Declaration

```
public abstract class DVBPKCS11Provider extends org.dvb.security.AuthProvider

java.lang.Object
  |
  +--java.util.Dictionary
        |
        +--java.util.Hashtable
              |
              +--java.util.Properties
                    |
                    +--java.security.Provider
                          |
                          +--org.dvb.security.AuthProvider
                                |
                                +--org.dvb.security.pkcs11.DVBPKCS11Provider
```

All Implemented Interfaces:

`java.lang.Cloneable`, `java.util.Map`, `java.io.Serializable`

Description

This class implements a PKCS11 security provider. It can be used in the following security related packages:

- In java.security for MessageDigest, SecureRandom, Signature, KeyPairGenerator and KeyStore related classes.
- In javax.crypto (JCE) for encryption and decryption.

Providers have a slot identifier associated with them identifying each smart card reader slot. These are numbered starting from zero. For details, see the PKCS 11 specification.

Constructors

DVBPKCS11Provider(String, double, String, AppID)

```
protected DVBPKCS11Provider(java.lang.String name, double version, java.lang.String info,
            org.dvb.application.AppID appID)
            throws SecurityException
```

Creates a new instance of DVBPKCS11Provider

Throws:

`java.lang.SecurityException` - when called with an appID not allowed by the DVBPKCS11 implementation

Methods

---

getSlotId()

```
public abstract int getSlotId()
```

This method returns the PKCS11 slot identifier currently associated with this provider. By default the slot identifier is defined by the property “dvb.security.pkcs11.defaultSlotId” It can be changed by calling setSlotId.

Returns:
a slot identifier.

---

getSlotList(boolean)

```
public org.dvb.security.pkcs11.SlotInfo[] getSlotList(boolean tokenPresent)
```

This method is used to get the list of PKCS11 Slot available for this provider. It is equivalent to the PKCS11 C_GetSlotList function to get the list of slot and C_GetSlotInfo to retreive slot information.

Parameters:
`tokenPresent` - boolean indicating if the returned list includes only the slots with a token present or all slots.

Returns:
the list of slot.

---

getTokenInfo(int)

```
public abstract org.dvb.security.pkcs11.TokenInfo getTokenInfo(int slotId)
            throws IllegalArgumentException
```

This method is used to retreive information about a PKCS11 token in a given slot. It is equivalent to the PKCS11 C_GetTokenInfo function to get this information.

Returns:
a TokenInfo object which gives a subset of the PKCS11 CK_TOKEN_INFO.

Throws:
`java.lang.IllegalArgumentException` - if the slot does not exist or there is no token in the slot

---

login(Principal, CallbackHandler)

```
public abstract void login(java.security.Principal identity,
            org.dvb.auth.callback.CallbackHandler handler)
            throws LoginException, NullPointerException
```

This method is used to explicitly log into a PKCS11 token. A call to this method will be equivalent to a call to the PKCS11 function C_Login. The PKCS11 user type will always be CKU_USER.

Overrides:
`login` in class `AuthProvider`

Parameters:
`identity` - This parameter is not used. It is kept to be compatible with the J2SE 5.0

`handler` - This parameter is used to get the pin code needed to login. The callbackHandler will get a PasswordCallback in which it should put the pin code. This parameter may be null in which case the handler that was previously set by setCallbackHandler is used.

Throws:
`org.dvb.security.LoginException` - This exception is under the conditions when C_Login would return an error return an error.

`java.lang.NullPointerException` - if the CallbackHandler parameter is null and either no previous call to setCallbackHandler has occurred or the last call to that method set the handler to null.

---

logout()

```
public abstract void logout()
            throws LoginException
```

This method is called to explicitly log out from a PKCS11 token. A call to this method will be equivalent to a call to the PKCS11 funtion C_Logout.

Overrides:
`logout` in class `AuthProvider`

Throws:
`org.dvb.security.LoginException` - This exception is thrown under the conditions when C_Logout would return an error.

---

setCallbackHandler(CallbackHandler)

```
public abstract void setCallbackHandler(org.dvb.auth.callback.CallbackHandler handler)
```

This method is used to set a default callback handler for the provider.

Overrides:
`setCallbackHandler` in class `AuthProvider`

Parameters:
`handler` - a Callback handler that will be used to get the pin code when the login method is called with a null handler.

---

setSlotId(int)

```
public abstract void setSlotId(int slotId)
            throws IOException, IllegalArgumentException
```

This method can be used to change the slot identifier used by the provider. The slot can only be changed when the provider is not logged into the token.

Parameters:
`slotId` - a slot identifier.

Throws:
`java.io.IOException` - this exception is thrown if this method is called when the provider is logged into the token.

`java.lang.IllegalArgumentException` - if the slot does not exist

org.dvb.security.pkcs11
SlotInfo

Declaration

```
public interface SlotInfo
```

Description

This interface is used to retrieve information about a PKCS11 slot. The information returned here is the equivalent to the one returned by the PKCS11 function C_GetSlotInfo.

Methods

---

getFlags()

```
public int getFlags()
```

This method returns the flags of the PKCS11 CK_SLOT_INFO.

---

getManufacturerID()

```
public java.lang.String getManufacturerID()
```

This method returns the ManufacturerID of the PKCS11 CK_SLOT_INFO.

---

getSlotDescription()

```
public java.lang.String getSlotDescription()
```

This method returns the slotDescription of the PKCS11 CK_SLOT_INFO.

---

getSlotID()

```
public int getSlotID()
```

This method returns the slot identifier associated this slot information.

org.dvb.security.pkcs11
TokenInfo

Declaration

```
public interface TokenInfo
```

Description

This interface is used to get information about a PKCS11 token. The information returned here is the equivalent to the one returned by the PKCS11 function C_GetTokenInfo.

Methods

---

getFlags()

```
public int getFlags()
```

This method returns the flags of the PKCS11 CK_TOKEN_INFO.

---

getLabel()

```
public java.lang.String getLabel()
```

This method returns the label of the PKCS11 CK_TOKEN_INFO.

---

getManufacturerID()

```
public java.lang.String getManufacturerID()
```

This method returns the manufacturerID of the PKCS11 CK_TOKEN_INFO.

---

getModel()

```
public java.lang.String getModel()
```

This method returns the model of the PKCS11 CK_TOKEN_INFO.

---

getSerialNumber()

```
public java.lang.String getSerialNumber()
```

This method returns the serial Number of the PKCS11 CK_TOKEN_INFO.

Annex AJ (normative): Cryptographic service provider installation

AJ.1 Introduction (informative)

PKCS11 smart card products in the market show significant variation. In practice, this variation is significant enough that a defining a default PKCS11 driver to be resident in all MHP terminals is impractical. The present document defines a mechanism to permit the downloading of cryptographic service providers in the form of Java classes. Specifically, a cryptographic service provider is a set of Java classes that provide a concrete implementation of security related functions.

To implement a cryptographic provider for the smart card, the following is needed:

a) Implement the subclasses of the needed SPI classes.
The following SPI (Service Provider Interface) classes are available :

```
java.security.SignatureSpi,
java.security.MessageDigestSpi,
java.security.KeyPairGeneratorSpi,
java.security.SecureRandomSpi,
java.security.AlgorithmParameterGeneratorSpi,
java.security.AlgorithmParametersSpi,
java.security.KeyFactorySpi,
java.security.cert.CertificateFactorySpi,
java.security.KeyStoreSpi,
javax.crypto.CipherSpi,
javax.crypto.MacSpi,
org.dvb.net.ssl.DVBKeyManagerFactorySpi,
org.dvb.net.ssl.DVBTrustManagerFactorySpi,
```

To access the smart card, the provider implementation must use the Non-CA smart card API as defined in clause 11.9.4.

b) Implement the master provider class which is a subclass of org.dvb.security.pkcs11.DVBPKCS11Provider. The main purpose of this class is to give the list of the SPI classes implemented by the provider. This list is given via a set of properties initialized in the constructor of the class.

The present document does not define a mechanism by which applications may request instances of java.security.SecurityPermission. Hence applications will not be able to use the methods addProvider and removeProvider from the class java.security.Security to install and remove providers.

AJ.2 The org.dvb.security.provider package

This package is defined later in this annex.

Package
org.dvb.security.provider

Description

Enables the use of providers (as supported by the org.dvb.spi package) as cryptographic service providers (as supported by the java.security package).

Class Summary	
Interfaces	
CryptographicService-ProviderProvider	This xlet-bound provider permits a cryptographic service provider to be packaged and managed as part of the MHP provider framework as supported through the org.dvb.spi package.
Classes	
ProviderManager	This class gives access to those cryptographic service providers visible to an application.

org.dvb.security.provider
CryptographicServiceProviderProvider

Declaration

```
public interface CryptographicServiceProviderProvider extends org.dvb.spi.XletBoundProvider
```

All Superinterfaces:

org.dvb.spi.Provider, org.dvb.spi.XletBoundProvider

Description

This xlet-bound provider permits a cryptographic service provider to be packaged and managed as part of the MHP provider framework as supported through the org.dvb.spi package. Xlet-bound providers shall not be visible to applications through the methods of the java.security.Security class.

Methods

---

getProvider()

```
public org.dvb.security.pkcs11.DVBPKCS11Provider getProvider()
```

Obtain a DVBPKCS11Provider to be used by this Xlet

Returns:

a DVBPKCS11Provider

org.dvb.security.provider
ProviderManager

Declaration

```
public class ProviderManager

java.lang.Object
  |
  +--org.dvb.security.provider.ProviderManager
```

Description

This class gives access to those cryptographic service providers visible to an application. The cryptographic service providers visible to an application shall include the following;

- The installed providers as returned by java.security.Security.getProviders
- Xlet bound providers which are bound to the calling Xlet

Where providers of the same name are visible to an application through both the above mechanisms, the Xlet bound provider shall always be used by this class, even if the installed provider has a higher version number. Installed providers can always be accessed through java.security.Security.getProviders.

Constructors

ProviderManager()

```
protected ProviderManager()
```

Creates a new instance of ProviderManager. This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

getInstance()

```
public static org.dvb.security.provider.ProviderManager getInstance()
```

Gets the singleton instance of the ProviderManager

Returns:
the ProviderManager.

---

getProvider(String)

```
public java.security.Provider getProvider(java.lang.String name)
```

Returns a visible provider with the specified name. If no provider with that name is visible to the calling application then null shall be returned.

Parameters:
`name` - the name of the provider

Returns:
a provider or null

---

getProviders()

```
public java.security.Provider[] getProviders()
```

Returns an array containing all the providers visible to the calling application.

Returns:
an array of providers

Annex AK (normative): Extended service selection API

Package
org.dvb.service.selection

Description
Extensions to the Java TV service selection API.

Class Summary	
Interfaces	
DvbServiceContext	An extension to ServiceContext permitting the discovery of the network interface (if any) being used by a service context.

org.dvb.service.selection
DvbServiceContext

Declaration

```
public interface DvbServiceContext extends javax.tv.service.selection.ServiceContext
```

All Superinterfaces:

`javax.tv.service.selection.ServiceContext`

Description

An extension to ServiceContext permitting the discovery of the network interface (if any) being used by a service context.

Methods

---

getNetworkInterface()

```
public org.davic.net.tuning.NetworkInterface getNetworkInterface()
```

Return the NetworkInterface reserved by this ServiceContext. The NetworkInterface instance returned shall be .equals() to one of those returned by NetworkInterfaceManager.getNetworkInterfaces().

Returns:

a NetworkInterface object or null if this ServiceContext has no NetworkInterface reserved

---

setDefaultVideoTransformation(VideoTransformation)

```
public void setDefaultVideoTransformation(org.dvb.media.VideoTransformation vt)
```

Sets the default video transformation to be applied to the new service following a service selection operation. The identity of the last application to call this method for each service context instance shall be remembered by the MHP terminal. If this is set then the presentation of the video of the new service will use the video transformation of the existing service until it is known whether that application survives. If that application survives then this transformation shall be applied to the video of the new service. If that application does not survive then the video transformation of the new service will be reset to the default for the platform and the value set by the call to this method discarded. This method shall have no effect if the ServiceMediaHandler for the service context is a component based player when service selection happens.

Parameters:

`vt` - the video default transformation or null to reset to the default for the platform

Since:

MHP 1.1.2

Annex AL (normative): Extended content referencing API

Package
org.dvb.locator

Description

Provides Locators for various concepts not addressed in the org.davic and javax.tv packages.

Class Summary	
Classes	
FrequencyLocator	Used to reference a service that does not carry any DVB-SI and hence does not appear in the service list of a receiver.
NetworkInterface-BoundMediaLocator	Class representing a MediaLocator combined with a network interface.

org.dvb.locator
FrequencyLocator

Declaration

```
public class FrequencyLocator extends org.davic.net.Locator
```

```
java.lang.Object
  |
  +--org.davic.net.Locator
        |
        +--org.dvb.locator.FrequencyLocator
```

All Implemented Interfaces:

javax.tv.locator.Locator

Description

Used to reference a service that does not carry any DVB-SI and hence does not appear in the service list of a receiver. The external form of locators of this class is implementation specific.

Since:

MHP 1.1.2

Constructors

FrequencyLocator(byte[], int)

```
public FrequencyLocator(byte[] delivery_system_descriptor, int program_number)
            throws InvalidLocatorException
```

Constructor for referencing a service which does not carry any DVB-SI.

Parameters:

`delivery_system_descriptor` - one of the delivery system descriptors defined in clause 6.2.13 (“Delivery system descriptors”) of the DVB-SI specification.

`program_number` - the MPEG program_number of the service within the transport stream

Throws:

`org.davic.net.InvalidLocatorException` - if the delivery_system_descriptor parameter is incorrect - the descriptor tag does not define one of the permitted descriptors, the length of the array is not correct for the descriptor tag, any values within the descriptor are outside any range defined for them.

Methods

---

getDeliverySystemDescriptor()

```
public byte[] getDeliverySystemDescriptor()
```

Return the delivery system descriptor as passed into the constructor

Returns:

a byte array containing a DVB-SI delivery system descriptor

---

getProgramNumber()

```
public int getProgramNumber()
```

Return the MPEG program number as passed in to the constructor

Returns:
an MPEG program number

org.dvb.locator
NetworkInterfaceBoundMediaLocator

Declaration

```
public class NetworkInterfaceBoundMediaLocator extends javax.media.MediaLocator

java.lang.Object
  |
  +--javax.media.MediaLocator
        |
        +--org.dvb.locator.NetworkInterfaceBoundMediaLocator
```

Description

Class representing a MediaLocator combined with a network interface. Used by applications that want to control which network interface is used by JMF when multiple network interfaces exist which are connected to the same actual network, for example a multi-tuner PVR.

JMF players constructed using instances of this class shall only use the specified network interface. If the media referenced by that media locator is not available via that network interface, the JMF player shall behave as if the media is not available at all, even if it is in fact available by another network interface.

Since:

MHP 1.1.2

Constructors

NetworkInterfaceBoundMediaLocator(MediaLocator, NetworkInterface)

```
public NetworkInterfaceBoundMediaLocator(javax.media.MediaLocator locator,
            org.davic.net.tuning.NetworkInterface ni)
```

Construct an instance of this class

Parameters:

`locator` - the MediaLocator to be combined with a NetworkInterface

`ni` - a NetworkInterface

Methods

---

getNetworkInterface()

```
public org.davic.net.tuning.NetworkInterface getNetworkInterface()
```

Return the network interface aspect of this MediaLocator

Returns:

the network interface passed into the constructor

Annex AM (normative): Smart card reader API

Package org.dvb.smartcard

Description

Provides access to smart card readers. This access includes information about the status of any smart card in those readers and any changes in that status.

Class Summary	
Interfaces	
SmartCardReaderListener	The listener interface to receive smart card reader status changes.
Classes	
SmartCardReader	Represents a physical smart card reader slot in the terminal.
SmartCardReaderEvent	Represents an event generated by a change in the status of a smart card reader.
SmartCardReaderManager	The smart card reader manager allow user to know the status of any slot available on the terminal.

org.dvb.smartcard
SmartCardReader

Declaration

```
public class SmartCardReader

java.lang.Object
  |
  +--org.dvb.smartcard.SmartCardReader
```

Description

Represents a physical smart card reader slot in the terminal.

Since:

MHP 1.1.3

Constructors

SmartCardReader()

```
protected SmartCardReader()
```

This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

addSmartCardReaderListener(SmartCardReaderListener)

```
public void addSmartCardReaderListener(org.dvb.smartcard.SmartCardReaderListener listener)
```

Allows the specified listener to received notifications about changes in the status of the smart card reader.

Parameters:

`listener` - the SmartCardReaderListener that will receive the notifications

---

getSlotId()

```
public int getSlotId()
```

Each single reader is identified on the terminal with an increasing identifier. Default identifier for single slot terminals is zero.

Returns:

int id associated to the reader

getStatus()

```
public int getStatus()
```

Retrieves current status of the smart card reader. The constant values are the ones defined in SmartCardReaderEvent.

Returns:
int current status of the reader

isSmartCardInserted()

```
public boolean isSmartCardInserted()
```

Allows applications to query if a smart card is inserted in the reader. True is returned also if no ATR is correctly retrieved (i.e. smart card inserted upside-down).

Returns:
boolean true if smart card is inserted in given slot

openRawConnection()

```
public javax.microedition.apdu.APDUConnection openRawConnection()
            throws IOException, ConnectionNotFoundException
```

Opens a raw APDU connection without selecting an application or managing channels. The following properties shall apply to raw connections.

- There may be only one raw connection open at the same time with the same smart card.
- The implementation shall open the connection without sending any extra commands.
- An MHP application is allowed to send Application Selection (SELECT FILE by DF NAME) and MANAGE CHANNEL commands.
- For the T=0 protocol, for case 4 and case 2 command APDUs the card may respond with 61 XX or 6C XX statuses. The implementation should not handle these special cases, it should neither send GET RESPONSE, nor resend commands. The MHP application is required to handle these cases.

Returns:
an APDUConnection with the selected smartcard

Throws:
`java.lang.SecurityException` - if the application does not have APDUPermission

`javax.microedition.io.ConnectionNotFoundException` - if either the smartcard is not inserted or if opening a connection is not permitted (e.g. for CA cards)

`java.io.IOException` - if an APDU connection is already open or if any other I/O error occurs

removeSmartCardReaderListener(SmartCardReaderListener)

```
public void removeSmartCardReaderListener(org.dvb.smartcard.SmartCardReaderListener
            listener)
```

Removes specified listener: the notifications about changes in the status of the smart card reader will no longer be forwarded to the given listener.

Parameters:
`listener` - the SmartCardReaderListener that was receiving the notifications.

org.dvb.smartcard
SmartCardReaderEvent

Declaration

```
public class SmartCardReaderEvent extends java.util.EventObject

java.lang.Object
  |
  +--java.util.EventObject
        |
        +--org.dvb.smartcard.SmartCardReaderEvent
```

All Implemented Interfaces:

java.io.Serializable

Description

Represents an event generated by a change in the status of a smart card reader. All available constants are defined within this class.

Since:

MHP 1.1.3

Fields

SMART_CARD_ERROR

```
public static final int SMART_CARD_ERROR
```

Smart card is inserted into the reader, there is electrical communication with the smart card but no ATR is retrieved.

SMART_CARD_IN

```
public static final int SMART_CARD_IN
```

A smart card is inserted into the reader and an ATR is correctly retrieved. This means the insertion contact is active and the reader is also able to communicate with the smart card.

SMART_CARD_MUTED

```
public static final int SMART_CARD_MUTED
```

Smart card is inserted into the reader but no ATR is retrieved because no electrical communication is established with the smart card.

SMART_CARD_OUT

```
public static final int SMART_CARD_OUT
```

Nothing is inserted into the reader, meaning the insertion contact is disabled.

Constructors

SmartCardReaderEvent(Object, int)

```
public SmartCardReaderEvent(java.lang.Object source, int type)
```

Constructor for a smart card reader event notifying the slot has identified a change in its status.

Parameters:

`source` - Object the `SmartCardReader` who is generating the event

`type` - int the event type

Methods

---

getType()

```
public int getType()
```

Retrieves the type of `SmartCardReaderEvent` that has been fired. It can be either `SMART_CARD_IN`, `SMART_CARD_OUT`, `SMART_CARD_MUTED` or `SMART_CARD_ERROR`.

Returns:

int type of event

org.dvb.smartcard
SmartCardReaderListener

Declaration
```
public interface SmartCardReaderListener
```

Description
The listener interface to receive smart card reader status changes.

Since:
MHP 1.1.3

Methods

---

smartCardReaderEventReceived(SmartCardReaderEvent)

```
public void smartCardReaderEventReceived(org.dvb.smartcard.SmartCardReaderEvent event)
```

Called by the terminal when a change in the status of the smart card reader is notified.

Parameters:

`event` - SmartCardReaderEvent the event that was fired

org.dvb.smartcard
SmartCardReaderManager

Declaration

```
public final class SmartCardReaderManager

java.lang.Object
  |
  +--org.dvb.smartcard.SmartCardReaderManager
```

Description

The smart card reader manager allow user to know the status of any slot available on the terminal. The manager can dispatch the change of status in any reader to applications that registered themselves for monitoring it or can synchronously return the current status of the reader. The SmartCardReaderManager is a singleton.

Since:

MHP 1.1.3

Constructors

SmartCardReaderManager()

```
protected SmartCardReaderManager()
```

This constructor is provided for the use of implementations and specifications which extend this specification. Applications shall not define sub-classes of this class. Implementations are not required to behave correctly if any such application defined sub-classes are used.

Methods

---

getInstance()

```
public static org.dvb.smartcard.SmartCardReaderManager getInstance()
```

Used to get the unique istance of the smart card reader manager.

Returns:

SmartCardReaderManager the manager singleton instance

---

getNumber()

```
public int getNumber()
```

Retrieves the number of smart card readers provided on the terminal.

Returns:

int number of card readers

getSmartCardReaders()

```
public org.dvb.smartcard.SmartCardReader[] getSmartCardReaders()
```

Allows application to retrieve an array including all the smart card readers provided on the terminal. In case no readers are provided, an array with length zero is returned.

Returns:

SmartCardReader[] array of smart card readers

Annex AN (normative): Provider APIs

Package
org.dvb.spi

Description

This package defines a central registry for all DVB Service Provider Interface (SPI) providers. This encourages a consistent architecture for such providers. Additionally, it gives some support for debugging. For example, a list of installed providers might be useful in a crash log.

In normal operation, xlets using a provider never get a direct reference to that provider. Rather, xlets interact with the terminal through standardized APIs, such as Java TV. The service underlying those underlying APIs can be:

- An integrated part of the implementation, or
- interoperable downloaded code, either in the form of an xlet-bound or a system-bound provider.

NOTE: The Java platform class `java.security.Provider` is unrelated to the providers defined in this package and its subpackages. Additionally, `java.security.Provider` in the Java platform is typically associated with a completely different lifecycle model.

Class Summary	
Interfaces	
`Provider`	Abstract interface for all DVB providers.
`SystemBoundProvider`	Interface for providers that are registered from one Xlet, but provide system-wide services.
`XletBoundProvider`	Interface for all Xlet-bound providers.
Classes	
`ProviderPermission`	This class is for applications which wish to be able to install providers.
`ProviderRegistry`	Registry of providers.
Exceptions	
`ProviderFailedInstal-lationException`	Thrown when there is a problem installing a provider.

org.dvb.spi
Provider

Declaration
```
public interface Provider
```

All Known Subinterfaces:
org.dvb.security.provider.CryptographicServiceProviderProvider, org.dvb.spi.selection.SelectionProvider, SystemBoundProvider, XletBoundProvider

Description
Abstract interface for all DVB providers.

Since:
MHP 1.1.3

Methods

---

getName()

```
public java.lang.String getName()
```

Returns the name of this provider. This can be used for debugging purposes, e.g. in a crash log. The name shall be encoded as defined for the permission request file in the main body of the present document. For example “0x0000000B.EMV_PK11.VISA_REVOLVER”.

Returns:
the name

---

getServiceProviderInterfaces()

```
public java.lang.Class[] getServiceProviderInterfaces()
```

Gives a list of the SPI’s implemented by this provider. The list shall be at least one element long, and shall contain only valid SPI interfaces defined by the terminal specification. Unknown interfaces (e.g. application-defined interfaces) shall be rejected, as documented in ProviderRegistry.

Returns:
a list of SPIs

See Also:
ProviderRegistry.registerXletBound(XletBoundProvider), ProviderRegistry.registerSystemBound(SystemBoundProvider)

---

getVersion()

```
public java.lang.String getVersion()
```

Return the version of this provider. The format of this string is not specified.

Returns:
the version of this provider.

providerRegistered()

```
public void providerRegistered()
```

Called by the system when this provider is registered.

providerUnregistered()

```
public void providerUnregistered()
```

Called by the system when this provider is unregistered.

org.dvb.spi
ProviderFailedInstallationException

Declaration

```
public class ProviderFailedInstallationException extends java.lang.Exception
```

```
java.lang.Object
  |
  +--java.lang.Throwable
        |
        +--java.lang.Exception
              |
              +--org.dvb.spi.ProviderFailedInstallationException
```

All Implemented Interfaces:

java.io.Serializable

Description

Thrown when there is a problem installing a provider.

Since:

MHP 1.1.3

See Also:

ProviderRegistry.registerSystemBound(SystemBoundProvider),
ProviderRegistry.registerXletBound(XletBoundProvider)

Constructors

ProviderFailedInstallationException()

```
public ProviderFailedInstallationException()
```

Constructs an exception with no reason.

ProviderFailedInstallationException(String)

```
public ProviderFailedInstallationException(java.lang.String s)
```

Constructs an exception with a reason.

Parameters:

s - the reason why the exception was thrown

org.dvb.spi
ProviderPermission

Declaration

```
public class ProviderPermission extends java.security.BasicPermission
```

```
java.lang.Object
  |
  +--java.security.Permission
        |
        +--java.security.BasicPermission
              |
              +--org.dvb.spi.ProviderPermission
```

All Implemented Interfaces:

`java.security.Guard`, `java.io.Serializable`

Description

This class is for applications which wish to be able to install providers. A ProviderPermission contains a name and an action string.

The permission name shall be either the fully qualified class name of the provider class to be installed or "*" meaning any provider. Applications may have multiple instances of this permission in order to be able to install more than one but not all providers.

The actions list shall either be "xlet" or "system". "xlet" means the right to install the provider as an xlet bound provider and "system" as a system bound provider. No checking shall be performed on whether the specified class name is consistent with the action.

Since:

MHP 1.1.3

Constructors

ProviderPermission(String)

```
public ProviderPermission(java.lang.String name)
```

Creates a new ProviderPermission with the specified name. The name is the symbolic name of the ProviderPermission.

Parameters:

`name` - the name of the ProviderPermission or "*"

ProviderPermission(String, String)

```
public ProviderPermission(java.lang.String name, java.lang.String actions)
```

Creates a new ProviderPermission object with the specified name. The name is the symbolic name of the ProviderPermission. The actions string should be either "xlet" or "system". This constructor exists for use by the Policy object to instantiate new Permission objects.

Parameters:

`name` - the name of the ProviderPermission or "*"

`actions` - the requested actions

org.dvb.spi
ProviderRegistry

Declaration

```
public class ProviderRegistry

java.lang.Object
  |
  +--org.dvb.spi.ProviderRegistry
```

Description

Registry of providers.

Since:

MHP 1.1.3

Constructors

ProviderRegistry()

```
protected ProviderRegistry()
```

This constructor is provided for use by implementations and by other specifications that extend this class. It is not to be used by normal applications.

Methods

---

getInstalledProviders()

```
public java.lang.String[] getInstalledProviders()
```

Return the names of all installed providers. These are the names returned by the getName methods on those Providers. Provider names shall be encoded as defined for permission request file in the main body of the present document. For example “0x0000000B.EMV_PK11.VISA_REVOLVER”.

Returns:

the names of all installed providers

See Also:

Provider.getName()

---

getInstance()

```
public static org.dvb.spi.ProviderRegistry getInstance()
```

Return the singleton provider registry as seen by the calling application.

Returns:

the provider registry

getProviderVersion(String)

```
public java.lang.String getProviderVersion(java.lang.String provider)
```

Return the version of an installed provider.

Parameters:
`provider` - the name of a provider as returned by the method getInstalledProviders

Returns:
the version of the specified provider

Throws:
`java.lang.IllegalArgumentException` - if the provider name is not one of those installed, i.e. is not one returned from a call to getInstalledProviders

See Also:
`Provider.getVersion()`

registerSystemBound(SystemBoundProvider)

```
public void registerSystemBound(org.dvb.spi.SystemBoundProvider p)
            throws ProviderFailedInstallationException
```

Registers a provider. Note that providers might be installed “automatically” by the terminal, e.g. due to signalling.

Parameters:
`p` - the provider to register

Throws:
`java.lang.IllegalArgumentException` - if Provider does not expoort a valid set of services as determined by Provider.getServiceProviderInterfaces()

`ProviderFailedInstallationException` - if the organisation_id in the name of the provider does not match the organisation_id in a certificate which can authenticate the provider class.

`java.lang.SecurityException` - if the caller, for all of the SPIs implemented by the provider, does not have a ProviderPermission whose name is the fully qualified name of the class returned by Provider getServiceProviderInterfaces and whose action is “system”.

See Also:
`Provider.getServiceProviderInterfaces()`

registerXletBound(XletBoundProvider)

```
public void registerXletBound(org.dvb.spi.XletBoundProvider p)
            throws ProviderFailedInstallationException
```

Registers a provider. Note that providers might be installed “automatically” by the terminal, e.g. due to signalling.

Parameters:
`p` - the provider to register

Throws:
`java.lang.IllegalArgumentException` - if Provider does not export a valid set of services as determined by Provider.getServiceProviderInterfaces(), or if the provider does not have have a non-null Xlet context.

`ProviderFailedInstallationException` - if the organisation_id in the name of the provider does not match the organisation_id in a certificate which can authenticate the provider class.

`java.lang.SecurityException` - if the caller, for all of the SPIs implemented by the provider, does not have a ProviderPermission whose name is the fully qualified name of the class returned by Provider getServiceProviderInterfaces and whose action is “xlet”.

See Also:

`Provider.getServiceProviderInterfaces()`,
`XletBoundProvider.getBoundXletContext()`,
`XletBoundProvider.getBoundPBPXletContext()`

---

unregister(Provider)

```
public void unregister(org.dvb.spi.Provider p)
```

Unregister a provider. Xlets that “manually” register a provider using one of the register methods of this class shall unregister that provider before returning from a successful destroyXlet call.

Parameters:

`p` - the provider to unregister

See Also:

`javax.tv.xlet.Xlet.destroyXlet(boolean)`

org.dvb.spi
SystemBoundProvider

Declaration
```
public interface SystemBoundProvider extends Provider
```

All Superinterfaces:
Provider

All Known Subinterfaces:
org.dvb.spi.selection.SelectionProvider

Description
Interface for providers that are registered from one Xlet, but provide system-wide services. Such providers shall be used by the system in such a way that there is no sharing of mutable object instances between the xlet that installs the provider, and any xlet that uses the services.

Since:
MHP 1.1.3

See Also:
XletBoundProvider

org.dvb.spi
XletBoundProvider

Declaration
```
public interface XletBoundProvider extends Provider
```

All Superinterfaces:
Provider

All Known Subinterfaces:
org.dvb.security.provider.CryptographicServiceProviderProvider

Description
Interface for all Xlet-bound providers. An instance of an Xlet-bound provider provides its services for exactly one xlet: The xlet with which that provider is registered. The classes of the provider are in the classloader hierarchy of the xlet itself. This leads to a very simple mechanism, because there are no issues with instance sharing between the provider and the xlet that uses the provider. However, it has the disadvantage that every xlet that needs the services provided must carry its own copy of the provider.

Since:
MHP 1.1.3

See Also:
SystemBoundProvider

Methods

---

getBoundPBPXletContext()

```
public javax.microedition.xlet.XletContext getBoundPBPXletContext()
```

A valid provider shall return a non-null value from at least one of the get...XletContext methods.

Returns:
the xlet context of the xlet to which the provider is bound

---

getBoundXletContext()

```
public javax.tv.xlet.XletContext getBoundXletContext()
```

A valid provider shall return a non-null value from at least one of the get...XletContext methods.

Returns:
the xlet context of the xlet to which the provider is bound

Package
org.dvb.spi.selection

Description

This package defines an SPI for selection of services and service components. The providers defined in this package allow the presentation of services whose location is not announced using standard signalling. One a SelectionProvider has been installed, the standard MHP APIs, such as the JavaTV service selection API, can be used to present those services.

Examples of API usage

Switched Digital

The following table shows the sequence of API calls involved in a service selection operation, both API calls between an application and the implementation and between the implementation and a SelectionProvider.

The table covers both the case when the service location is known and when the location is unknown. The first column indicates if the step applies when the service location is unknown. The second column indicates whether the step applies when the service location is known. Most steps either apply in both cases at the same point in the sequence or only apply when the service location is unknown. Two steps apply in both cases but at different points in the sequence.

Unknown Service Location	*Known Service Location*	*Step*	*API call by application*	*API call to/from provider*
Y	Y	Provider is installed	`ProviderRegistry.registerSystemBound`	`Provider.providerRegistered`
Y	Y	Provider is initialised	None	`SelectionProvider.init`
Y	Y	Implementation asks provider for supported services	None	`SelectionProvider.getServiceList()`
Y	Y	Each supported service is merged into the service list of the receiver	None	Methods on each ServiceReference returned from `SelectionProvider.getServiceList()`
N	Y	Extract tuning information for service	None	For MHP, `org.dvb.locator.FrequencyLocator.getDeliverySystemDescriptor()`
Some time later				
Y	Y	Application obtains service object corresponding to locator of service	SIManager.getService(LocatorFactory.createLocator(“dvb://’movie-channel-1.broadcaster-b.com’”)	None

Y	Y	Application asks for service to be presented	Service-Context.select(Service)	None
Y	N	Create session for the presentation of the requested service.	None	1) new ServiceReference(..) 2) SelectionProvider.newSession
Y	N	Implementation asks provider to present channel.	None	SelectionSession.select
Y	N	Provider asks head-end for channel	None	Existing java.net APIs
Y	N	Head-end returns reference to channel location	None	Existing java.net APIs
Y	N	Provider passes on reference to channel location to implementation	None	1a) For MHP, new FrequencyLocator(...) 1b) For OCAP, new OCAPLocator(int frequency, int programNumber,int modulationFormat, ...) 2) Return from call to SelectionSession.select()
Y	N	Extract tuning information for service	None	For MHP, org.dvb.locator.FrequencyLocator.getDeliverySystemDescriptor()
Y	Y	Implementation tunes to appropriate frequency etc	None	None
N	Y	Create session for the presentation of the requested service.	None	1) new ServiceReference(..) 2) SelectionProvider.newSession
Y	N	Inform provider that implementation is ready to receive content	None	SelectionSession.selectionReady
Y	N	Provider tells server to send content	Provider sends message to switched digital server	Existing java.net APIs
Y	Y	Content arrives	1) new NormalContentEvent 2) Service-Context-Listener.receiveServiceContext-Event(..)	None
Some time later				

Y	Y	Content stops being presented (change to new channel, ...)	Either none or Service-Context.select() with a different service.	SelectionSession.destroy
Y	Y	Content may stop being deliv-ered	Provider may tell head-end that this content is no longer needed if the head-end is counting the number of users of the content	Existing java.net APIs

Class Summary

Interfaces

SelectionProvider	A provider of service selection.
SelectionProviderCon-text	Platform implementations that wish to receive notifications from a SelectionProvider register an instance that implements this interface with the SelectionProvider.
SelectionSession	A session for presentation of one or more services over a period of time by a SelectionProvider.
ServiceDescription	Represents the description of a service.

Classes

KnownServiceReference	A reference to a service that is reached with the mediation of a Selection-Provider.
LocatorScheme	This class is used to represent a locator scheme that is supported by a SelectionProvider.
ServiceReference	A reference to a service that is reached with the mediation of a Selection-Provider.

org.dvb.spi.selection
KnownServiceReference

Declaration

```
public class KnownServiceReference extends ServiceReference

java.lang.Object
  |
  +--org.dvb.spi.selection.ServiceReference
        |
        +--org.dvb.spi.selection.KnownServiceReference
```

Description

A reference to a service that is reached with the mediation of a SelectionProvider. This class represents services whose location is already known to the provider without needing to ask a server or head-end.

Since:

MHP 1.1.3

See Also:

SelectionProvider

Constructors

KnownServiceReference(String, String, Locator)

```
public KnownServiceReference(java.lang.String transportIndependent,
            java.lang.String transportDependent, javax.tv.locator.Locator actualLocation)
```

Create a ServiceReference for the given service identified by the combination of a transport independent and transport dependent identifiers.

Parameters:

`transportIndependent` - The transport-independent locator of the service.

`transportDependent` - The transport-dependent locator of the service.

`actualLocation` - The actual location of the service.

Methods

---

getActualLocation()

```
public javax.tv.locator.Locator getActualLocation()
```

Return the actualLocation as provided when this ServiceReference was constructed.

Returns:

a Locator

---

getLocator()

```
public javax.tv.locator.Locator getLocator()
```

Gives the transport-dependent locator that will be used to represent this service through the Java TV APIs, both in this xlet and in others.

Overrides:
getLocator in class ServiceReference

---

getServiceIdentifier()

```
public java.lang.String getServiceIdentifier()
```

Description copied from class: org.dvb.spi.selection.ServiceReference

Return the transport independent locator of the service

Overrides:
getServiceIdentifier in class ServiceReference

Returns:
the serviceIdentifier string passed into the constructor.

org.dvb.spi.selection
LocatorScheme

Declaration

```
public class LocatorScheme

java.lang.Object
   |
   +--org.dvb.spi.selection.LocatorScheme
```

Description

This class is used to represent a locator scheme that is supported by a SelectionProvider.

Since:

MHP 1.1.3

Constructors

LocatorScheme(String, boolean)

```
public LocatorScheme(java.lang.String scheme, boolean providerFirst)
```

Construct a LocatorScheme.

Parameters:

`scheme` - the name of the locator scheme which is handled, not including the ":" character

`providerFirst` - true if this provider shall handle the scheme before any handler in the platform implementation, false if this provider shall handle the scheme after any handler in the platform implementation and only for locators not handled by the platform implementation.

Methods

---

getProviderFirst()

```
public boolean getProviderFirst()
```

Returns whether the provider is to handle the scheme before any platform handler for the scheme.

Returns:

true if this provider shall handle the scheme before any handler in the platform implementation, false if this provider shall handle the scheme after any handler in the platform implementation and only for locators not handled by the platform implementation.

---

getScheme()

```
public java.lang.String getScheme()
```

Returns the scheme.

Returns:

scheme the name of the locator scheme which is handled, not including the ":" character

org.dvb.spi.selection
SelectionProvider

Declaration

```
public interface SelectionProvider extends org.dvb.spi.SystemBoundProvider
```

All Superinterfaces:

org.dvb.spi.Provider, org.dvb.spi.SystemBoundProvider

Description

A provider of service selection. For example, a SelectionProvider can be installed in an always-running service-unbound xlet to provide the ability to reach services that do not have standarized SI signalling in an IPTV network.

The process for determining which Provider (if any) shall be used to present a transport independent service is defined by the following steps in the order given.

1) Consult the service list. If the service appears in the service list then make an selection between the available sources of that Service as defined by ServiceContext.select(Service).

2) If there one Provider registered to support the locator scheme of the locator for the Service, ask that Provider to present that service. The service selection operation shall fail if the provider cannot present it.

3) If more than one Provider has registed as supporting the locator scheme of the locator for the Service, offer the Service to each Provider in turn until either one of them does not fail or no more Providers are available in which case the service selection operation shall fail.

NOTE: If the performance penalty of polling multiple Providers for the same locator scheme is undesirable, service providers / operators using multiple Providers should ensure they use different Locator schemes.

Providers should select the transport dependent locators returned such that there is no collision the transport dependent locators returned by other Providers that may offer the same transport independent service. Where an MHP terminal is managed by a service provider / operator, the service provider / operator should enforce this if they permit more than one Provider to be installed.

Where there is a collision and a transport dependent locator can be accessed by more than one Provider, the selection of which to use is implementation dependent.

A SelectionProvider may inform the implementation of the actual location of a service by two mechanisms.

- For services which are already present in the network, the actual location can be passed in ServiceReference objects. These can be provided by the getServiceList method when a provider is first installed and later by the SelectionProviderContext. For these services, the implementation shall use this actual location to present the service without calling the select method. A session shall be created using the ServiceReference used to present the service in order that the provider can be notified when the service is no longer used. The session instance should be created once the platform has started finding the service (e.g. during tuning or after sending an IGMP join request) in order to avoid delaying the presentation of the service.
- For services whose actual location is not passed in a ServiceReference (e.g. services not already present in the network), the implementation shall use the select method to obtain the actual location.

The mechanism by which the actual location of a service is determined may change dynamically, e.g. as the set of services available in the network changes.

Since:

MHP 1.1.3

See Also:

org.dvb.spi.Provider.getServiceProviderInterfaces()

Methods

getServiceDescriptions(ServiceReference[])

```
public org.dvb.spi.selection.ServiceDescription[]
            getServiceDescriptions(org.dvb.spi.selection.ServiceReference[] services)
```

Called by the terminal to request service description information from an SI source. The output shall be returned in an array of the same size and order as the input. If information is not available on any service listed in the input then the corresponding entry in the results array shall be null.

Parameters:
`services` - References identifying the services whose descriptions are requested

Returns:
an array of service descriptions

getServiceList()

```
public org.dvb.spi.selection.ServiceReference[] getServiceList()
```

Give a list of the services provided by this provider. The services returned from this method shall be merged into the platform service list as returned by javax.tv.service.SIManager.filterServices (null). Where the transport independent identification of a service is equal to one already in the service list then that transport independent service shall acquire an additional transport dependent service. Where the transport independent identification of a service is not equal to one already in the service list, a new service shall be added to the service list and SIChangeEvents generated to appropriate listeners.

The list of services returned shall include both those where the actual location is returned in the ServiceReference and those where the actual location is to be returned from a later call to the select method.

Returns:
a list of ServiceReference instances.

See Also:
`SelectionProviderContext.serviceListChanged(ServiceReference[])`

getSupportedLocatorSchemes()

```
public org.dvb.spi.selection.LocatorScheme[] getSupportedLocatorSchemes()
```

Returns the list of locator schemes handled by this provider. This list should not change over time; it is expected that platforms will usually call this method exactly once, after installation of a provider. There is no method to unregister a scheme other than unregistering the provider.

init(SelectionProviderContext)

```
public void init(org.dvb.spi.selection.SelectionProviderContext c)
```

Called by the platform to register its handler for events originating in the provider. This method shall be called after providerRegistered and before any other methods on the provider are called. Only one handler can be registered at any one time.

Parameters:
`c` - the handler

newSession(ServiceReference)

```
public org.dvb.spi.selection.SelectionSession
            newSession(org.dvb.spi.selection.ServiceReference service)
```

Called by the platform to create a session to manage the presentation of a service. A new session shall be created for each service to be presented by a provider.

Parameters:

`service` - the service whose presentation is managed through this session

Returns:

a session

org.dvb.spi.selection
SelectionProviderContext

Declaration
```
public interface SelectionProviderContext
```

Description
Platform implementations that wish to receive notifications from a `SelectionProvider` register an instance that implements this interface with the `SelectionProvider`.

Since:
MHP 1.1.3

Methods

---

serviceDescriptionAvailable(ServiceReference[])

```
public void serviceDescriptionAvailable(org.dvb.spi.selection.ServiceReference[]
            serviceReferences)
```

Called by a source when service description information is available to offer that information to the platform implementation. The new list replaces any previous list.

Parameters:

`serviceReferences` - The ServiceReference instances for which descriptions are available. This array must not change after this method is invoked.

---

serviceListChanged(ServiceReference[])

```
public void serviceListChanged(org.dvb.spi.selection.ServiceReference[] serviceReferences)
```

Called by a source when the list of services changes. The new list replaces any previous list.

The services passed into this method shall be compared with the service list returned from the call to getServiceList when this provider was first registered. Where services are added, these shall be merged into the platform service list as defined in the description of the getServiceList method. Where services are removed, if the transport independent service is left with no transport dependent services then it shall be removed from the platform service list. In all cases where the platform service list changes, SIChangeEvents shall be generated to appropriate listeners.

Parameters:

`serviceReferences` - The ServiceReference instances for the available services. This array must not change after this method is invoked.

---

updateService(ServiceReference)

```
public void updateService(org.dvb.spi.selection.ServiceReference service)
```

Called by a source to update the details of a service it supports. This includes changing the service between one whose location is already known and one whose location must be found when it is selected. It also includes changing the location of a service whose location is already known. ServiceReferences shall be matched using the transport independent and transport dependent names.

Parameters:

`service` - the new service reference

Throws:

`java.lang.IllegalArgumentException` - if a service with the same service identifier and transport independent locator has not been previously returned by this source to the implementation

org.dvb.spi.selection
SelectionSession

Declaration
```
public interface SelectionSession
```

Description
A session for presentation of one or more services over a period of time by a SelectionProvider. The first operation on a new session will always be selection of a service in a service context, and all subsequent operations will pertain to the same service context.

Since:
MHP 1.1.3

Methods

---

destroy()

```
public void destroy()
```

Called by the platform when the service bound to this session is no longer being used by the implementation. The selection provider should do any needed clean-up here, e.g. informing a server that the service is not needed any more. Once destroy is called, the terminal implementation discards the SelectionSession.

---

select()

```
public org.davic.net.Locator select()
```

Sets up delivery of a stream representing the service, and delivers a locator for reception of that stream. For example, either a unicast locator or a frequency locator might be returned, under the apprlpriate circumstances.

Returns:
a locator for where the stream can be found

---

selectionReady()

```
public void selectionReady()
```

Called when the implementation is ready to receive content on the locator returned by the select method. When using unicast protocols where the content must only be sent when the MHP terminal is ready, it is now safe to request the content be sent.

A SelectionSession might be destroyed after a select, but before this method is called. In this case, this method may not be called. Applications should therefore not expect this method to be called after destroy() is called on this session.

See Also:
destroy()

---

setPosition(long)

```
public long setPosition(long position)
```

Set the position within the media. If this session does not support trick modes, this method returns -1 and has no effect.

Parameters:

`position` - The position within the program, in milliseconds

Returns:

The new position, or -1 if position setting isn't supported.

---

setRate(float)

```
public float setRate(float newRate)
```

Sets the speed of playback. If this session does not support trick modes, this method returns 1 and has no effect. Calling this method with the value 1.0f shall always succeed, and shall result in a return value of 1.0f.

Parameters:

`newRate` - New playback rate. Implementations shall make a best effort to approximate this rate.

Returns:

The new rate, if known. If not known, the value java.lang.Float.NEGATIVE_INFINITY is returned.

org.dvb.spi.selection
ServiceDescription

Declaration
```
public interface ServiceDescription
```

Description
Represents the description of a service.

Since:
MHP 1.1.3

Methods

---

getDeliverySystemType()

```
public javax.tv.service.navigation.DeliverySystemType getDeliverySystemType()
```

Return the type of the delivery system.

Returns:
the type of the delivery system by which this service is delivered

Throws:
`java.lang.IllegalArgumentException` - if the returned ServiceType is not from a class loaded by the system classloader.

---

getLongName(String)

```
public org.dvb.spi.util.MultilingualString getLongName(java.lang.String perferredLanguage)
```

Return the long name of this service.

Returns:
the name

---

getServiceType()

```
public javax.tv.service.ServiceType getServiceType()
```

Return the type of this service. The service type returned shall be from a class loaded by the system classloader.

Returns:
the service type of this service

Throws:
`java.lang.IllegalArgumentException` - if the returned ServiceType is not from a class loaded by the system classloader.

org.dvb.spi.selection
ServiceReference

Declaration

```
public class ServiceReference

java.lang.Object
  |
  +--org.dvb.spi.selection.ServiceReference
```

Direct Known Subclasses:

KnownServiceReference

Description

A reference to a service that is reached with the mediation of a SelectionProvider.

Since:

MHP 1.1.3

See Also:

SelectionProvider

Constructors

ServiceReference(String, String)

```
public ServiceReference(java.lang.String transportIndependent,
            java.lang.String transportDependent)
```

Create a ServiceReference for a service. The two strings shall both be the external form of Locators, for example a transport independent “dvb:” locator string and provider specific locator string.

Parameters:

`transportIndependent` - The transport-independent locator of the service.

`transportDependent` - The transport-dependent locator of the service.

Methods

---

getLocator()

```
public javax.tv.locator.Locator getLocator()
```

Gives the transport-dependent locator of the service

Returns:

the trasnport dependent string passed into the constructor

getServiceIdentifier()

```
public java.lang.String getServiceIdentifier()
```

Return the transport independent locator of the service

Returns:
the transportIndependent string passed into the constructor.

Package
org.dvb.spi.util

Description
Utility classes used by other providers.

Class Summary	
Classes	
MultilingualString	A string that has an associated language code.

org.dvb.spi.util
MultilingualString

Declaration

```
public final class MultilingualString

java.lang.Object
  |
  +--org.dvb.spi.util.MultilingualString
```

Description

A string that has an associated language code.

Since:

MHP 1.1.3

Constructors

MultilingualString(String, String)

```
public MultilingualString(java.lang.String s, java.lang.String languageCode)
```

Initialize a new MultilingualString.

Parameters:

`s` - The string that is in the given language.

`languageCode` - The language code encoded as per ISO 639.2.

Methods

---

getLanguageCode()

```
public java.lang.String getLanguageCode()
```

Return the language code.

Returns:

The language code encoded as per ISO 639.2.

---

getString()

```
public java.lang.String getString()
```

Return the string.

Returns:

The string that is in the given language.

---

toString()

```
public java.lang.String toString()
```

Return a string representation of this object

Overrides:
`toString` in class `Object`

Returns:
a string

Index

Symbols

Numer-

History

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V1.1.1	November 2001	Publication
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