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Digital Video Broadcasting (DVB);
Companion Screens and Streams;
Part 1: Concepts, roles and overall architecture

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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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Founded in September 1993, the DVB Project is a market-led consortium of public and private sector organizations in the television industry. Its aim is to establish the framework for the introduction of MPEG-2 based digital television services. Now comprising over 200 organizations from more than 25 countries around the world, DVB fosters market-led systems, which meet the real needs, and economic circumstances, of the consumer electronics and the broadcast industry.

The present document is part 1 of a multi-part deliverable covering the DVB Companion Screens and Streams Specification, as identified below:

Part 1: "Concepts, roles and overall architecture";

Part 2: "Content Identification and Media Synchronization";

Part 3: "Discovery".

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Introduction

The present document is the first part of a series provides background information to assist in the understanding of subsequent parts.

Personal, smart devices like tablet computers and smart phones enable new user experiences for broadcast service consumption. These experiences are built on a range of functionality that allow for the connection of the experience on the television and that on the companion device. The present document is the first in a series of specifications that can be used separately or together to provide these new user experiences for the full range of DVB provided broadcast services.

The present document describes the key concepts used and the framework within which the other parts of this multi-part deliverable operate and provides an informative descriptive introduction to the interfaces defined in each of the parts. As such it describes various areas:

- the main functional roles
- the architectural frameworks
- the interfaces defined by this multi-part deliverable

The present document, and the framework on which it is based, assumes a network in the home to which devices are connected, that this network is in turn connected to the internet, and that services can be provided from the internet into the home. This allows for the provision of, and use of, services based in the internet that assist the provision of new user experiences.

The subsequent parts of this multi-part deliverable provide the details of the interfaces, and provide the further architectural details relevant to the interfaces they define. However, they all work within the generic framework set out within the present document.

1 Scope

The scope of the present document is to describe the framework and architecture used by subsequent parts of this multi-part deliverable that allow for new user experiences through companion devices to be provided to the full set of DVB services. As such, the present document is abstracted from any one delivery mechanism for a DVB service. Where appropriate, subsequent parts of this multi-part deliverable will define the interaction with a given delivery mechanism for a DVB service.

The purpose of the present document is to provide an understanding of the approach taken to support these new user experiences and the setting within which the interfaces have been designed. This represents non-normative background information which assists in the understanding of the subsequent parts of this multi-part deliverable.

Therefore, the present document describes concepts, functional roles, overall architecture and the main interfaces defined by this multi-part deliverable that support these new user experiences. The present document does not define these interfaces, but informatively describes them, their relationship and their role in the overall architecture.

There are various aspects that are out of scope of this multi-part deliverable. Of most relevance are:

- the mechanisms by which content is delivered, and
- the role of a third-party companion screen application provider.

2 References

2.1 Normative 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.

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The following referenced documents are necessary for the application of the present document.

Not applicable.

2.2 Informative 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.

NOTE: While any hyperlinks included in this clause were valid at the time of publication, ETSI cannot guarantee their long term validity.

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] IETF RFC 5905 (June 2010): "Network Time Protocol Version 4: Protocol and Algorithm Specification", D. Mills, U. Delaware, J. Martin, J.Burbank and W.Kasch.

NOTE: Available at http://www.ietf.org/rfc/rfc5905.txt.

[i.2] ETSI TS 103 286-2: "Digital Video Broadcasting (DVB); Companion Screens and Streams; Part 2: Content Identification and Media Synchronisation".

NOTE: This document is under development. The current draft is available at http://www.dvb.org/resources/public/standards/a167-2.pdf.

[i.3] ETSI TS 103 286-3: "Digital Video Broadcasting (DVB); Companion Screens and Streams; Part 3: Discovery".

NOTE: This document is under development. The current draft is available at http://www.dvb.org/resources/public/standards/a167-3.pdf.

[i.4] IETF RFC 6455 (December 2011): "The WebSocket Protocol", I. Fette, A. Melnikov.

NOTE: Available at http://www.ietf.org/rfc/rfc6455.txt.

[i.5] W3C Recommendation 16 January 2014: "Cross-Origin Resource Sharing".

NOTE: Available at http://www.w3.org/TR/cors/.

[i.6] IETF RFC 2616 (June 1999): "Hypertext Transfer Protocol -- HTTP/1.1", R. Fielding, J. Gettys, J. Mogul, H. Frystyk, L. Masinter, P. Leach, T. Berners-Lee.

NOTE: Available at http://www.ietf.org/rfc/rfc2616.txt.

3 Abbreviations

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

CDN	Content Delivery Network
CoD	Content on Demand
CORS	Cross Origin Resource Sharing
CSA	Companion Screen Application
CSS-CII	Interface for Content Identification and other Information
CSS-DA	Interface for Discovery and Association
CSS-LP	Interface for Link Proxy
CSS-MRS	Interface for Material Resolution Service
CSS-TE	Interface for Trigger Events
CSS-TS	Interface for Timeline Synchronization
CSS-WC	Interface for Wall Clock
DASH	Dynamic Adaptive Streaming over HTTP
HTTP	HyperText Transfer Protocol
IP	Internet Protocol
ISOBMFF	ISO Base Media File Format
MPD	Media Presentation Description
MPEG	Multimedia Pictures Expert Group
MRS	Material Resolution Service
MSAS	Media Synchronization Application Server
NTP	Network Time Protocol
SC	Synchronization Client
STB	Set Top Box
TV	Television
URL	Universal Resource Locator
WC	Wall Clock

4 Overview

4.1 General

The various parts that make up this multi-part deliverable provide a complementary set of solutions that can be combined to enable companion devices to support new user experiences for broadcast and Content on Demand (CoD) service consumption. There is no requirement that all parts be implemented as the parts provide a toolbox of solutions, where such parts as are needed are selected. For instance, it is possible that certain environments may already have functionality covered by a certain part, or require a different solution based on certain specific requirements. Such environments may select only some parts from this series. Similarly, certain parts of this multi-part deliverable provide a range of functionality and a given environment may choose to make certain parts optional.

4.2 Background

In the generic architecture used for this multi-part deliverable, the presence of internet connections to all devices is assumed. From this assumption, it follows that services can be provided to devices from the internet, e.g. cloud services, and that these services can be used to augment existing broadcast and CoD services. It is outside the scope of this multi-part deliverable whether these services are provided by the broadcaster or a third party, whether they are implemented as dynamic, scalable cloud services, fixed servers, or even fixed values. Whilst some of the interfaces rely on the presence of a connection to the internet, others only need a connection to the home network to function. Whether an internet connection is used in all cases is outside the scope of this multi-part deliverable.

This multi-part deliverable aims to support many different potential use cases, such as live events, pre-recorded broadcasts, live broadcasts, as well as recorded content and video on demand services. This wide range of use cases requires functionality that is not required in all situations, but is essential for certain situations.

EXAMPLE 1: With video on demand content it is possible to prepare all information in advance and to have that information embedded inside software that provides the extended experience on a companion device. By comparison the live broadcast content will generally not know everything that will happen, or when it will happen, and so functionality is required for live that is not required for video on demand.

Similarly, the details of how content is broadcast will vary from operator to operator. For instance, some operators will have complete control over a single transmission through a single delivery system, whereas others will need to support multiple delivery routes through multiple channels, over some of which they may have little or no control. Hence there are many options. Some of these options represent optimizations, where others provide functionality optimized for certain models of content delivery.

EXAMPLE 2: Consider a content item that is delivered over multiple different delivery routes, some of which may not be under the control of the entity providing the content item. In this case, it is likely that there are multiple different values used in relationship to the content, such as identifiers, timing information or even delivery formats. To enable the provider of the content item to support a single extended experience for all delivery routes, mechanisms are needed that support differing identifying schemes, timing information and formats.

4.3 Document structure

The remainder of the present document covers two areas. The first area is covered in clauses 5 and 6 and it provides the descriptions of key concepts (in clause 5) and the generic architecture (in clause 6). The second area, covered in clause 7 onwards, describes and introduces the functionality provided by each part of this multi-part deliverable.

5 Functional roles, concepts and relationships

5.1 General

This clause describes key concepts used by this multi-part deliverable that are then used in the generic architecture in the following clause 6. Clause 5 is structured as follows:

- Clause 5.2 introduces the concepts that represent intangible components of the architectures.

- Clause 5.3 introduces the main roles within the architecture, and as appropriate the services that they can provide.
- Clause 5.4 introduces the main devices used by the architecture.
- Clause 5.5 shows how these concepts, roles and devices interact.

5.2 Concepts

5.2.1 Content and timed content

A concept repeatedly used above is that of content. Content can refer both to the broadcasts made by an operator, e.g. a television programme transmitted to the audience, as well as extra content that a broadcaster makes available to go with the programme. This extra content may be generic information, such as websites, or it may represent audio or audio-visual enhancements, or interactive content (games, quizzes, etc.). Any of the above content may or may not be timed content; and therefore, it may or may not have one or more timelines describing progression through it. Typically both broadcast content and CoD are timed, whereas extra content may or may not be timed content.

5.2.2 Timelines

A timeline represents a way of describing the progress of presentation of content or a time position in the content, and therefore it enables synchronizing with content. Typically, content will have many timelines, corresponding to different points in its production and eventual delivery.

EXAMPLE: Consider a television show such as Top Gear. During the creation of the show, the editorial planning teams will often plan the show with reference to at least one editorial timeline, and possibly more for certain segments. This timeline can be abstract, but typically has a relationship to the timeline used in the delivery of the master version of the show from the production team to the broadcaster. This master content may then be edited for subsequent broadcast, e.g. to include adverts, meet timing constraints or comply with local laws; this would generate another timeline. Finally this content may be delivered through a number of different routes such as a satellite broadcast, a terrestrial broadcast and via a catch-up service. Each of these different routes may have different timeline values, or different timeline types reflecting the delivery packaging such as transport stream or DASH based ISOBMFF.

It is possible to map between timelines by providing mapping information. This is very useful as extra content can be prepared against one timeline, such as the editorial timeline described in the above example, which is independent from the timeline used in delivering the content to the television. The mapping information is then used to translate from that delivery timeline to the editorial timeline. Similarly, timeline mapping can be used to synchronize two items of timed content by either mapping between their two timelines, or more commonly by mapping both to a common master timeline.

5.2.3 Companion screen application

The companion device is assumed to provide the companion experience via an application that runs on the device. This enhances or extends the content experience delivered by the TV Device. This companion screen application (CSA) can be specific to a given programme or show, or can be more generic covering a channel or series of channels. The concept is that this application makes use of the interfaces provided by the series of specifications to provide enhanced companion experience, but that there is no expectation that the application CSA makes use of any given interface, i.e. the CSA is free to choose what experience it provides and what interfaces it uses to support that experience. The platforms and technologies used to implement the CSA are outside the scope of this multi-part deliverable.

5.3 Roles

5.3.1 Broadcaster

The role of the broadcaster is that of providing content, i.e. supporting a broadcast service. In this context they may not actually broadcast the content (that may be handled by the role of the delivery service provider), and the content may not be broadcast, e.g. it may be provided as CoD. In the model of the present document, the content provided is both the broadcast content and that related to the companion experience, including the CSA itself and any content that the CSA presents. How the user obtains and initiates the companion experience is outside the scope of this multi-part deliverable.

NOTE: CSAs are expected to be provided by the broadcaster, but this is not required. CSAs can be provided by a third party. However, it is likely that some level of interaction with the broadcaster is required to enable the best quality experience through access to the best information.

The role of the broadcaster also encompasses providing services to the CSAs which support the companion experience, i.e. supporting companion services, such as a service for mapping from a delivery timeline to editorial content and its timeline. Through such companion services, the broadcaster may provide additional information about the content or timeline as they see fit.

However, the architecture allows these services to be provided by other roles beyond those of the broadcaster, even though they are shown as part of the broadcasters' role within this clause.

5.3.2 Delivery Service Provider

The role of the delivery service provider is that of conveying the content to the consumer, and covers a very wide range such as Television Service Providers, Internet Service Providers and CDN Service Providers. In many cases the broadcaster will also be the delivery service provider but this is not required. However, for simplicity, it is generally assumed that the delivery service provider is either the broadcaster, or that the relationship between the two allows for a flow of such information as is needed by the specifications. Such a flow of information is outside the scope of this multi-part deliverable.

EXAMPLE: A delivery service provider is usually responsible for allocating identifiers used in the delivery of content, such as DVB event identifiers. The identifiers may be needed elsewhere, so it is assumed that the delivery service provider is able to communicate them to the broadcaster, assuming they need them. Similarly, some content timelines may only be known and created during the transmission of the content and may also need to be similarly communicated. Conversely it is also assumed that identifiers and timelines created by the broadcaster at the time of content creation could be communicated to the Delivery Service Provider for them to use for transmission as necessary.

It is very possible that, in some cases, there will be multiple delivery service providers that are working with a given broadcaster. It is also possible that a given delivery service provider will work with many broadcasters. Finally, though not necessarily, it is possible that a delivery service provider may support multiple different delivery methods, e.g. they might support both terrestrial broadcast and a DASH based catch-up service.

The role of delivery service provider is outside the scope of this multi-part deliverable.

5.3.3 Consumer

The final role is that of the consumer who owns the TV Device, as described in clause 5.4.1, that presents the content and owns one or more companion devices such as tablets or smart phones running CSAs that will be part of the enhanced content experience. For convenience, the specifications series is generally written assuming that the consumer owns a single TV device. However, there is no requirement for this to be the case and the present document will work in a consumer's home that has multiple televisions. However, the use of multiple televisions together in a single content experience is outside the scope of this multi-part deliverable. The use of one TV Device and multiple CSAs on multiple companion devices is inside the scope of this multi-part deliverable.

5.4 Devices

5.4.1 TV Device

The TV Device is either a television or a device such as a set-top box (STB) that is connected to a television. It is also assumed that the TV Device represents a "single output" device, i.e. it presents a single item of content at a time. If a single physical device supports multiple outputs (e.g. a multi-output STB), this would be considered multiple logical TV devices.

Within the architecture, it is assumed that the TV device is connected to the home network and receives content using one of the standard DVB delivery formats. However, the architecture and interfaces defined in this multi-part deliverable are intended to be extensible for any content delivery method, DVB or other, in the future.

5.4.2 Companion Device

The companion device is a generic term for a device owned by the consumer such as (but not limited to) a smart phone or a tablet that is used by the consumer whilst consuming content. The companion device is typically connected to the home network, and thence to the internet. The alternative model where the companion device is connected to an alternative network, such as a mobile network, and so to the internet, but not to the home network is considered in the architecture, but not explicitly supported by this multi-part deliverable.

The companion device hosts one or more CSAs as described in clause 5.2.3 above. The distinction between the device and CSA is that the device can host multiple CSAs, and that the device is typically owned by the consumer, whereas the CSAs are typically provided by broadcasters or a third party (including, in some models, the TV Device manufacturer).

5.5 Relationship of concepts, roles and devices

Figure 5.5.1 shows the connections between the concepts, functional roles (and their services) and the devices assumed by this multi-part deliverable, and as described by clauses 5.2 to 5.4.

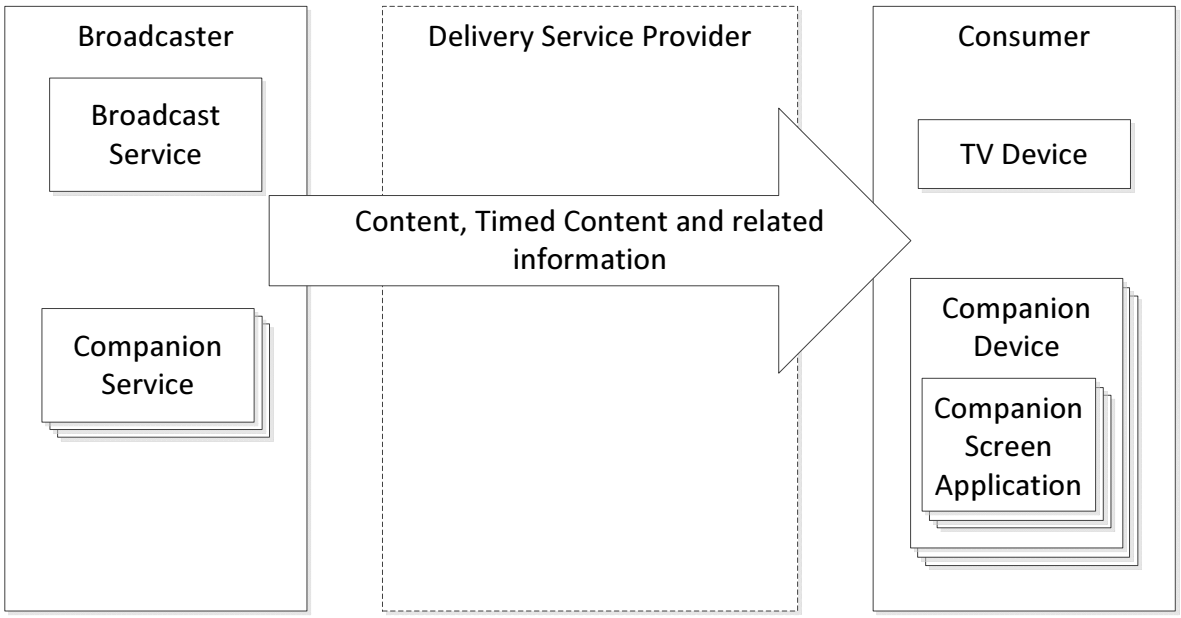

Figure 5.5.1: Relationship of concepts, roles and devices

There is a flow of content, potentially both timed and not timed, from the broadcast service of the broadcaster. This flow is carried by the delivery service provider to the consumer. This flow of information may be augmented by additional information (or metadata) from the companion services that may also be provided by the broadcaster. These additional information flows may well be carried by different delivery service providers, e.g. where companion services are provided over the internet and the timed content is provided by a terrestrial broadcast. Finally, the consumer makes use of these flows: the TV device consumes the timed content and a CSA consumes other content flows (which may also be timed) and the additional information that helps it provide the companion experience.

6 General architecture

6.1 Introduction

The general architectural framework is shown in figure 6.1.1. This illustrates the main components of the architecture and the information flows between them. Each of the parts within this multi-part deliverable works inside this framework. This is done by taking the framework and

- tailoring certain components, or
- adding functional blocks to certain components, combined with
- defining interfaces within one or more of the information flows.

The architecture does not show the roles of the delivery service provider or the consumer or the companion device, but they are implied within the architecture. These roles are referred to in subsequent descriptions and in the other parts of this multi-part deliverable.

This architecture adds a home network and a link proxy to the components shown in figure 5.5.1. The role of the home network is to support communications between the TV device and the companion device and the CSAs that run on the companion device. As it is possible that the companion device, the TV Device, or both, may not be directly connected to the home network, the Link Proxy is introduced as an architectural component to support the case where direct communications between the companion screen applications and the TV device are not possible.

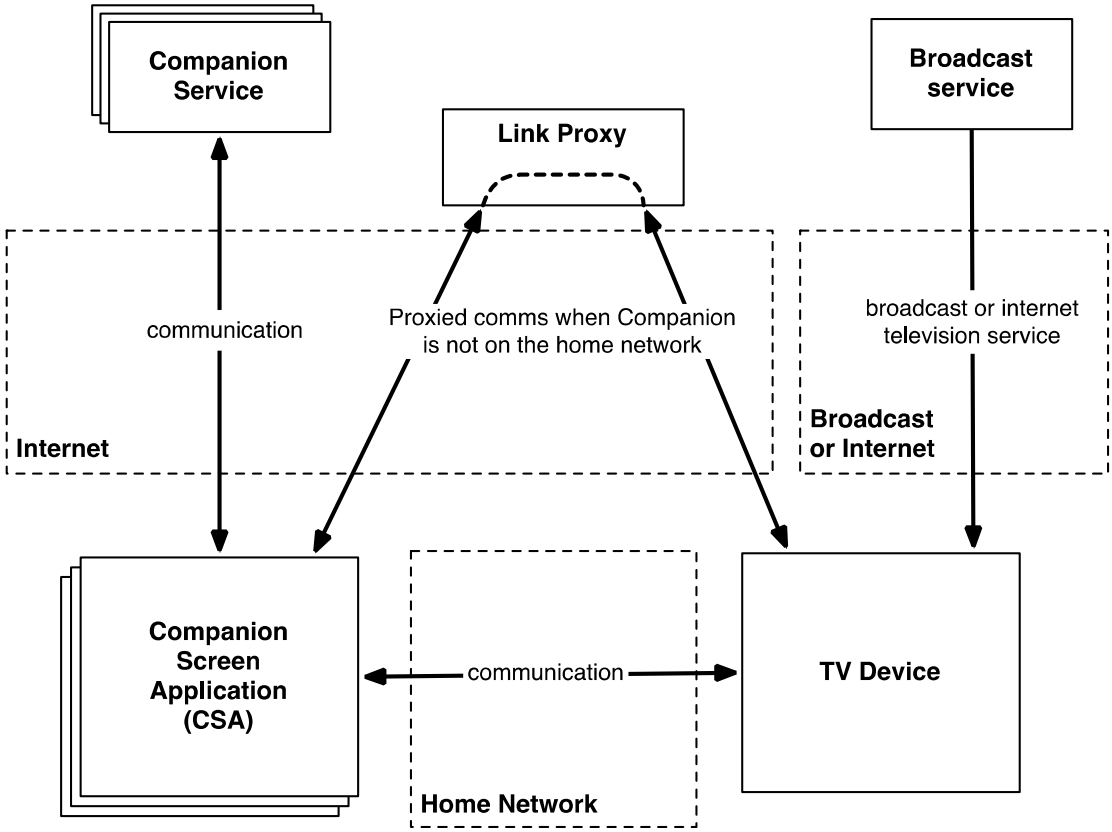

Figure 6.1.1: Data flows for the general architecture

The generic model of operation is that a TV Device is receiving and displaying content, typically from a broadcast, CoD service, the internet, or local storage (in the case of recorded content). The companion screen application communicates with the TV device, either directly across the home network or via the link proxy, and also interacts with one or more companion services. Using the information obtained via these communications, the companion screen application is able to provide the companion experience, possibly making use of additional content provided by the broadcaster or third party through its companion services.

6.2 Companion Services

The interactions between the CSA and the TV device allow the CSA access to certain aspects of information carried by the broadcast or CoD service. This information may not provide enough information or content required to build the companion experience. Thus the purpose of the companion services is to provide any additional metadata or content that the CSA may need, or to provide services that can interpret the information contained within the broadcast.

Typically the companion service is provided by the broadcaster, but this is not required. However, it is likely that for at least some potential functions of the companion services, additional information flows between the broadcaster, the delivery service provider and the companion service are likely. These information flows are outside the scope of this multi-part deliverable.

Companion services are accessed via the internet. The expectation is that they can be deployed equally as cloud services or as specific servers managed and supported directly by a broadcaster or third party; however this multi-part deliverable only defines the interfaces to these services and not how they are implemented.

Currently the only defined Companion Service is the Material Resolution Service described in clause 7.3 and defined in ETSI TS 103 286-2 [i.2]. However, it is likely that additional services will be provided, e.g. to support the delivery of content, that are outside the scope of this multi-part deliverable (though they may well conform to other DVB specifications).

6.3 Link Proxy

The link proxy is the architectural component that supports indirect communications between the TV Device and the companion screen applications, assuming that both are connected to the internet. Although the model shows a single link proxy entity, it is likely that any definition will support a more flexible and complex model for the link proxy. Currently, there is no part that defines or refines this component. For further information, see clause 9.

6.4 Defined Interfaces

Figure 6.4.1 details all the currently defined interfaces within this multi-part deliverable with the abbreviations by which they are known and the typical components they are used between. Also shown in this diagram is the broadcast content or CoD delivered to the TV Device via a broadcast platform or the internet. Whilst this multi-part deliverable makes use of this interface, and in some instances augments the interface, it is not defined by this multi-part deliverable.

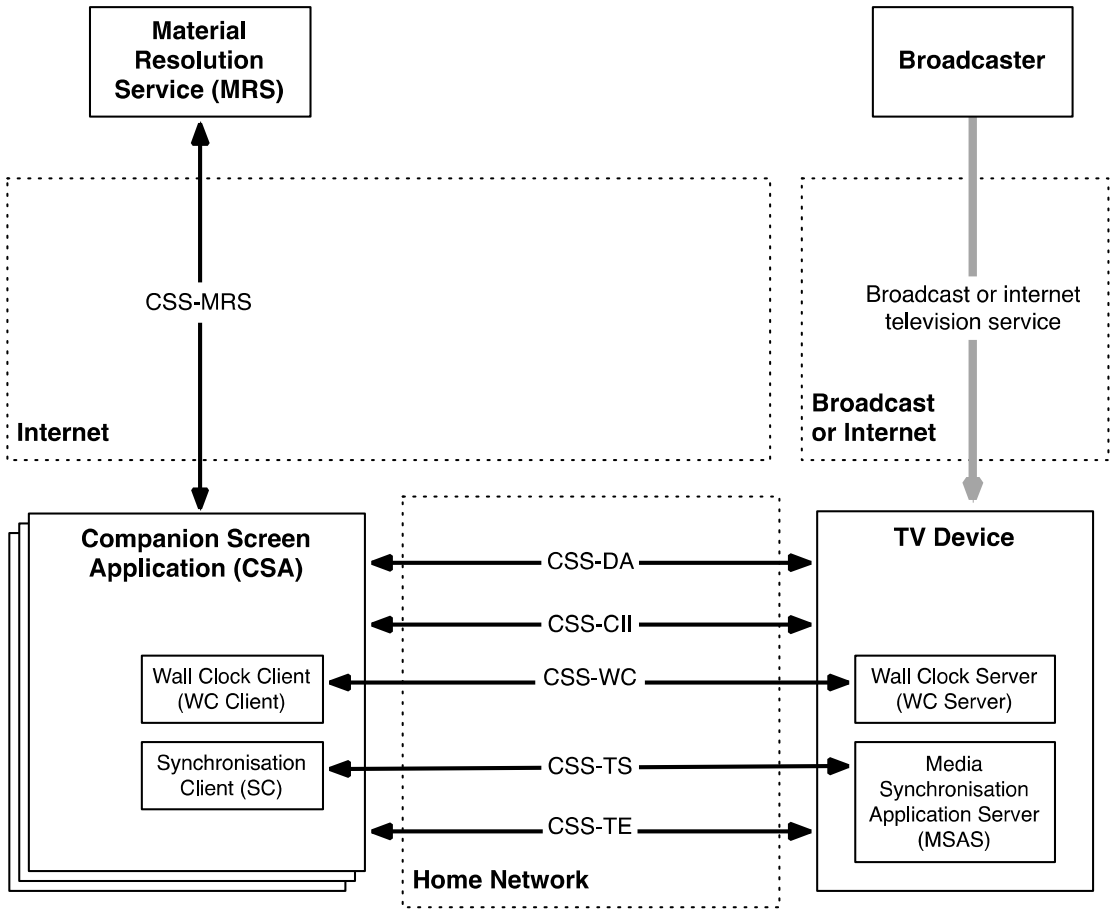

Figure 6.4.1: Interfaces defined

The following interfaces are described in more detail in clause 7 and defined in ETSI TS 103 286-2 [i.2]:

- CSS-CII: Content Identification and other Information is described in clause 7.2.
- CSS-MRS: Material Resolution Service is described in clause 7.3.
- CSS-WC: Wall Clock is described in clause 7.4.
- CSS-TS: Timeline Synchronization is described in clause 7.5.
- CSS-TE: Trigger Event is described in clause 7.6.

The following interface is described in more detail in clause 8 and is defined in ETSI TS 103 286-2 [i.3]:

- CSS-DA: Discovery and Association.

7 Interfaces for Content Identification and Media Synchronization

7.1 General

7.1.1 Overview

Clause 7 describes the specific interfaces that enable a Companion Screen Application (CSA) to synchronize its presentation of Timed Content with the presentation of Timed Content by a TV Device. These are illustrated in figure 7.1.1.1.

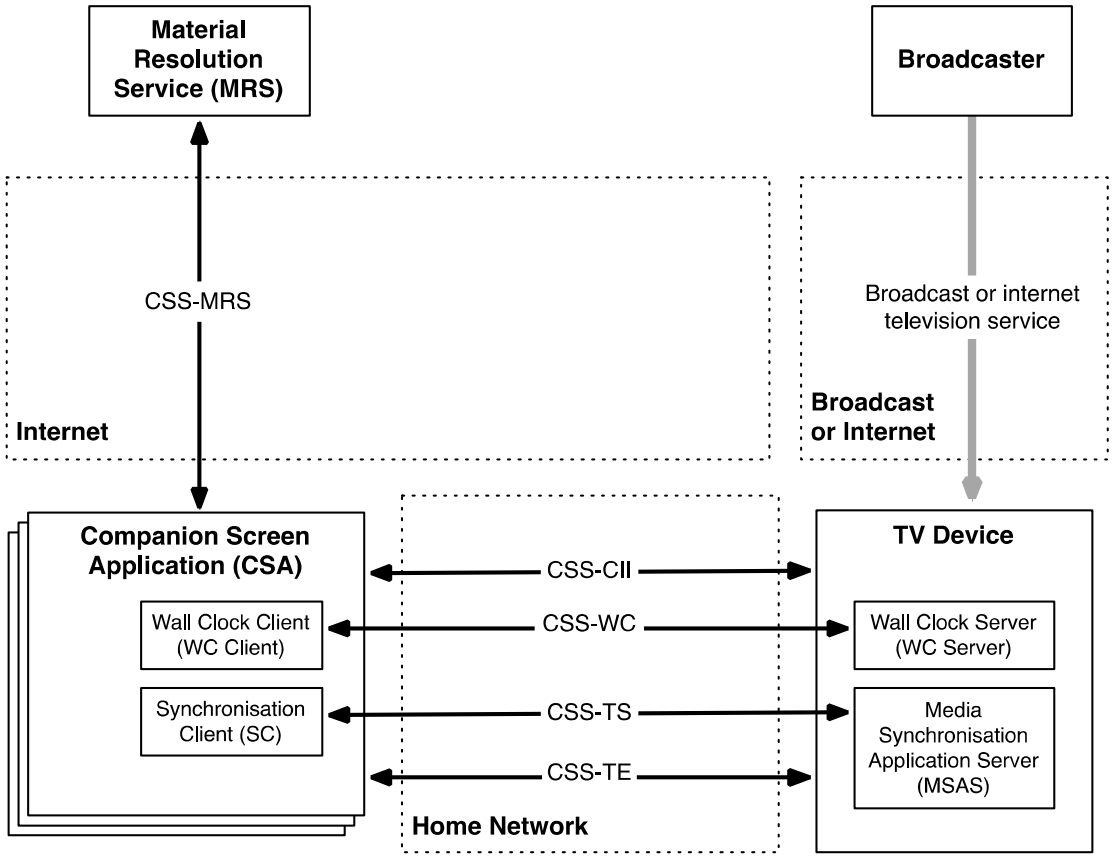

Figure 7.1.1.1: Interfaces for Content Identification and Media Synchronization

These interfaces represent the specification of the functionality within the generic architecture outlined in clause 6. The following clauses provide a brief high-level discussion of the functionality of these interfaces. The interfaces are specified in full in ETSI TS 103 286-2 [i.2].

Every interface listed is optional within the context of this multi-part deliverable; however some interfaces make reference to functionality provided by other interfaces. Any given TV Device or CSA will make use of, or support, such interfaces and functional components as are relevant to the functionality the CSA is providing.

The TV Device and CSA, from an architectural perspective, are considered to contain functional blocks, termed elementary functions, which handle some of the interface interactions. Wall Clock Client (WC Client) and Server (WC Server) elementary functions use the CSS-WC interface. Media Synchronization Application Server (MSAS) and Synchronization Client (SC) elementary functions use the CSS-TS interface.

The interfaces are described in clause 7 with reference to the following by way of examples. In these examples:

- The TV Device is assumed to be presenting a broadcast service. However the architecture is also applicable to synchronization against any type of Timed Content delivered to the TV Device by a range of mechanisms including delivery over managed and unmanaged IP networks.

- The CSA is assumed to be designed by a broadcaster to support all programmes shown across the broadcasters' broadcast services across multiple broadcast platforms. The CSA also supports the broadcaster's own programmes when transmitted by other broadcasters or delivery service providers if commercial agreements are in place to support it. However the architecture is also applicable to any other type of Companion Screen Application created by advertisers or third parties contingent on appropriate commercial agreements being in place.

In clause 7 it is assumed that the CSA has already discovered and associated with the TV Device and knows the location of service endpoint for the Content Identification and other Information (CSS-CII) interface that is implemented by the TV Device.

The CSA retrieves a Content Identifier that identifies the Timed Content being presented by the TV Device via the CSS-CII interface. The CSA also obtains status information and the locations of other interface endpoints via this interface.

The CSA can understand the Content Identifier directly to recognize what editorial content is being presented and the editorial significance of that content and the intended CSA behaviour.

Alternatively, or additionally, the CSA can communicate with a Material Resolution Service via the CSS-MRS interface to retrieve information on the editorial structure of the content and information that describes the Timelines signalled in the broadcast and how to map from those Timelines to the Timelines of the editorial content.

EXAMPLE 1: The user is watching a cookery show on the TV Device and activates the CSA. The CSA retrieves a Content Identifier and the URL for the CSS-MRS endpoint from the TV Device via the CSS-CII interface. The CSA passes the Content Identifier to the MRS via the CSS-MRS interface. The information that is returned enables the CSA to determine that the user is watching a cookery show. The information includes links to data on the recipes for the show. The CSA retrieves this data and provides it to the user for the whole duration of the show until the Content Identifier changes.

The CSA can synchronize to a Timeline embedded within the Timed Content being presented by the TV Device via the CSS-TS interface. This enables the CSA to potentially achieve frame accurate synchronization of presentation of its own Timed Content to that of the TV Device.

Architecturally, a CSA is considered to include a Synchronization Client (SC) elementary function that controls the timing of presentation at the CSA. The TV Device is considered to include a Media Synchronization Application Server (MSAS) function that coordinates the timing of presentation between the TV Device and the SC functions of one or more CSAs it is communicating with. The SC function in each CSA provides details of the range of presentation timing it can achieve and the MSAS function responds with recommended presentation timing. This exchange of timing information takes place via the CSS-TS interface.

EXAMPLE 2: The user is watching sports coverage on the TV Device and activates the CSA. The CSA retrieves a Content Identifier from the TV Device via the CSS-CII interface that identifies the Timed Content currently being viewed by the user. The CSA passes the Content Identifier to the Material Resolution Service via the CSS-MRS interface. The information that is returned contains proprietary identifiers that the CSA recognizes as indicating the location and identity of a corresponding commentary audio stream. The information also informs the CSA that the broadcast includes signalling of a Timeline and how that Timeline relates to the Timeline of the commentary audio stream. The SC function of the CSA exchanges timing information with the MSAS function of the TV Device in terms of the timeline of the broadcast via the CSS-TS interface. This enables the CSA to synchronize its presentation of the alternative audio stream to the sports coverage being presented on the TV Device.

The CSA can also subscribe to receive notifications, from the TV Device, of Trigger Events that are signalled in the broadcast or stream by the broadcaster via the CSS-TE interface. The CSA may already know the locator information it needs to provide to the TV Device via this interface to subscribe. Alternatively, the CSA may obtain this as part of the information provided via the CSS-MRS interface.

EXAMPLE 3: The user continues to watch the sports coverage and use the same CSA as in example 2. The information provided via the CSS-MRS interface also tells the CSA about a Trigger Event that is signalled in the broadcast when a goal is scored. The CSA uses the locator information and the CSS-TE interface to subscribe to receive notifications from the TV Device when that Trigger Event is signalled.

It is often necessary to compensate for the effect of latency across the home network when using the CSS-TS or CSS-TE interfaces. To do this, the CSS-WC interface is used to synchronize an estimate of a clock locally generated at the TV Device and measurements of this clock are included in the messages carried across the other interfaces. This clock is known as the Wall Clock. It is the WC Client function of the CSA and the WC Server function of the TV Device that use the CSS-WC interface to enable the CSA to estimate the Wall Clock.

7.1.2 Optionality of specification components

A TV Device that is compliant with ETSI TS 103 286-2 [i.2] normally implements at least the CSS-CII interface.

A TV Device that enables a CSA to use Timelines to synchronize its presentation with the TV Device provides (via the CSS-CII interface) the location of an endpoint for an implementation of the CSS-TS interface and CSS-WC interface.

A TV Device that enables a CSA to subscribe to notifications of Trigger Events provides (via the CSS-CII interface) the location of an endpoint for an implementation of the CSS-TE interface and should provide the location of an endpoint for an implementation of the CSS-WC interface.

NOTE: For most anticipated usage scenarios, the CSS-TS, CSS-TE and CSS-WC interfaces are recommended to be implemented by the TV Device.

For a range of media formats and delivery mechanisms, ETSI TS 103 286-2 [i.2] defines Content Identifier formats and how methods of Timeline signalling and Trigger Event signalling are detected by a TV Device and exposed via the CSS-CII, CSS-TS and CSS-TE interfaces.

For any given media format or delivery mechanism that a TV Device permits synchronization to, the TV Device typically supports all types of Timeline signalling specified in ETSI TS 103 286-2 [i.2] that apply to that media format or delivery mechanism.

For any given media format or delivery mechanism that a TV Device permits detection of Trigger Events from, the TV Device normally support all types of Trigger Event signalling specified in ETSI TS 103 286-2 [i.2] that apply to that media format or delivery mechanism.

It is recommended that a broadcaster implement the CSS-MRS interface.

7.1.3 Recommendations for profiling

To make use of ETSI TS 103 286-2 [i.2] it is recommended that a profile be defined.

In any profile it is recommended to define:

- the interfaces to be implemented and where the endpoints for the interfaces are located;
- the types of Timed Content that the TV Device may present and any Content Identifiers for types of timed Content not defined in ETSI TS 103 286-2 [i.2];
- the minimum number of concurrent CSAs and connections that can be handled for each interface;
- the policy for handling of the "Origin" header for interfaces that use the WebSocket protocol [i.4];
- the policy for handling headers used in Cross Origin Resource Sharing (CORS) [i.5] for interfaces that use the HTTP protocol [i.6]; and
- the maximum frequency with which messages are permitted to be transmitted or received across each interface.

In any profile that includes the CSS-WC interface it is recommended to define:

- the minimum precision and maximum frequency error of the Wall Clock (see clause 8.2 of ETSI TS 103 286-2 [i.2]).

In any profile that includes the CSS-TS interface it is recommended to define:

- the types of Timelines that are supported;
- the amount by which the timing of presentation is permitted to vary before updated timing information is sent via the CSS-TS protocol (limiting how accurate synchronization can be); and
- the buffering capability of the TV Device (its ability to delay presentation of Timed Content).

In any profile that includes the CSS-TE interface it is recommended to define:

- the Trigger Event types that are supported; and
- the minimum number of subscriptions that a TV Device needs to support for concurrent Trigger Event subscriptions per connection to the interface.

NOTE: A device may support more than the profile suggests, but by defining the minimum number any CSA interacting with a device conforming to that protocol will know the number of subscriptions it is worthwhile to try to make. A CSA still needs to handle the situation where it is not possible to make a subscription since the limit may have been reached by subscriptions of other CSAs that are connected to the TV Device.

In any profile that includes the CSS-MRS interface it is recommended to define:

- types of identifiers used for different elements of editorial structure (represented by Materials, as defined in clause 5.6 of ETSI TS 103 286-2 [i.2]) and the semantic meanings that they imbue;
- semantic meanings of parent-child relationships between elements of editorial structure (again, represented by Materials);
- supported update protocols;
- the use (or non-use) of HTTP request and response headers and authentication mechanisms to identify and determine the authorization of CSAs (if required); and
- the security and access methods and mechanisms. These are not explicitly defined by the specification, and hence the profile may choose to define mechanisms for use with the underlying mechanisms (e.g. approaches to HTTP authentication) defined by this multi-part deliverable.

7.2 CSS-CII - Content Identification and other Information

The CSS-CII interface exists between the TV Device and the Companion Screen Application. It has the following functions:

- Retrieving Content Identifier(s) from the TV Device.
- Retrieving information on the status of presentation from the TV Device.
- Retrieving the CSS-MRS endpoint name or address from the TV Device.
- Retrieving the CSS-WC endpoint name or address from the TV Device.
- Retrieving the CSS-TS endpoint name or address from the TV Device.
- Retrieving the CSS-TE endpoint name or address from the TV Device.
- Retrieving private data.

The TV Device receives broadcasts or streams from a broadcaster that includes metadata that coarsely identifies the editorial content.

The CSA uses the CSS-CII interface to acquire from the TV Device a snapshot formed from this metadata, pertaining to content presenting on the TV Device at that time. This snapshot is packaged up by the TV Device as a Content Identifier and other relevant data. The Content Identifier uniquely identifies the source of the Timed content (such as the broadcast service the TV Device is tuned to) and other metadata coarsely identifying the editorial content being presented. For a broadcast, this coarse metadata includes the most recently signalled TV Programme (DVB event) that is being presented for that service.

EXAMPLE 1: A TV Device provides a Content Identifier based on a DVB URL indicating the network, transport stream, service and current DVB event corresponding to the DVB broadcast service that the TV Device is currently presenting to the user.

EXAMPLE 2: On a different occasion, the TV Device provides the URL of the MPD of an MPEG DASH presentation that it is presenting to the user, including the id of the current DASH period.

The CSA can also use the CSS-CII interface to determine the state of presentation of Timed Content by the TV Device. This principally indicates to the CSA whether the user can see and/or hear the Timed Content that the TV Device is trying to present and enables the CSA to react accordingly.

NOTE: In reporting state of presentation, the TV Device assumes that the user is looking at the display and has not muted the volume. It is not indicative of whether the user is paying attention or not.

EXAMPLE 3: A TV Device is in the process of tuning to a DVB broadcast service and is not yet displaying video or outputting audio. It therefore indicates that presentation is in a state of transition. When the TV Device starts to display video and output audio it updates the status of presentation to indicate that presentation is now "okay".

The CSA can also use the CSS-CII interface to obtain the location of the endpoints of the other interfaces. If the location of the MRS is signalled in the Timed Content presented by the TV Device, then this is also provided to the CSA via this interface.

EXAMPLE 4: A TV Device wishes to provide some additional information about what it is displaying, including the audio language being presented, the audio format (e.g. stereo or 5.1 surround), if the audio is muted and which, if any, subtitles are being displayed. The manufacturer of this TV Device has chosen to publish details of the format of this information and has specified that the location of the publication is used as the type field in the private data of information sent over the CSS-CII interface. The TV device then includes the relevant private data, marked with the relevant type, sent over the CSS-CII interface.

7.3 CSS-MRS - Material Resolution Service

The CSS-MRS interface exists between the Companion Screen Application and the Material Resolution Service. It has the following functions:

- Retrieving Material Information from the Material Resolution Service (MRS).
- Providing updates to the Material Information.
- Providing correlation timestamps (the mapping between defined timelines).
- Providing updates to correlation timestamps.
- Providing private data.

A CSA passes a Content Identifier that it obtained from the TV Device via the CSS-CII interface to an MRS via the CSS-MRS interface. The MRS searches for and provides an appropriate set of information that pertains to the Content Identifier and returns it. This information is known as Material Information and it describes:

- the editorial structure of the broadcast, including proprietary identifiers and private data;
- the Timelines signalled in the broadcast;
- how Timelines signalled in the broadcast map to the Timelines of the editorial structure;

- details of Trigger Events that may be signalled in the broadcast; and
- URLs for endpoints that can provide updates to any of this information.

NOTE 1: The content identifier does not include the ability to include private data (beyond that supplied in the broadcast by the broadcaster, or delivery service provider, and carried in the ancillary data mechanisms). Thus a TV Device or a CSA cannot directly send the MRS private information. This is a deliberate design choice to support maximal scalability of the MRS interface. However, the MRS could respond with private data that allowed for a further dialogue that did include additional information. In addition, although outside the scope of this multi-part deliverable, an authentication mechanism could be used on the MRS interface that allowed some devices to identify themselves, thereby allowing for additional private data to be provided.

Units of the editorial structure are known as Materials. Timelines are described in terms of their tick rate and the mappings between Timelines are described by pairs of values (one from each Timeline) known as Correlation Timestamps.

EXAMPLE 1: A CSA retrieves Material Information via the CSS-MRS interface. A Timeline is signalled in the broadcast and the CSA becomes aware of this Timeline because it is described in the Material Information. The CSA uses the CSS-TS interface to determine the current point on that Timeline corresponding to what is being presented by the TV Device. Using the mappings in the Material Information it determines that a particular advert is currently showing and is able to present an option for the user to find out more about the product and to present a video clip such that it is synchronized frame accurately to the advert showing on the TV Device.

EXAMPLE 2: A CSA retrieves Material Information via the CSS-MRS interface. The CSA checks this Material Information and finds private data that has a type identifying this data as a format that the CSA understands and can use. In this private data the CSA finds a URL that identifies the location of another application that can be run with the material. The CSA then, if necessary, downloads and then runs the application.

The data model for Material Information embodies an abstraction from the specifics of the broadcast or IP delivery platform being used by the TV Device. The CSA can process Material Information (to determine what editorial content is being presented and synchronize with its timelines) at an abstract level without requiring platform specific knowledge to interpret and use it.

The editorial meaning of a Material and the CSA's expected behaviour when one corresponds to the Timed Content currently being presented by the TV Device is outside the scope of this multi-part deliverable. Use of identifiers and private data to impart meaning to Materials need to be agreed between MRS operators and CSA authors. Again, this is outside the scope of this multi-part deliverable. However, the globally unique typing of such information means that a CSA is able to avoid misinterpreting Materials.

EXAMPLE 3: A delivery service provider who is a DVB broadcast platform operator manages a single central MRS. Each broadcaster provides their own CSAs for use with only their own DVB services. Some advertisers also provide CSAs designed to synchronize with adverts across multiple broadcasters' services. Each broadcaster attaches their own independent sets of identifiers to Materials to indicate which programme the Material corresponds to. Advertisers also attach their own independent identifiers to Materials representing their adverts, as agreed with the broadcasters and platform operator. Type information associated with identifiers distinguishes the different sets of identifiers. When an advertiser or broadcaster CSA retrieves Material Information from the MRS it will only recognize identifiers that the broadcaster or advertiser uses and will ignore Materials with other identifiers.

The location of the endpoint of the CSS-MRS interface can be signalled in the broadcast or CoD being presented by the TV Device and then passed to the CSA via the CSS-CII interface. Alternatively the CSA can know the location of the endpoint by other means that is outside the scope of this multi-part deliverable.

EXAMPLE 4: A delivery service provider who is a DVB broadcast platform operator creates a DVB broadcast containing services of several broadcasters. Each broadcaster operates its own separate MRS. The platform operator signals in the broadcast the appropriate URL of the MRS for each service.

Establishing what, or how much, actual Material Information is returned to the CSA is outside the scope of this multi-part deliverable.

EXAMPLE 5: A CSA is normally forbidden access to Material Information that details how to determine when the TV Device is rendering an advert. However an arrangement between the broadcaster and the advertiser could allow this additional detail to be returned.

Material Information can also include the URLs of endpoints of update services from which the CSA can request updates to Material Information.

EXAMPLE 6: For a broadcast channel, a sporting event overruns and the broadcast adjusts the schedule of programmes for the channel. The CSA is connected to an update service listed in Material Information. It therefore receives an update to the Material Information reflecting the editorial changes to the schedule.

EXAMPLE 7: The user is watching a live sporting event and a CSA is presenting streamed video for an alternative camera angle synchronized to the presentation of the broadcast by the TV Device. The camera generating the alternative angle is not perfectly synchronized with the camera being used for the broadcast. Over time the count of frames progressing at each camera starts to differ. Because this cannot be predicted in advance, the CSA connects to an update service listed in Material Information that provides regular updates to the Correlation Timestamp.

NOTE 2: A TV Device wishing to present multiple streams in synchrony (such as independently delivered audio and video streams) could also use the CSS-MRS interface to retrieve Correlation Timestamps that describe the timing relationships between the multiple streams. But this is outside the scope of this multi-part deliverable.

7.4 CSS-WC - Wall Clock

The CSS-WC interface exists between the Wall Clock Server (WC Server) elementary function of the TV Device and the Wall Clock Client (WC Client) elementary function of the Companion Screen Application. It has the following function:

- Creating an estimate at the CSA of the Wall Clock at the TV Device.

Both the WC Server and the WC Client have access to some local time source, such as a hardware nanosecond counter. At the WC Server this is known as the Wall Clock. The WC Client synchronizes its estimate of the Wall Clock to the Wall Clock of the WC Server.

This synchronization process involves the exchange of messages between WC Server and WC Client where time values are sampled from both these time sources. Using these measurements, the WC Client can estimate the progress of the WC Server Wall Clock while compensating for network latency in the exchange of protocol messages.

NOTE 1: This process is based on the principles used in NTP, RFC 5905 [i.1]. However, unlike the clock being estimated in NTP, the Wall Clock does not represent real date and time.

When timing information is exchanged between TV Device and CSA via the CSS-TS or CSS-TE interfaces, the messages conveying them will be subject to network latency. For a CSA to achieve accurate time synchronization with the TV Device, both CSA and TV Device need to compensate for this latency.

The timing information is therefore expressed in terms of the Wall Clock, or includes a snapshot of the value of the Wall Clock corresponding to the moment at which the timing information applies. The CSA or TV Device receiving a message can then observe the apparent progress of the Wall Clock since the message was generated and therefore compensate for network latency.

EXAMPLE: The TV Device sends a message across the CSS-TS interface to a CSA indicating that the Timeline of the Timed Content it is presenting was at time X when the Wall Clock was at time Y. For simplicity we assume that the units (the tick rate) of both Wall Clock and Timeline are the same. The CSA receiving the message observes that the Wall Clock is now at time Y+D where D is the difference between the Wall Clock time Y when the Timeline was observed to be at time X and the Wall Clock time at which the CSA makes this observation. The CSA therefore knows that the current point on the Timeline for Timed Content being presented by the TV Device is X+D.

The accuracy with which the Wall Clock is estimated by the WC Client limits the accuracy of synchronization achievable between the TV Device and CSA. The accuracy of the estimate is maximized by using stable and accurate clock oscillators, maximizing clock measurement precision and minimizing the latencies of exchanging CSS-WC messages.

NOTE 2: The WC Server function could be implemented in a device other than the TV Device, however for most use cases it is strongly recommended that it is implemented within the TV Device.

7.5 CSS-TS - Timeline Synchronization

The CSS-TS interface exists between the MSAS elementary function of the TV Device and the SC elementary function of the Companion Screen Application. It has the function of Timeline Synchronization between SC and MSAS, comprising:

- the SC function selecting a Timeline that is being signalled in the broadcast; and
- the MSAS function and SC function exchanging presentation timing information in terms of the selected Timeline.

This mechanism provides the CSA with a means to synchronize itself against a single Timeline. There may be situations where a CSA wishes to work with multiple timelines (rather than translating everything into a single timeline). In this case, the CSA would need to create multiple instances of the CSS-TS interface, one for each timeline with which it wished to work.

The CSA synchronizes its presentation of Timed Content with the Timed Content being presented at the TV Device by using the CSS-TS interface. The SC function of the CSA reports timing information describing the earliest and latest times at which it can present its Timed Content. If the CSA is already presenting its Timed Content, then it can also include the actual timing of presentation it is currently using.

Architecturally, the TV Device is assumed to internally have its own SC function to manage the timing of presentation by the TV Device itself. It is assumed that there is an internal flow of information within the TV Device that is equivalent to the flow of information via the CSS-TS interface.

The MSAS function of the TV Device collates timing information from all SCs (including its own) and computes the best timing of presentation for all CSAs and the TV Device itself. The result of this computation is disseminated to all CSAs as a recommendation for timing of presentation.

NOTE 1: There is no guarantee that the MSAS function will select a timing of presentation that is achievable by all SCs as well as the TV Device.

EXAMPLE 1: A TV Device is presenting a DVB broadcast service. A CSA is presenting an Internet delivered stream that takes 6 seconds longer to arrive at the CSA than a DVB broadcast. The TV Device can only delay presentation of broadcast by 5 seconds. The TV Device therefore recommends to the CSA that it will be delaying presentation by only 5 seconds. This is 1 second earlier than the presentation timing than the CSA can achieve. The CSA decides whether to make a best effort to achieve close to this, or whether to not attempt to do so.

Timeline Synchronization is an on-going process that involves regular communication whilst synchronization is to be maintained in order to avoid drift and cope with changes in presentation timing by the TV Device (such as discontinuities due to the user using a pause function on the TV Device).

EXAMPLE 2: The timeline signalled in a DVB broadcast ticks at the video frame rate of 50 fps. However the locally generated Wall Clock, when converted to the same units as the video frame rate, turns out to differ from it by approximately 1 000 ppm (0,1 %). Therefore the relationship between the Wall Clock and the signalled Timeline will change by 1 frame every 20 seconds. The MSAS function will therefore send updated Timestamps via the CSS-TS interface every few seconds.

EXAMPLE 3: The user pauses the programme being presented by the TV Device because the TV Device has broadcast pausing functionality. The MSAS function sends a message to all SC functions reporting that the timeline is paused. When the user resumes the presentation, the MSAS function sends a new message to all SC functions reporting that the timeline is no longer paused and providing new timing information.

When the SC function uses the CSS-TS interface, it begins by specifying the type of Timeline signalling to be detected from the broadcast by the TV Device. This Timeline is used as the reference frame for exchange of timing information across the interface and is termed the Synchronization Timeline. Different SCs can make a different choice of Synchronization Timeline.

The SC also specifies a set of values for the Content Identifier. This set is a description of the context in which the SC wishes for the timing information to be available. The Timeline is considered, by the MSAS, to be available for use across this interface if and only if:

- the requested type of Timeline is recognized by the TV Device;
- the requested Timeline is currently signalled in the broadcast service being presented; and
- the current Content Identifier for the TV presentation matches the set of values provided.

The MSAS reports the availability of the Timeline given the Timed Content currently being presented by the TV Device by either providing timing information or indicating the unavailability of the Timeline. The MSAS function does not close or refuse a connection by an SC to this interface because a Timeline is unavailable. A reasonable implementation is expected to accept a connection to any timeline that it supports, subject to any resource limitations, even if the requested Timeline is not currently or ever available.

EXAMPLE 4: When the SC function of a CSA begins to use the CSS-TS interface, it requests a Timeline that is not being signalled for the DVB broadcast service currently being presented by the TV Device. The Timeline is therefore unavailable, and the messages sent by the MSAS function via the CSS-TS interface indicate this. The user then instructs the TV Device to tune to a different DVB service. The requested Timeline is available for this DVB service and therefore the MSAS function starts sending messages containing timing information.

EXAMPLE 5: When the SC function of a CSA begins to use the CSS-TS interface, it requests a Timeline that the TV Device does not recognize. The Timeline is therefore unavailable and the messages sent by the MSAS function via the CSS-TS interface indicate this. The connection to the interface remains open.

EXAMPLE 6: When the SC function of a CSA begins to use the CSS-TS interface, it requests a Timeline that the TV Device is currently able to provide for the current DVB broadcast service. The set of Content Identifiers that the SC specifies limits the availability of the Timeline to that same current DVB broadcast service. The user then instructs the TV Device to tune to a different DVB service. The TV Device can also provide the specified Timeline for this service. However, the TV Device determines that the Content Identifier no longer matches the set that was specified and so instead sends a message to indicate that the Timeline is no longer available. The connection to this interface remains open.

NOTE 2: The MSAS function could be implemented in a device other than the TV Device, however for most use cases it is strongly recommended that it is implemented within the TV Device.

7.6 CSS-TE - Trigger Event

The CSS-TE interface exists between the TV Device and the Companion Screen application. It has the following function:

- Subscription to Trigger Event sources.
- Notification of Trigger Events.
- Notification of changes to subscriptions (e.g. when a specific event source "disappears").
- Private data.

The mechanisms for Timeline Synchronization described in clause 7.5 primarily enable coordination of presentation on the TV Device and the CSAs when the sequence is known in advance. Trigger Events allow, but are not restricted to providing, coordination when the timing of discrete events is not known in advance. It is assumed that the CSA has the capability to respond to the event.

The CSA knows (or discovers) the location of the Trigger Event signalling in the broadcast signalling or content metadata currently being presented by the TV Device. The CSA communicates with the TV Device to subscribe to notifications of the Trigger Events and provides the location of the event signalling in the broadcast. If the TV Device detects the event signalling it notifies the CSA.

EXAMPLE 1: A user is watching a live sporting event using the TV Device. When the score changes, the broadcaster signals a Trigger Event by sending a DSM-CC Stream Event in the DVB Broadcast. The CSA has already subscribed to that Trigger Event via the CSS-TE interface, specifying the location that the TV Device should check in the broadcast signalling to detect the Stream Event. The CSA then receives a notification message when the TV Device detects the signalling. The message includes payload data from the Stream Event that contains an updated score for the sporting event.

A CSA can subscribe to multiple Trigger Events via the interface and can change its subscriptions.

When the CSA uses the CSS-TE interface, it begins by specifying a set of values for the Content Identifier. This set is a description of the context in which the SC wishes for the subscriptions to be maintained. If the current Content Identifier is not one of the specified values then the TV Device cancels that CSA's subscriptions to Trigger Events and refuses any new subscription requests as they are related to the old Content Identifier with which the interface was associated when it was created, but it does not close the connection. In this situation a CSA can close existing connections and open new ones.

EXAMPLE 2: The user is watching the same sporting event as in example 1 however the user instructs the TV Device to tune to a different DVB service. The Content Identifier corresponding to the DVB service that is now being presented does not correspond to one of the permitted set. The TV Device therefore notifies the CSA that the subscription to the sports score Trigger Event has been cancelled. The CSA therefore chooses to close the connection to the CSS-TE interface.

8 Interfaces for Discovery

8.1 General

Clause 8 describes the interface defined in ETSI TS 103 286-3 [i.3] that enable a CSA to find and associate with a TV Device. This interface allows the CSA to establish communications via the discovery of the relevant interface end-points needed by this multi-part deliverable, e.g. the CSS-CII described in clause 7, and is built upon UPnP™.

A device such as a TV Device is able to offer any UPnP™ services (functionality) in addition to that described in ETSI TS 103 286-3 [i.3].

8.2 CSS-DA - Discovery and Association

The CSS-DA interface exists between the TV Device and the Companion Screen Application. It has the following function:

- discovery
- association methods that avoid the need to re-discover on all communications

The CSS-DA interface is defined in ETSI TS 103 286-3 [i.3], and shown in figure 8.2.1.

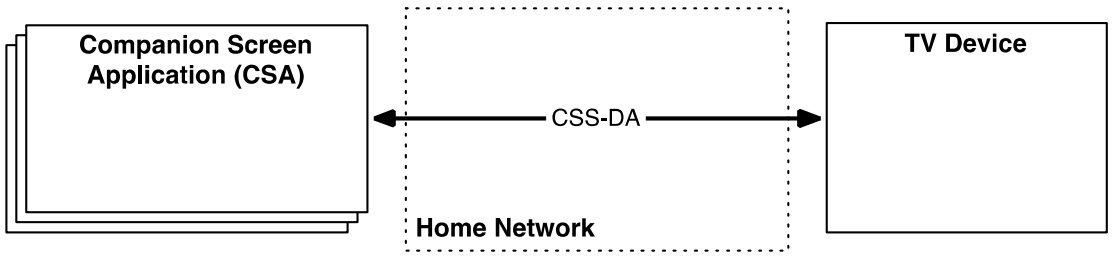

Figure 8.2.1: Interfaces for Discovery and Association

Specifically, the interface uses the UPnP™ Application Management Service Specification with a specific end point name that is used to advertise and locate interface end points offered by a device that comply with this multi-part deliverable.

NOTE: The UPnP™ term "Application Management" refers to the UPnP™ concept of an application as a software entity interacting with the UPnP™ stack. This is separate from the use in this multi-part deliverable of an application as in the context of a companion screen application. Consequently the UPnP™ Application Management is not used here as a means of managing applications remotely on a companion screen or TV Device.

9 Interfaces for indirect communication

9.1 General

Although normally the devices in the home will be connected to a common home network allowing them to communicate with each other (and that supports functionality such as the ability to send multicast messages that reach all clients on the network), this need not always be the case. For instance a companion device may be connected to a mobile network and not connected to the home network, or the home network may be partitioned in a way that blocks certain direct communications, e.g. via the presence of a firewall or a network address translation device. A STB for a cable IP television service may only be connected to a head-end with no direct local home network access. In these cases additional functionality is required to support the interfaces above.

9.2 CSS-LP - Link Proxy

The CSS-LP interface exists between the TV Device and CSA, via an internet based proxy service, and serves to provide a means of supporting all other TV Device and CSA communications when direct communications are not possible (e.g. where the two parties do not possess a direct communication path). It is expected that the CSS-LP interface will be defined in future additions to this multi-part deliverable. It may or may not be entirely transparent to the existing protocols.

History

Document history		
V1.1.1	May 2015	Publication