ETSI TR 102 282 V1.1.1 (2004-02)

Technical Report

**Standardization Work Programme
in support of digital interactive television
and the effective implementation
of article 18 of Directive 2002/21/EC**

CENELEC

European Broadcasting Union · Union Européenne de Radio-Télévision

EBU·UER

ETSI

ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00   Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or
perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF).
In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive
within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status.
Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, send your comment to:
editor@etsi.org

Copyright Notification

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

This Technical Report (TR) 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.

European Broadcasting Union
CH-1218 GRAND SACONNEX (Geneva)
Switzerland
Tel: +41 22 717 21 11
Fax: +41 22 717 24 81

The contents of the present document were discussed with relevant stakeholders representing the industry as well as regulatory authorities from EU and EFTA Member States during two Open Meetings in the autumn of 2003. In this respect, the authors would like to thank all contributors to the process for their kind cooperation and would like to thank ETSI and CENELEC for all support in organizing the meetings and drafting thepresent document.

Introduction

The European Commission's eEurope 2005 Action Plan [1] for the further development of the Information Society includes among its priorities extending the role of digital television based on a multi-platform approach. The objective is to provide widespread access to advanced communications and information services for all European citizens, with increased broadband access. If widely implemented, digital interactive television may complement PC and Internet-based access to Information Society services in the EU.

The goal of the present document is to define further standardization work in this field, in accordance with the European Commission's mandate [2] in support of digital TV and Interactive Services. This mandate follows the Commission's earlier invitation to the ESOs to assess how standardization can contribute to achieve the required level of interoperability; an invitation which resulted in the CENELEC report on standardization in digital interactive television [3]. The recommendations in this CENELEC report were developed through an examination of the relevant technical issues affecting the availability of interactive services across different EU markets and platforms, taking into account both existing relevant standards, and related ongoing standardization activities. Other important considerations included the legal requirements of the relevant European regulatory framework and inputs from a range of stakeholders representing diverse interests.

In drafting the present document, a conscious effort was made to match the objectives stated in the Framework Directive [4] with the requirements from the market, with respect to digital interactive television services. This Directive provides a regulatory framework for all electronic communications networks and services, in the context of increased convergence in telecommunications, media and information technology; it specifically addresses digital and interactive services in the provisions of articles 17 and 18 in order to promote the free flow of information, media pluralism and cultural diversity.

The Standardization Work Programme contained in the present document is intended to assist the European Commission and the market in furthering the state of interoperability of digital interactive television services. However, it is not within the mandate of the present document to determine or recommend whether any existing or proposed standard should or should not be made compulsory, or even whether such a standard should be included in the Commission's list of standards and specifications [5].

1 Scope

The present document encompasses the recommendation for a standardization Work Programme in the field of digital interactive television services. It applies the recommendations in the CENELEC report on Standardization in digital interactive television [3], taking into account developments since that document was written.

In doing so it identifies additional standardization work in 4 interrelated areas that were found to be relevant to the interoperability of digital interactive TV services. These areas are:

    i)   functional receiver specifications;

    ii)   Service Information;

    iii)   APIs, execution and presentation engines; and

    iv)   content authoring formats and guidelines. Work items in these areas have been considered in respect of all types of interactive services.

The Work Programme defines a set of deliverables, a timeline for the execution of specified work items and the identification of the appropriate industry consortiums and ESOs to carry out the work. In doing so it takes into account relevant ongoing standardization activity as well as the legal requirements of the regulatory framework.

Taken together, the items in the Work Programme provide a collection of additional tools that will assist stakeholders in significantly improving the availability of digital interactive television services across new as well as established digital interactive television markets.

2 References

For the purposes of this Technical Report (TR), the following references apply:

[1] COM(2002) 263: "Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the regions: eEurope 2005: An information society for all".

[2] DG ENTR-D4 CSG M/331: "Standardisation mandate to CEN, CENELEC and ETSI in support of digital TV and interactive services".

[3] CENELEC: "Standardisation in digital interactive television, Strategy and recommendations for a standardisation policy supporting the effective implementation of the Framework Directive 2002/21/EC and the establishment of required interoperability levels in digital interactive television".

[4] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive).

[5] 2002/C 331/04: "List of standards and/or specifications for electronic communications networks, services and associated facilities and services".

[6] SEC(2003) 992: "Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the regions on the transition from analogue to digital broadcasting (from digital 'switchover' to analogue 'switch-off')".

[7] Directive 2002/19/EC of the European Parliament and the Council of 7 March 2002 on access to, and interconnection of electronic communication networks and associated facilities (Access Directive).

[8] CENELEC/ENTR/e-Europe/2002-0497: "Order voucher relating to European Standardization Initiatives in support of the eEurope Action Plan".

[9]   ETSI TS 101 812: "Digital Video Broadcasting (DVB); Multimedia Home Platform (MHP) Specification 1.0.3".

[10]   ETSI TS 102 812: "Digital Video Broadcasting (DVB); Multimedia Home Platform (MHP) Specification 1.1".

[11]   ETSI EN 300 468: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems".

[12]   ETSI TR 101 211: "Digital Video Broadcasting (DVB); Guidelines on implementation and usage of Service Information (SI)".

[13]   ETSI ETR 162: "Digital Video Broadcasting (DVB); Allocation of Service Information (SI) codes for DVB systems".

[14]   CENELEC: "Standardisation Requirements for Access to Digital TV and Interactive Services by Disabled People", final report to CENELEC on "TV for All".

[15]   INFSO-B1/SVDB M/328: "Standardisation mandate to CEN, CENELEC and ETSI in the field of Information and communication technologies".

[16]   IEC 62216-1: "Digital terrestrial television receivers for the DVB-T system - Part 1: Baseline receiver specification".

[17]   Nordig: "Unified Requirements for profiles Basic TV, Enhanced, Interactive and Internet for Digital Integrated Receiver Decoders and relevant parts of Integrated Digital TV sets for use in cable, satellite, terrestrial an IP-based networks".

[18]   ETSI ES 201 488 (all parts): "Access and Terminals (AT); Data Over Cable Systems".

[19]   ETSI TS 101 909-2: "Digital Broadband Cable Access to the Public Telecommunications Network; IP Multimedia Time Critical Services; Part 2: Architectural framework for the delivery of time critical services over cable Television networks using cable modems".

[20]   ETSI TS 102 201: "Digital Video Broadcasting (DVB); Interfaces for DVB Integrated Receiver Decoder (DVB-IRD)".

[21]   ISO/IEC Guide 71: "Guidelines for standards developers to address the needs of older persons and persons with disabilities".

[22]   DTI: "Digital Television for All - A report on usability and accessible design".

[23]   ISO/IEC 13818-1: "Information technology - Generic coding of moving pictures and associated audio information: Systems".

[24]   ETSI EN 300 743: "Digital Video Broadcasting (DVB); Subtitling systems".

[25]   ISO Guide 65: "Assessments of Organic Certifying Agencies".

[26]   ETSI TS 102 819: "Digital Video Broadcasting (DVB); Globally Executable MHP (GEM) Specification 1.0.0".

[27]   SMPTE 397M-2003: "Television - Declarative Data Essence - Transitional".

3 Definitions and abbreviations

3.1 Definitions

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

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

Application Programming Interface (API): interface between the application software and the features, functions and/or resources provided by a digital interactive receiver platform

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

enhanced broadcast: digital interactive services mode allowing the user to interact with content present in the broadcast stream without requiring the presence of an active return channel

execution engine: an API with the exclusion of that part containing the presentation engine, regardless of whether the presentation engine is integrated into the API, plugged into the API or runs as an application on top of the API

functional receiver specification: specification of an interactive digital television device, usually including hardware performance and software behaviour definitions and requirements in order to be able to properly work in given scenarios to support the provision of interactive digital television services with a given quality level

horizontal market: market situation where equipment for the reception of digital interactive television services, based on technology available to all manufacturers and other relevant entities under equal circumstances, can be purchased by end-users in a retail market, while technology to access such equipment with digital interactive television services is available to broadcasters and other relevant stakeholders under equal circumstances as well

interactive broadcast: digital interactive services mode requiring an active return channel in order for all its features to function properly

interactive platform: for a particular digital television network, the combination of receiver and infrastructure capabilities enabling the realization of interactive services

plug-in: 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. HTML 3.2 or MHEG-5

presentation engine: software device, either integrated in an API, plugged into an API or running as an application on top of an API, presenting interactive content contained in a broadcast stream on a screen without interfacing with or having access to features, functions and/or resources provided by a digital interactive receiver platform

zapper-box: digital receiver not equipped with interactive capabilities and typically designed to facilitate tuning to digital TV channels only

3.2 Abbreviations

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

ACAP	Advanced Common Application Platform
ANIEL	Asociación Nacional de Industrias Electrónicas y de telecomunicaciones
API	Application Programming Interface
ARIB	Association of Radio Industries and Businesses
ARPU	Average Revenue Per User
ATSC	Advanced Television Systems Committee
BAT	Bouquet Association Table
CA	Conditional Access
CAT	Conditional Access Table
CATV	CAble TV
CEN	Comité Européen de Normalisation
CENELEC	Comité Européen de Normalisation ELECtrotechnique

CI	Common Interface
DASE	DTV Application Software Environment
DigiTAG	Digital Television Action Group
DIT	Discontinuity Information Table
DOCSIS	Data-Over-Cable Service Interface Specification
DTAP	Digital Television Action Plan
DTG	Digital Television Group
DTI	Department of Trade and Industry
DTT	Digital Terrestrial Television
DTV	Digital TeleVision
DVB	Digital Video Broadcasting
EACEM	European Association of Consumer Electronics Manufacturers
EBU	European Broadcasting Union
EC	European Community
ECCA	European Cable Communications Association
EICTA	European Communications and consumer electronics Technology Industry Association
EIT	Event Information Table
EMM	Entitlement Management Message
EPG	Electronic Program Guide
ERG	European Regulators Group
ESO	European Standardization Organisation
ESOA	European Satellite Operators Association
EuroDOCSIS	European version of the Data-Over-Cable Service Interface Specification
GBS	Generic data Broadcasting and Service information protocols
GEM	Globally Executable MHP
HTML	HyperText Mark-up Language
ICT	Information and Communications Technology
iDTV	interactive Digital Television
IRG	Independent Regulators Group
iTV	interactive Television
IEC	International Electrotechnical Commission
IPR	Intellectual Property Rights
IRD	Integrated Receiver Decoder
ISO	International Organisation for Standardization
ITU	International Telecommunications Union
JTC	Joint Technical Committee
MHEG	Multimedia-Hypermedia Experts Group
MHP	Multimedia Home Platform
MPEG	Motion Pictures Experts Group
NIT	Network Information Table
OCAP	Open Cable Application Platform
OMA	Open Mobile Alliance
PAT	Program Association Table
PC	Personal Computer
PCF	Portable Content Format
PID	Packet Identifier
PMT	Program Map Table
PSI	Program Specific Information
PSTN	Public Switched Telephone Network
PVR	Personal Video Recorder
RST	Running Status Table
SI	Service Information
SIT	Selection Information Table
SDT	Service Description Table
SMATV	Satellite Master Antenna TV
SMPTE	Society of Motion Picture and Television Engineers
ST	Stuffing Table
STB	Set-Top Box
SVGA	Super Video Graphics Adapter/Array
TDT	Time and Date Table
TOT	Time Offset Table
TS	Transport Stream

TV	Television
W3C	World Wide Web Consortium
WML	Wireless Mark-up Language
xDSL	undefined profile of the Digital Subscriber Line technology

4   Economic and regulatory environment

The number of installed digital receivers in Europe has grown to more than 32 million over the last years, representing some 21 % of households (as documented for example by the recent communication from the European Commission on digital switchover [6]). This however is an average number and penetration figures deviate considerably on a per country (or even on a per network) basis. This means digital television in some markets has seen (very) positive development but overall, penetration in Europe is lagging behind when compared to the US, where penetration is almost twice as high.

However, the majority of European digital TV households do have access to some form of interactive services in addition to digital programming. Similar to the penetration figures though, the quantity of interactive services available to customers differs significantly on a market by market basis. Moreover, due to a variety in digital receivers and software interfaces applied, most applications and content designed for platform A, operated by broadcaster or operator X cannot be delivered to platform B, operated by broadcaster or operator Y, even in the same digital interactive market, without additional technical measures.

This has caused a situation where there is limited interoperability between digital interactive content and services, causing a possible barrier to the free flow of information, media pluralism and cultural diversity in the European Community as digital interactive television is expected to play an important role in the further development of the information society, this limited interoperability may be addressed through further standardization.

4.1   Development of digital interactive television

The recent CENELEC Report on standardization in digital interactive television [3] described a number of historic and economic reasons explaining the differences in digital interactive market development across Europe, such as the different economics that apply to broadcasters, pay TV service providers and network operators, or the specific characteristics of the analogue market environment that broadcasters, operators and manufacturers launched their digital interactive products and services in.

As a result of this, penetration of digital television services and usage of interactive applications not only differ strongly on a market by market basis, but also considerable differences in market dynamics and market characteristics occur. Consequently, established mature markets, where considerable investments have been made by consumers as well as by service providers, exist next to emerging markets where investments have been smaller and a mature digital audience is not yet available. Also, according to circumstances, stakeholders may choose (or chose) to adopt a "vertical" approach to market development (in which case technical platforms, end-users need to access digital television services, are controlled and managed by the service provider), or a horizontal approach (in which case these platforms are not controlled by a single service provider).

Despite the many differences however, it can be stated that the overall importance of interactive services for the roll out of digital television so far has been relatively low. However, if a distinction is made between different types of interactive services, market acceptance of "enhanced broadcast" services has been considerably higher than the acceptance of "higher profiles" such as interactive broadcast or Internet access. Nevertheless, there is confidence among many stakeholders that more sophisticated interactive services will acquire greater prominence in the near future, although these expectations may not prove to be equally justifiable across all markets. Some policy goals, such as a fully inclusive eGovernment, may require such sophisticated approaches to encourage truly interactive services incorporating return channel functionality.

Notwithstanding differences in market development and the generally slow customer take up of interactive services, it is also recognized that further work on interoperability between technical platforms and portability of digital interactive services is necessary in order to support expansion of markets beyond the boundaries of a specific platform or for realizing longer term growth of interactive services overall. Consequently many stakeholders recognize that additional specifications, guidelines or standards could potentially be supportive, although under the assumption that differences in market circumstances be reflected by the standardization processes to be undertaken, as well as by their results.

Stakeholders, in putting forward their requirements for further standardization, do not put the same emphasis on the different types of interactive television services; an effort has been made to address enhanced broadcast (i.e. that type of interactive service relying on "local interactivity" and not requiring an active return path) as well as interactive broadcast (i.e. that type of interactive service requiring an active return path) in the Work Programme. This has been done in view of future expectations with respect to interactive services. An effort was also made - to the extent possible within the scope of the present document- to consider the delivery of digital interactive television services using broadband IP based delivery (e.g. using xDSL or cable modem technology) into the analysis and recommendations.

4.2   Regulatory requirements and framework

In articles 17 and 18 of the Framework Directive [4], interoperability between iTV services is addressed in relation to the free flow of information, media pluralism and cultural diversity. With respect to this interoperability, article 18 of the Directive states:

1. In order to promote the free flow of information, media pluralism and cultural diversity, Member States shall encourage, in accordance with the provisions of Article 17(2):

    a. providers of digital interactive television services for distribution to the public in the Community on digital interactive television platforms, regardless of the transmission mode, to use an open API;

    b. providers of all enhanced digital television equipment deployed for the reception of digital interactive television services on interactive digital television platforms to comply with an open API in accordance with the minimum requirements of the relevant standards or specifications.

2. Without prejudice to Article 5(1)(b) of Directive 2002/19/EC (Access Directive) [7], Member States shall encourage proprietors of APIs to make available on fair, reasonable and non-discriminatory terms, and against appropriate remuneration, all such information as is necessary to enable providers of digital interactive television services to provide all services supported by the API in a fully functional form.

3. Within one year after the date of application referred to in Article 28(1), second subparagraph, the Commission shall examine the effects of this Article. If interoperability and freedom of choice for users have not been adequately achieved in one or more Member States, the Commission may take action in accordance with the procedure laid down in Article 17(3) and (4).

As a result of the provisions in Article 17(1) of this Directive, an interim issue of a list of standards [5], encouraging the harmonized provision of electronic communication networks and services and of associated facilities was published. The use of standards appearing in this list should be encouraged by Member States.

In addition, in order to facilitate the effective implementation of the Directive, the Commission may also require the evaluation and delivery of additional specifications, standards or guidelines by the ESOs. With respect to digital interactive television, this was embedded in the commissioning of the CENELEC report on Standardization in digital interactive television in October 2002 [8] and the mandate to draft a standardization Work Programme [3] following the conclusion of said report.

With respect to the objectives and legal requirements of the Framework Directive, the present document recognizes that an "effective" implementation of these objectives will be best achieved in a market driven way. Therefore, views from various stakeholders have been taken into account, and consequences for further market development have been addressed.

4.3   Available and required standardization

As far as digital interactive television services are concerned, five specifications, standards and guideline documents so far have been included in the interim version of the List of standards [5]. These are the 1.0.3 version of the MHP specification [9] and its 1.1 version [10], as well as the DVB-SI specification [11], the guidelines document for DVB-SI implementation [12] and the document on the allocation of SI codes [13].

According to stakeholders, the above mentioned standards and specifications establish a basis for supporting the objectives and requirements of the Framework Directive [4] in markets across Europe, albeit at different points in time involving different market circumstances. In order to increase the effectiveness of the Framework Directive and to better address interoperability in all markets, additional standards and specifications are needed in several areas to complement the set already available. However, when defining the work items, the following issues should at least be taken into account.

First, standardization work items have to be supported by the market, because resources from the industry will be required to produce them; if there is not a genuine requirement, this support is unlikely to be made available.

Second, standardization can support market development, but "over-standardization" may obstruct it; the right balance between standardization and stakeholders' ability to differentiate their products must also be considered.

Third, although additional standardization may help to improve interoperability in digital interactive television services substantially in a number of markets across Europe, due to the many differences as well as time pressure, standardization is unlikely to deliver solutions addressing all stakeholders' issues in all individual markets.

4.4   Impact of competing standards on interoperability

Despite the recognition by most stakeholders that additional standardization may support increased interoperability, there is an ongoing debate on whether the availability of multiple (similar or competing) specifications or standards could have a negative impact on interoperability and the dissemination of interactive content and services. Although the present document recognizes this debate, it nevertheless defines a Work Programme which implicitly supports an approach where more than a single standard is available to stakeholders in order to pursue the objectives as laid down in the Framework Directive. This approach, referred to as the "toolbox concept", results from the analysis of many stakeholders' points of view and is believed to best address the overall market environment.

This approach implicitly anticipates the availability of more than a single standard; therefore, before defining the actual contents of this toolbox, its application will be discussed, as well as the possibility of generating adverse effects, e.g. as a result of creating competing standards.

4.4.1   The working of the toolbox

Fundamentally, standards depend on key stakeholders' investment of time, effort and money to be successful. Strong differences of opinion with regard to business interests, or the technologies needed to support those interests, represent considerable barriers to convergence on a common standard. The CENELEC report [3] demonstrated that there is no commonly agreed upon approach to improving interoperability, or even defining what interoperability means. Indeed, while stakeholders agree on the desirability of providing greater consumer choice and improved interoperability, they continue to express a diverse range of opinions on how best to achieve those goals.

The currently available plurality of technical solutions enabling digital interactive television services can be seen as a result rather than a cause of disagreement between key stakeholders on how best to develop the market for interactive television services and there is no evidence that any single technical solution will succeed in unifying the views of relevant stakeholders in all markets.

The toolbox proposed by the present document is expressly designed to address these different views as well as to allow flexible migration toward and development of a more interoperable market providing greater customer choice. In doing so it encompasses the relevant specifications and standards already contained in the List of standards [5] as well as the additional solutions described in clause 5 and listed in clause 6 of the present document.

Design and working of the toolbox are based on the following key principles:

- The toolbox should allow stakeholders to pick solutions best suited to enable the dissemination of interactive content and improve interoperability, regardless whether they follow a horizontal or a vertical business philosophy.

- Solutions contained in the toolbox must be "internally coherent", i.e. the solutions in the toolbox should enable dissemination of interactive content and improve interoperability; solutions should also be applicable in situations where different stakeholders choose different (combinations of) tools from the toolbox for use in the same market.

- The toolbox should enable stakeholders to take either a "bottom-up" (i.e. focusing on the receiver side of the chain) or a "top-down" (i.e. focusing on the broadcast side of the chain) approach when addressing interoperability issues; both approaches should be possible in an economically viable way (see also clause 5).

Feedback from stakeholders indicates a toolbox concept as described in clauses 5 and 6 could provide solutions that can improve interoperability either on the receiver or on the broadcast side of the chain, without incurring substantial additional cost. However, it should be noted that stakeholders' use of one or more solutions from the toolbox will have to be driven by market development. Some possible solutions may emerge before others when applying different elements of the toolbox. For example, the incorporation of an MHEG-5 presentation engine into an MHP receiver may occur before the appearance of a single digital receiver addressing multiple - or even all - specific markets characteristics across Europe.

It should be understood that the capabilities of the solutions contained in the toolbox to address interoperability between digital interactive television services are not infinite. Issues could still arise in situations where the toolbox contains only limited solutions, for example when broadcasters are transmitting substantial numbers of sophisticated and technically complex interactive applications in an existing multiple API environment; or in situations where broadcasters seek to address the different capabilities of different delivery infrastructures. With respect to the latter, over time, the development of digital receivers equipped with multiple tuners may support the longer term goal of universal interoperability.

Further, it should be understood that the toolbox concept was designed to allow all stakeholders to improve interoperability in interactive television services in their specific markets, while recognizing the differences between markets. Cooperation between stakeholders therefore remains essential, regardless of the actual contents of the toolbox. Moreover, although the design of the toolbox is based on market requirements put forward by all stakeholders, it will be applied by the industry. This does not guarantee that the resulting solutions will always be optimal from a consumer perspective.

4.4.2   Consequences of the toolbox approach

This standardization Work Programme sets out to address a number of different areas in which additional specifications, standards or standardization work is required. These areas are:

   i)   functional receiver specifications;

   ii)   SI;

   iii) APIs, execution and presentation engines; and

   iv)   content authoring formats and guidelines.

These areas correspond to the different layers of the broadcast delivery chain. This is illustrated by the - simplified - figure 1. As specifications in different layers should be seen as complementary rather than competing, it is reasonable to assume that the toolbox as such does not contain competing standards, specifications or guidelines.
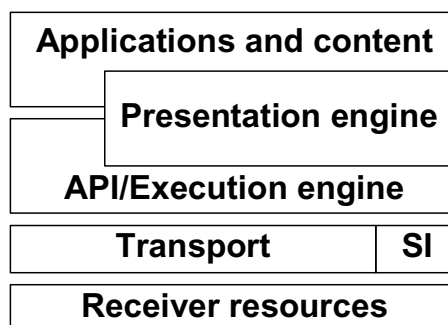

Figure 1

There are however other aspects of a toolbox approach that should be considered when addressing the possibility of adverse competition between standards, even if those standards affect different layers of the broadcast chain. The toolbox recognizes the utility of supporting the coexistence of different approaches (for example a vertical approach and a horizontal approach) within a single market, while facilitating better cooperation between different stakeholders, ultimately enabling migration towards commonly agreed technical solutions in the future. It is possible that specific tools, when combined with existing technical concepts outside the toolbox (e.g. the combination an existing API and a proprietary receiver specification used with a standardized PCF) could be used or interpreted as "quasi-standards" which might be used as a substitute for a standardized API contained in the toolbox (e.g. MHP). Therefore it can be argued this approach enables - or even encourages - operators of existing (proprietary) API platforms not to migrate to a standardized one.

In this respect it should be understood the toolbox in itself does not guarantee interoperability or the dissemination of interactive content and services; but neither can the availability of a single standardized technology provide such a guarantee. Each European market may develop at its own speed; the conditions required to reach minimum reasonable economies of scale may be different. Therefore, each toolbox option may bring advantages and disadvantages that are specific to each market.

The toolbox has the potential to facilitate migration from existing legacy systems to a harmonized interoperable solution. It can also address fragmented markets where different solutions are in use. However, cooperation between market players remains a prerequisite to the successful application of the toolbox, and any resulting market development and consumer benefits. Conversely, the lack of cooperation among market players, regardless or the choice of solutions, will most likely adversely affect market development and consumer interests.

As an example, in markets where vertical solutions are chosen, players:

i) may accept a proprietary technology, setting a de facto standard;

ii) may choose several proprietary solutions competing in the same market and reach an agreement on the use of one or several of the tools available to reach acceptable levels of interoperability; or

iii) may not be able to accept any of the technological solutions offered by competitors, consequently not reaching agreement on cooperation and the use of any of the standard tools available.

On the other hand, in markets where horizontal platforms are chosen, players:

i) may reach agreement to use a given technology (proprietary or standardized) to reach acceptable levels of interoperability; or

ii) may not be able to reach agreement on a common approach, instead choosing to implement non-interoperable (standardized or proprietary) solutions.

These relatively simplistic examples illustrate that acceptable levels of interoperability can be reached in a variety of ways, but the availability of standards does not solve cases where there is no cooperation between market players.

Finally, the toolbox approach chosen in this Work Programme does not guarantee the adoption of a single solution addressing interoperability between digital interactive television services. However there is a strong belief among a vast majority of stakeholders that the dynamics driving the development of markets across Europe will ensure the most economically and technically feasible solutions to emerge in both vertical and horizontal environments, and that the toolbox approach will help, although not solving the problem.

4.4.3   Competing standards

The toolbox, as describer in the previous sections, does not contain directly competing solutions, however, the question of the possible positive or negative impact of the availability of multiple standardized solutions addressing the same technical issues remains. Such availability might slow the development of new technologies, content and services by creating uncertainty among the industry players and consumers. Alternatively, a more modular approach to standards and standardization may positively impact market development by offering more flexible solutions.

As far as the ICT industry is concerned, there have been standardization processes that led to very successful market development based on a single standard; there are also markets, for example in the interactive television domain, that have developed relatively prosperously based on competing technical concepts or standards. It is, therefore, difficult to address the effect of competing standards on interoperability and market development without considering the specific circumstances in a given market.

Several stakeholders recognize the value of a modular approach in standardization, as this can facilitate the achievement of the twin goals of market development and an increased level of standardization (for example, examining the evolution of networking services indicates that such an approach can be successful over time). At the same time it is recognized that, for horizontal environments, the presence of multiple, non-interoperable solutions will slow down market development. Also it should be noted that the use of multiple standards (either through applying different alternative technologies or by inconsistent selection of elements of the tool box when targeting the same specific market), particularly in small regional markets may not generate sufficient critical mass.

Given the disparate level of development between the various regional markets, the option for a modular approach would seem justified. The proposed toolbox exploits a number of existing industry initiatives aimed at improving interoperability and consumer choice, without requiring all stakeholders to support or deploy all elements. Such an approach is focused on evolutionary rather than disruptive technologies, permitting progress to be made while helping to depolarize the current debate on interoperability and consumer choice.

4.4.4 Conclusions on the impact of competing standards on interoperability in digital interactive television

When reviewing the different aspects that need to be taken into account when analyzing the impact of competing standards on interoperability, the following conclusions can be drawn.

First, a toolbox approach, rather than a single technology, better suits stakeholders' needs in terms of increasing interoperability but, such an approach could also enable competing technologies. Cooperation between stakeholders in their efforts to improve interoperabilty remains essential, regardless of the choice of technology or the choice of business models.

Second, there is sufficient evidence from the market as well as feed-back from stakeholders that there is a strong momentum for the development of interactive television services in many of the markets across Europe; such momentum is essential in ensuring digital interactive television markets will develop in the most efficient ways, horizontally or vertically, and will use the relevant solutions from the toolbox. The chances of a situation where interoperability does not improve over current market conditions are regarded as small.

Third, the toolbox as recommended does not contain directly competing solutions; it should not automatically be assumed that this modular approach, or even the potential for resulting competing standards will have an adverse effect on the development of digital interactive television services in mixed horizontal and vertical market environments. Although unlikely in the case of a horizontal environment, under some circumstances, markets may be triggered rather than blocked by such competition.

4.5 Limitations of the standardization Work Programme

Although a toolbox approach as described will support increased interoperability, it should be noted that impact and reach of standardization are limited. As pointed out in previous clauses, cooperation between stakeholders is crucial, not only to interoperability itself, but also to the effectiveness of standardization. Consequently, standardization does not necessarily remove any need for regulation, either at a national or at a European level. Moreover, with regard to interoperability, it must be noted that the effectiveness of any standardization is dependent on the willingness and ability of relevant stakeholders to verify their compliance with applicable standards.

It should be understood that the present document cannot address all issues potentially influencing interoperability between iTV services, as some of these can only be regarded in a broader context. Examples of these issues are the differences between various transmission systems (e.g. cable, satellite or terrestrial) or the impact of Conditional Access systems.

Consequently, rather than ignore such issues (which could limit the effectiveness of this standardization Work Programme in certain situations), the present document has attempted to identify them, and if necessary, recommend that the relevant organizations address them, or point out ongoing projects or published reports already dealing with such issues.

4.5.1   Human interfaces

This Work Programme makes an effort to take into account the relevant principles embedded in the eEurope 2005 Action Plan for the further development of the information society, as well as generic eInclusion principles and the requirements contained in the report on TV for All. In this respect it should also be noted that a number of stakeholders raised issues concerning Human Interfaces at the consumer end of the broadcast delivery chain. Although several techniques (e.g. infra-red or Bluetooth) are available, further standardization concerning the wider aspect of all Human Interfaces may be necessary. This subject however does not fall within the scope of this Work Programme but may be dealt with by other bodies such as the ETSI Technical Body Human Factors Group.

4.5.2   Conditional access

A number stakeholders have put forward issues related to the use of CA systems (used by service providers to authorize a specific set of customers to receive protected digital services) as a potential barrier to interoperability in digital television and consequently to interactive services. CA systems can be embedded in a digital receiver, or supplied in the form of a CA module which can be plugged into receivers that support such modules. A combination of both is also possible.

The two standardized options currently available enabling interoperability between digital receivers equipped with different CA systems are Simulcrypt and Multicrypt, which can be used in conjunction with a Common Interface slot to support CA modules designed for that purpose. With Simulcrypt, interoperability is achieved through agreement among broadcasters interconnecting head-end chains. With Multicrypt, functionality in the receiver equipped with a Common Interface allows it to operate with several Conditional Access systems (either embedded or supplied in a module). Both these options have already been defined in the European regulatory framework.

Although these approaches were developed to allow interoperability between different receivers across different networks, some stakeholders have expressed concerns that commercial issues have so far prohibited widespread deployment. These concerns include cost of implementation, commercial availability of related technologies in standardized form, and security and integration concerns which impact multiple stakeholders in the content delivery value chain.

The subject of CA, as such, does not fall within the scope of the present document. However, the concerns expressed are indicative of both the complexity of issues, and the need to take a balanced, cooperative approach which considers both technical and commercial factors when addressing interoperability of digital television and interactive services.

4.5.3   Existing technology

The present document discusses standardized technology as well as technology that is in the process of being standardized. Although it recognizes the fact that existing technology or platforms may play a role in furthering interoperability in some markets, it cannot address requirements directly related to these platforms. For example, the need to develop MHP plug-in versions of existing API systems, according to some stakeholders could increase interoperability and market development in a number of cases, but falls outside the scope of this Work Programme; also the suggested development of MHP versions that can be plugged into existing API systems cannot be addressed. However, it should be noted that these efforts could have considerable impact on the improvement of interoperability where there is demonstrated market demand; likewise, a refusal to carry out such work, despite demonstrated market demand, could have considerable negative effects.

4.5.4   Other related research and projects

There are a number of related activities that were considered by the authors during the drafting of the present document, although they are not directly addressed in its results. Of particular relevance in this respect are the efforts of the European R&D community, acting under the European Commission's strategic objective "Networked Audiovisual Systems and Home Platforms" of the Sixth Framework program. The New Media Council forum, now under incorporation, could also play an important role by advising the R&D communities in respect of achieving the pursued eEurope 2005 and new framework regulatory package goals.

Finally, although it is not within the scope of this Work Programme to address whether additional specifications, standards or guidelines could or should be included in future editions of the List of standards [5], for reasons of efficiency, particular attention has been given to coordinate the drafting of this Work Programme with the activities carried out in conjunction with the EU mandate on the review of the List of standards [15].

5   Analysis of relevant recommendations and developments

In the CENELEC Report [3], there are a number of recommendations which discuss how further standardization could lead to increased interoperability in digital interactive TV markets across Europe. These recommendations are based on an analysis of developments and requirements in several individual markets, as well as on the requirements of the regulatory framework contained in the Framework Directive [4].

As the analysis shows, circumstances in various markets can differ significantly, for example with respect to service penetration, size, dominant infrastructures, regulatory environment or choice of software platforms. Consequently, stakeholder A's choice of technology (whether standardized or not) for improving consumer access to services in market X may be inappropriate or unacceptable to stakeholder B in market Y for certain technical, regulatory or economic reasons, despite the fact that A and B have the same objectives.

Rather than identifying a specific technical solution (or combination of technical solutions) for a specific market environment, the present document advocates the development of a toolbox, as described in the previous clause, containing a range of relevant technical complementary solutions, and consisting of specifications, standards and guidelines already existing as well as standards yet to be produced. Although for certain market environments (e.g. "greenfield" markets on one side or established markets on the other side) applying specific solutions may be easier or more effective, it is believed that taking this approach will enable adequate (combinations of) solutions to emerge across Europe in a market driven way.

In view of the variety in market circumstances a toolbox approach is more likely to have a direct and broad positive impact than a single technical solution and supports many stakeholders' perception that the development of digital interactive television services will increasingly be driven by regional market circumstances. Indeed, experience shows that in some markets, stakeholders have already reached agreement on how to better facilitate interoperability.

The aim of this clause is to analyse market and regulatory requirements as well as available and ongoing or initiated standardization activity, in order to identify the solutions supporting increased interoperability of digital interactive television services that are required to complete the toolbox, and can actually be developed or delivered within the (timing) constraints set by the market as well as by the regulatory framework.

5.1   General issues

When defining this Work Programme for further standardization in support of digital TV and interactive services, a number of general principles should be taken into account, in addition to the more detailed and specific recommendations that will be addressed in the clauses hereafter.

First, for many stakeholders, the establishment of a transparent digital interactive television receiver market for manufacturers and end users (also referred to as a horizontal market) is seen as an essential precondition for market growth. Establishment and growth of such a market are believed by these stakeholders to be best supported by focusing on interoperability on the receiver side (the "bottom" of the delivery chain). This includes standardization of the software layers in a digital interactive receiver. However, there are other markets where many stakeholders believe standards, primarily focusing on supporting the ability to deliver services to multiple networks and platforms, are the best way to support market growth. For these stakeholders, the focus is on portability of services across service providers and network operators (the "top" end of the delivery chain). These differences are often related to the investments stakeholders have already made to build up an installed base of digital interactive television customers. As a result, specific solutions intended to increase interoperability may have very different cost implications, depending on the market environment in which they are applied. When assessing the adequacy of each option, the early take-up of interactive digital television services should not constrain long term future opportunities for the implementation of harmonized technologies.

Second, internal coherence and external compliance of defined solutions is essential; therefore, a collection of work items should preferably be technically agnostic to market environments: work items should not negatively impact established digital interactive TV markets or operations, but they should make solutions enabling roll-out of new (e.g. standardized) technology in established markets available. In addition, applying one solution should not prevent other stakeholders in the same market from implementing other solutions from the toolbox; and, the use of a particular standard from the toolbox should not require the presence of other solutions contained in the toolbox.

Third, and in addition to the recommendations presented in the CENELEC Report, recent developments have shown that all solutions, regardless of their nature, will have to be available to stakeholders within a limited timeframe in order to make a useful contribution to the objectives and requirements contained in the regulatory framework. Therefore in carrying out the analysis it should be addressed whether certain issues, specifications or standards are actually critical to support interoperability, whether they merely encourage further take up of digital interactive television services, or whether they need to be addressed outside the standardization domain.

5.2   Functional receiver specifications

The CENELEC Report [3] indicates consumer equipment may represent a key issue with respect to facilitating interoperability between interactive digital television services; however this does not prejudice the importance of other elements in the value chain. Set-top boxes represent part of the investment required by operators to roll out these services. Considerable investment is also required for back office provisioning, the return path, customer care and information portals. Nevertheless, consumer equipment standards may play a key role in some markets, such as those in which the consumer is a direct purchaser of the equipment.

Consumer equipment standards should include minimum functional requirements, and enhanced or interactive digital receiver equipment should, for example, be capable of supporting an open API – specifically in horizontal terrestrial environments and cable transmission networks and market environments. Moreover, satellite operators would welcome a set of minimum common functional requirements for satellite interactive set-top-boxes in Free To Air markets. This minimum functionality includes radiofrequency tuner capabilities, channel decoding functions, memory processing, capability for software upgrading and downloading, video and audio characteristics, installation procedures, etc.

In addition to these minimum requirements for interactive STBs based on the goal of facilitating interoperability, it is also important to consider the state-of-the-art in related technologies, home platform environments and businesses practices; standardization work should also bear in mind the needs of the consumers, in particular elderly people and those with disabilities.

The following drawing depicts the taxonomy of digital television platforms in most of the European markets.
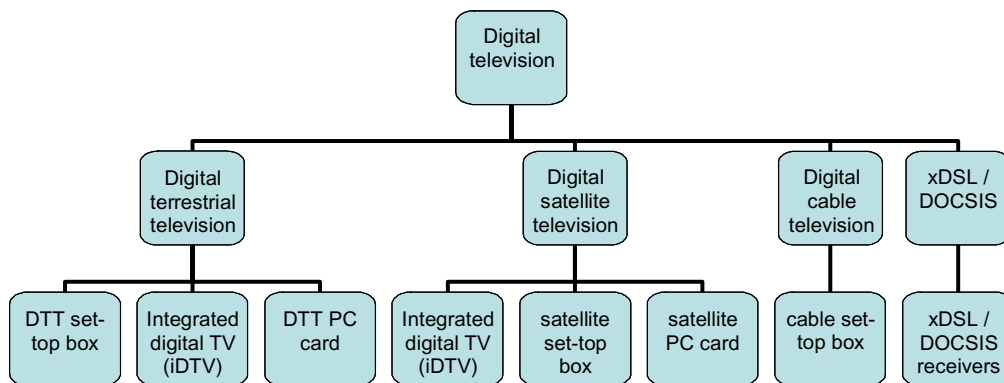
Figure 2

5.2.1   Standardization initiatives

Since the initial launch of interactive digital television services, a number of standardization initiatives have been developed in Europe. These initiatives aim to provide specifications and guidelines for the design and performance of digital interactive digital receivers. Among these, initiatives focusing on terrestrial, cable or satellite delivery of digital television services can be identified.

5.2.1.1   Terrestrial delivery

E-Book developed by EICTA: EICTA, taking into consideration contributions from DigiTAG, Nordig, UK DTG (using the UK DTG D-Book as starting point) and ANIEL, developed a specification for digital terrestrial receivers; this is the "Baseline Digital Terrestrial TV Receiver Specification" or E-Book, originally produced by EACEM in cooperation with DigiTAG, later standardized by IEC and CENELEC and available since October 2001, see IEC 62216-1 [16]. The EICTA specification was developed also after two years of requirements capture in DigiTAG and other fora. The standard aims to improve the economies of scale, which may be limited by the use of multiple incompatible platforms in the same market. EACEM/EICTA decided to address this situation by developing a basic specification as a minimum platform, providing secure reception of broadcast content and associated services. This includes both free to air as well as pay TV services via the DVB common interface. This is intended to deliver a stable base from which new services can be built. The incorporation of the CI is seen as an important element, providing flexibility for future implementations, and assisting in support for the needs of disabled users.

This specification has been used relatively successfully since its adoption to help guide discussions in several terrestrial networks (e.g. Germany, Spain and Italy) as a basis for further local discussions on how to roll out new networks and services. The specification also defines Rules of Operation for the new networks concerned.

The EICTA specification/IEC-CENELEC standard concerns:

   i)   broadcasters;

   ii)   service providers; and

   iii)   receiver manufacturers.

The objective of the standard is to define how to provide broadcasts that are understood by all receivers and enable receivers to provide good facilities to their users as well as to define the behaviour required from receivers to work well with these broadcasts and to be attractive to consumers.

Although this specification does not specifically consider fully interactive applications and the associated data broadcasting to support them, it does specify a return path through a modem for PSTN connections, for further interactive applications. Subtitling and teletext are considered to be components of TV services.

It is understood that this standard should be upgraded to include interactive services and a standardized API. Based on the API specified by DVB, a new standardization effort was started in 2002 aimed at upgrading the E-Book to include interactive services (identifying the API as an optional element in a receiver) and some other amendments

NorDig: The NorDig consortium produced a receiver specification applicable for all transmission networks (including IP based networks) for use in Scandinavia [17]. The aim of the specification is to ensure all consumer equipment supports a common set of minimum requirements, independent of the infrastructure that is used. The 1.0 version of the NorDig-Unified specification, published 16th October 2002, provides a family of specifications addressing profiles without interactive capabilities up to an Internet Access profile, based on the use of the MHP profiles.

D-Book: Within the UK, a specification for the Baseline Functional Specification for DTT receivers has been developed and is intended to form part of the "D-book" (see bibliography section). It has been provided as a basis for three further activities:

   i)   the provision of detailed technical specifications in the DTG "D-Book";

   ii)   to allow DTG Testing to create a set of test suites so that manufacturers can demonstrate technical compliance to each item; and

   iii)   the management of branding or other commercial processes based on specification conformance.

The specification was developed by a group consisting of broadcasters, multiplex operators and manufacturers, and considers the requirements of those parties. The objective of this baseline specification is to enable the provision of receivers that will ensure a high-quality user experience in the reception of current and future UK DTT transmissions of television services and interactive applications. It thus considers three types of issues:

   i)   technology needed to receive all services available at installation;

   ii)   technology needed for system management and evolution and;

   iii)   usability and completeness of consumer product.

The specification includes items which are "required" (meaning the item's inclusion is necessary to meet the objectives of the specification) and "optional" (for which implementation is voluntary).

5.2.1.2 Cable delivery

Below are described a number of standardization initiatives in the cable domain. In this respect several types of cable infrastructure and several scenarios are considered: the conventional cable broadcast networks without return channel, the conventional cable broadcast network upgraded with a return channel (based on the cable infrastructure or assisted by PSTN modems) and other cable networks designed and deployed as complete two-way communications networks [18] and [19].

EICTA: EICTA announced in September 2003 that it has initiated a joint project with a number of cable operators to define and create a common digital television cable receiver specification, similar to work done for DTT receivers (E-Book). This cable receiver specification intends to build, where feasible, on existing standards and specifications. The purpose of the joint project is to prepare the ground for the development of a set-top box based on open digital TV standards that meets the needs of the cooperating cable network operators to lower receiver costs and maximize the Average Revenue Per User (ARPU) when deploying their various digital TV services.

EICTA claims that despite a host of new and emerging digital TV technologies, many European cable network operators have been unable to grow sufficiently to provide competitive, feature-rich services to their subscribers. An important reason for this has been the complex diversity of networks and associated requirements, and the large number of different receiver models that have been developed and supplied by consumer electronics manufacturers. The new cooperative agreement aims to address this by providing a robust design specification for an interoperable digital cable receiver platform that can be adopted by manufacturers, and which fulfils the economic and functional requirements of a number of European cable network operators.

ECCA: In September 2003, ECCA announced that a number of European cable operators started an activity aimed at establishing the key pre-conditions required to initiate the mass production of cable-ready TV equipment such as set-top-boxes. The intention is to provide direction to the supplier community ensuring the development of equipment which meets the requirements of the cable industry.

In a first phase, ECCA is collecting commercial STB requirements. These efforts will result in a document to be presented to the supplier industry by means of a workshop as well as submitted to relevant standardization bodies. This first phase is being finalized by the end of the 2003. A release of the document on Commercial Requirements for a Low-end Digital Cable Receiver Unit of a Digital Cable-Media Set-top Box has been made available in November 2003. The commercial requirements for the cable receiver unit relates to both hardware components and software components. The software components, however, can only be specified in their relationship to the hardware. ECCA's commercial requirements document focuses mainly on hardware requirements and provides only very generic requirements for software.

Some MSOs are considering a rapid introduction of full interactive DTV services. According to their experience, only a significant enhancement of entertainment value encourages customers to adopt digital. This added value can only be achieved by means of a sophisticated service offering and thus by the full support of high level interactivity. Other MSOs intend to use a step-by-step approach, as their customers do not seem to be interested in using highly sophisticated services right from the beginning. Therefore, ECCA's first step is to familiarize cable customers with interactive applications by means of a preferably simple system. The migration to a full interactive and sophisticated service portfolio is intended in subsequent steps.

ECCA's second phase will focus on the development of a document defining technical STB requirements in a joint effort between cable operators and suppliers. These technical requirements will be the basis for a subsequent standardization process. The second phase will finish not later than mid-2004.

The ECCA Cable-Media STB standardization working group encourages the ongoing development of a set of cable-media industry standards that will support next generation digital consumer devices, encourage supplier competition, and create a retail hardware platform. ECCA believes this will ensure seamless delivery of interactive services and content to and between multiple devices in the home.

In addition to the above, there is ongoing activity to standardize extensions of EuroDOCSIS [18] cable modem functionality to enable descrambling and decoding of broadcast MPEG2 digital video, transported together with the DOCSIS signalling information in the same Transport Stream, along with the specifications of an embedded DOCSIS appliance. This appliance will enable viewers to access remote servers for the delivery of interactive television services; those appliances will be compliant with the ECCA commercial requirements for low end (one-way broadcast) STBs.

NorDig/cable: Based on the NorDig Unified specification, the Finnish cable TV association, in December 2002 published additional requirements for the Finnish cable market (see bibliography section). The specification is primarily nationally oriented as it makes the use of a specific (embedded) CA system compulsory. It is currently the only specification for a digital cable receiver including a common API platform.

As can be seen, these initiatives may involve some duplication of work. However, some stakeholders believe that the existence of these separate initiatives might not be a problem in itself, as these initiatives are varied in scope and have very different support bases. During the second phase of the standardization Work Programme, this potential duplication of work or differing targets should be clarified.

5.2.1.3   Satellite delivery

In satellite delivery, efforts were made by satellite operators to recommend uniform specifications for satellite receivers. A significant part of the satellite digital broadcasts however, are provided by vertical operators, who often provide their own detailed specifications to manufacturers. The common elements of these specifications are typically based only on parameters linked to the physical layers, as these are the only ones identified as being incorporated in all of the service requirements available.

No detailed references are currently available for STBs to be used in horizontal platforms for interactive services delivered by satellite. With the introduction of free-to-air satellite interactive services, guidance for standardized interactive STBs will be important. On the other hand, some satellite operators believe that the current business scenarios for the delivery of interactive digital television services via satellite do not raise any serious interoperability issues and no urgent standardization work item is needed.

5.2.1.4   Interfaces DVB-IRD

The DVB Project developed a specification as an application standard, identifying recommended interfaces for the connection of Digital Video Broadcast Integrated Receiver Decoder (DVB-IRD) equipment [20]. This standard lists a number of optional interfaces which are recommended to be available for connection of the IRDs. It includes references to physical layers for a modem for PSTN, a modem for CATV and SMATV. It is noted that no reference is currently included for Ethernet ports to allow for the implementation of a return channel based on xDSL networks.

If a recommended interface is supported, then the full specification of that interface, which may include options, applies. Interfaces not mentioned in the standard are not excluded. For mechanical and electrical details of the interfaces, reference is made to existing standards of IEC or CENELEC wherever possible, or standards which are known to be in an advanced state of development.

5.2.1.5   xDSL

Several stakeholders noted that neither industry consortiums (e.g. DVB) nor standardization bodies (e.g. ETSI or CENELEC) have developed specifications or standards for the implementation of interactive digital television services based on an xDSL broadband return channel. Nevertheless, some activity has been initiated by DVB to establish best practice mechanisms using the IP infrastructure to transport DVB signals.

So far, no guidelines have been developed on the possible options or recommendations regarding the use of xDSL networks for the delivery of DVB signals, which profiles should present the xDSL set-top-box, and which options should be implemented in order to upgrade other broadcast/delivery networks with a return channel based on xDSL technology. DVB has previously produced specifications covering similar issues for other return channels based on PSTN, GSM, DECT, Cable modem, SMATV, RCS, etc.

Although several stakeholders feel one should not aim at developing new specifications where standards already exist and meet the requirements for interactive digital television, either in full or in part, it may helpful if relevant bodies continue the elaboration of suitable guidelines for the provision of interactive digital television services, based on standards already available, and particularly including the provision of return channel option through the xDSL network infrastructures.

5.2.2   Profiles and options

Given the variety of services possible via interactive television, as well as the varying conditions in different markets, specifications and standards frequently contain, in addition to a basic configuration, additional options and/or profiles (collections of options). Such options give manufacturers and network operators flexibility in how they develop and deploy products and services. It is equally possible that regional groups of stakeholders may desire, and agree upon a regional base specification that requires support for certain options or profiles. Such profiles may range from a simple receiver without any interactivity or return channel, to fully interactive boxes with return channel support. Although this can be a pragmatic and effective approach, it can also lead to possible interoperability issues as the number of implementations incorporating different profiles or options grows. For example, significant interoperability problems may be created by widespread deployment of very basic set-top boxes (zapper boxes), which may not be equipped with minimum mechanisms or resources to facilitate migration to other profiles which could support interoperability through one or more components in the tool-box approach.

Many stakeholders are looking to MHP to facilitate interoperability in the interactive digital television domain. This standard was developed by DVB. Issues requiring clarification or fixing are duly undertaken by this organization. Moreover, DVB has established a permanent maintenance process of MHP and related specifications and thus, any pending issue identified by applications developers is being addressed by DVB as part of this Work Programme.

Efforts by organizations like EICTA to develop specifications (terrestrial, cable) for subsequent proposal to ESOs are based on the need of the industry to reach consensus for commercial horizontal markets where receivers can interoperate in different networks. This is the case of the refinement, augmentation, or option-selection of DVB specifications. Some further analysis will be made in order to identify the potential contribution to interoperability issues which could be facilitated by the head-end equipment of the infrastructures involved.

Some stakeholders believe that the implementation of voluntary test suites and certification schemes would be a positive step towards scenarios where relevant players could verify their designs, equipment performances and behaviour against well-defined compliances matrices.

Further studies are being conducted by DVB to develop commercial requirements for broadband IP Television. The results of this work might bring additional elements to the overall interoperability equation. This is an activity which is just being started by the DVB and may involve other components related to business scenarios using IP networks for the delivery and return channel media. This DVB activity may lead to additional specifications to be developed to match all business and infrastructure scenarios envisaged.

Other issues, outside the scope of the present document, but having some impact on overall interoperability involve concerns related to security, privacy, etc.

5.2.3   Consideration of standardization requirements for Access to Digital TV and Interactive Services by all consumers

In the area of common requirements for receivers capable of supporting assistive services for users with disabilities, much effort seems to be required. Apart from some initiatives by a few entities, it seems there is a lack of commonly agreed standards or, at a minimum, common design practices. Below, some rationale on current thinking of Consumers Associations representing consumers and people with disabilities is provided, reflecting the current state of the art with respect to the requirements for truly interactive TV for All.

Interactivity via Digital TV will be important to the housebound and disabled people; these people should not be excluded from access to these services. The display capabilities of a standard TV screen are however inferior to those of SVGA monitors used with PCs. The resulting 'on screen' presentation can have severe limitations, particularly for sight-impaired people.

Assistive services for disabled people are, for example, based on subtitling, signing and audio description. Receivers should be able to receive such services, and provide the option to continue displaying subtitles while other text or graphics are on screen. Consumers suggest that a conformance centre for DTV equipment should be established whereby all assistive service decoding and presentation displays are tested for a minimum compliance. However, it is also recognized that much can be achieved through the introduction of codes of best practice and general agreement between providers, producers and consumers.

The ISO/IEC guidelines for standards developers to address the needs of older persons and persons with disabilities [21] should also be taken into account. Design factors which aid people with sensory and cognitive impairments also improve usage by more able consumers. While it might be argued that considerations may have cost penalties, these may be offset if addressed early in the design stage and applied across the entire range rather than in a few specialized top of the range devices. The benefit for the manufacturer is that the product appeals to a wider consumer base.

The TV for all report [14] states "it is of vital importance that any interactive digital television technology should not move in a direction that will alienate disabled people wishing to use DTV". As for the purchase of the decoders, this special but sizeable group of European society should not need to purchase several set-top boxes in order to access services on different platforms. Therefore, the importance of development of standards suitable to match the needs of people with disabilities has been strongly emphasized by several stakeholders. When continuing the process of developing standards in support of digital TV and interactive services it is therefore recommended the "Design for all" concept is taken into account.

A report from DTI [22] in the UK has addressed similar issues. This report was commissioned as part of the "human aspects" element of the Digital Television Action Plan (DTAP). Its purpose is to address human issues so as to help encourage and enable the take-up of digital services by viewers with differing needs. It is relevant to ensure that a "domestic electronic communications apparatus" is capable of being used easily and without modification, by the widest possible range of individuals (including those with disabilities). From a usability perspective, currently available Digital Television (DTV) equipment and services are significantly different from current analogue television equivalents. Whereas analogue televisions are self-contained devices with one remote control handset, DTV is mainly received using a separate set-top box with its own, additional, remote control. The greater number of channels, and additional features such as electronic programme guides and interactive services, mean that users of DTV equipment are required to use their remote controls more extensively (in combination with on-screen menus) to choose channels, and navigate through information and options. The report identifies a number of areas in which manufacturers, retailers, government, broadcasters and other stakeholders could usefully collaborate to improve the usability and accessibility of DTV.

For the foreseeable future the television receiver with its display screen and associated audio outputs will remain the primary device for access to digital television, whether as a standalone device, such as an iDTV, or by connection to peripheral equipment such as decoders, set-top boxes and PVRs. With very few exceptions today these are controlled by external devices: remote controls, keyboards and the mouse.

The range of facilities now provided by receivers can be considerable; the downside however, is that in turn these can lead to a proliferation of control switches and connections. Encouragement is needed for digital television equipment manufacturers and service operators to place an increasing level of importance in making the equipment and services user friendly and easier to use. Considerable progress towards realizing this would be achieved if manufacturers and service providers included requirements to satisfy disabled viewers" needs in the design phases of new products and services.

If, for any user, the avoidance of multiple set-top boxes to access platforms of interest is important, this is even more important for the disabled consumer and especially those with limited disposable income. Little is to be gained if access to several platforms can only be gained through proliferation of multiple set-top boxes. Yet, as many of their design principles are being based on the MPEG2 architecture, a relatively simple modification should allow, say, a terrestrial set-top box to decode both satellite and cable services as well. Many consumers would find it hard to find any other widely-used product to be so restrictive.

Because of business strategies, some initial deployments of set-top boxes may be based on the so called "zapper boxes". While this strategy has been very reasonable and solid in the past, when the cost difference between a zapper box and an average performance STB was significant, today these cost differences are modest in relative terms but are negligible in absolute terms. The future penalties imposed by the limited performances of zapper boxes should require careful thoughts prior to actually deploying these devices. In addition to the impact for regular users, these appliances do bring added obstacles for further upgrading the STB to include additional features matching people with disabilities.

It has to be noted that the ETSI has a specialized Technical Committee, the Human Factors TC, that has expertise to address the needs of the disabled people and is identified as a group developing guidelines and recommendations for the implementation of solutions matching the needs of people with disabilities. It is understood that the interactive digital television domain does not bring many more components to the requirements from people with disabilities, but solutions for interactive digital services must follow the general guidelines, criteria, standards, best practices, etc., applicable to any other digital television service.

5.2.4   Conclusions on functional receiver specifications

There are a number of European bodies capable of assisting in the standardization process; their efforts should ultimately be channelled through the CENELEC/EBU/ETSI Joint Technical Committee Broadcast. DVB, EICTA and other bodies (ECCA, DigiTAG, etc.), including their respective members, should be invited to fuel the standardization process with respect to definitions of baseline receivers. These specifications should cover hardware and software requirements, and particularly address interfaces required; among these minimum functionalities are: radiofrequency tuner capabilities, channel decoding functions, memory processing, capability for software upgrading and downloading, video and audio characteristics, installation procedures, etc. Bearing in mind that some efforts have been already initiated, it seems reasonable to request the finalization of these specifications by not later than mid 2005. Also, existing ETSI/DVB standards should be considered for the upgrading of receivers. The goals of this standardization work should be:

1.   Development of baseline specifications for interactive digital set-top boxes for terrestrial delivery. Specific coordination should be pursued, as soon as possible, with EICTA, DigiTAG, UK DTG, NORDIG, ANIEL and other European Organizations for input to JTC Broadcast.

2.   Development of baseline specifications for interactive digital set-top boxes for cable delivery. Specific coordination should be pursued, as soon as possible, with EICTA, ECCA, NORDIG CABLE and other European Organizations for input to JTC Broadcast. This activity will include typical broadcast-driven cable systems and other two ways telecom-driven cable systems. These activities may finally result in a single standard or more than one standard if it is found that there are a variety of commercial requirements or differing market conditions across Europe.

3.   Development of baseline specifications for interactive digital set-top boxes for satellite delivery. Specific coordination should be pursued, as soon as possible, with EICTA, Satellite Operators through ESOA, NORDIG and other European Organizations for input to JTC Broadcast. Current industry practices in Free-To-Air satellite receivers should also be actually surveyed.

4.   Development of baseline specifications for interactive digital set-top boxes capable to operate with a return channel based on xDSL. Specific coordination should be pursued, as soon as possible, with EICTA, DVB, Telecom operators and other European Organizations for input to JTC Broadcast. Current work being conducted in several organizations should be coordinated, as much as possible.

Annex A highlights the situation in Europe concerning ongoing initiatives and available specifications with respect to standardization efforts for functional requirements for interactive digital television receivers as well as with respect to recommendations for this standardization Work Programme.

There is widespread agreement items 1, 2 and 4 above should be developed as a matter of urgency in order to provide reasonable guidance to broadcasters, manufacturers and consumers in order to facilitate the early start-up of interactive services. This finding is strongly supported by interested stakeholders. Concerning the third bullet point, coordination with service providers using vertically integrated business models should be pursued in order to produce a minimum set of specifications which would assist users' and customers' access to services available on the air. Stakeholders seem to be prepared to cooperate in the development of corresponding specifications and standards under the condition of voluntary adoption.

The standardization process should bear in mind the overall perspective that address market requirements. As per DVB specifications, where a number of options and profiles are available to be selected by implementers according to market needs, the standardization Work Programme should ensure that no technologies and/or infrastructures are left outside the option menu. For example, the specification and/or guidance on how to implement return channels via Ethernet ports or embedded DOCSIS modems should also be considered.

The standardization process has the potential for adverse effects, which can be avoided through a proper approach to the governance of each standard. Standardization for the sake of promoting interoperability does not necessarily imply a sacrifice of competition and differentiation or disregard for the ownership of intellectual property. It implies a requirement to balance such interests with the general public's interest in common standards and their objectives, to the extent needed to improve interoperability. Standards should be voluntary and standardization effort should be driven by industry. Industrial organizations have themselves elaborated criteria for openness, which should be considered when developing standards.

In addition, it is recommended future standardization activity should consider the results of studies carried out by CENELEC, consumer associations and other relevant organizations, when addressing design requirements meeting the needs of disabled people. It is recommended these requirements be dealt with by the specialized ETSI Technical Committee on Human Factors, as most of these requirements are not exclusive to the interactivity domain but affect digital television services in general.

Consumers Associations have raised a number of issues which are recommended to be taken into account when taking the standardization work programme into the next phases of actual development (e.g. co-existence of CA systems, labelling of controls and connections, or modular development of consumer equipment).

5.3 Service Information

Service Information (SI), specified by DVB [11], which forms a part of DVB bit streams, is used in order that the user can be provided with information to assist in selection of services and/or events within the bit stream, and so that the IRD can automatically configure itself for the selected service. Some SI data for automatic configuration is also specified by ISO/IEC as PSI [23].

5.3.1 The DVB-SI specification

The DVB-SI specification [11] specifies additional data complementing PSI by providing information aiding automatic tuning of IRDs, and additional information intended for display to the user. The manner of presentation of the information is not specified, and IRD manufacturers are free to choose appropriate presentation methods, if any. Rules of operation for the implementation of the DVB/SI specification are given in a Technical Report [12].

ISO/IEC 13818-1 [23] specifies information which is referred to as PSI. The PSI data provides information to enable automatic configuration of the receiver to de-multiplex and decode the various streams of programs within the multiplex. For further information on PSI, see annex B.

As an important step towards the identification of the ways the SI specification is actually being implemented and used in the market, EICTA, in cooperation with DigiTAG, conducted a detailed survey with several operators (some of which reside in the same country); some of the main conclusions can be summarized as follows:

- All basic functionality related to SI is generally operational, i.e. receivers offer installation functions based on the NIT and SDT and offer basic access to EIT information. Services can be rendered using information in the PMT and the referenced component streams.

- With respect to much of the less commonly used functionality, some interoperability issues exist. These can be resolved in quite a few cases by simply following DVB rules, but in some cases specific interpretations of DVB specifications are necessary. On some issues significant discussions were required to reach a compromise that typically has to fulfil the following requirements:

  i) any specified solution should be backwards compatible with all installed receivers;

  ii) any specified solution should be implementable by operators (which often have significant constraints in their broadcasting network operations); and

  iii) any mandatory specified solution should be acceptable to receiver manufacturers.

EICTA believes that there are still gaps which require further work, specifically with respect to the fact that:

i) new networks with new requirements are still coming on-line;

ii) compliance to the specifications can be improved by test streams and test procedures; and

iii) further alignment with a recent update of the D-Book may result in some further adjustments and improvements (not only in the SI chapter).

Having noted these EICTA/DigiTAG efforts, it not clear whether the identification of these issues, and the solutions adopted, are being communicated to/discussed by DVB/ETSI, in order to properly identify the implementations which embody the best practices of the SI in the market.

5.3.2   The DVB-SI Guidelines

Rules of operation for the implementation of the DVB-SI specification are given in TR 101 211 [12], providing implementation guidelines, semantics and a minimum profile for the use and implementation of the DVB SI coding in a DVB environment including satellite, cable and terrestrial networks. It is assumed that the mandatory requirements of the DVB-SI standard are duly implemented by broadcasters, service providers and IRD manufacturers. The guidelines are intended to be highly recommended rules for the usage of the DVB-SI syntax specified in the SI specification. As such, they facilitate the efficient and reliable implementation of basic user-interaction functions in IRDs. The rules apply to broadcasters, network operators as well as to IRD manufacturers. The rules are specified in the form of constraints on the DVB-SI streams or in terms of intended interpretation by IRDs. The specification of these functions in no way prohibits IRD manufacturers from including additional features, and should not be interpreted as stipulating any form of upper limit to the performance. The guidelines do not cover features related to user-interface details or advanced EPGs. Such issues are left to the marketplace.

It is highly recommended that an IRD should be designed to allow for future compatible extensions to the DVB-SI syntax. All the fields marked "reserved" (for ISO), "reserved_future_use" (for ETSI), and "user defined" in EN 300 468 [11] should be ignored by IRDs designed not 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 may not be standardized.

The functional receiver specifications developed by EICTA, NORDIG, UK DTG, etc., do include the requirement to use the DVB-SI mandatory features in all broadcast transmissions. The user interfaces there defined provide recommendations and guidelines to receiver manufacturers on what SI information to present to users and how to present it, while leaving a substantial degree of freedom for individual manufacturers to differentiate their implementation.

Receivers should skip parts of the signalling that they don"t 'understand'. The objective of this policy is forward compatibility, i.e. to enable receivers to continue operating, also with signals compliant with future versions of this specification or in case signals, compatible with a version of this specification, are extended in a compatible, but private way. Receivers should also skip unrecognised user or private fields in public descriptors.

Broadcasters shall follow the rules on how to use SI/PSI information strictly in accordance with the DVB-SI specification.

5.3.3   Allocation of SI Codes

The assignment and allocation of identifiers among all interested entities is provided by the DVB document on allocation of SI and Data Broadcasting codes [13]. This document is continuously maintained by the DVB Project Office, channelling its formal adoption through the ETSI/CENELEC/EBU Joint Technical Committee Broadcast. It should also be noted ETSI currently have an active work item revising this document. The revised version is expected to be published with the number TR 101 162.

In addition to this record of codes, some Member States have set up national registries to facilitate registration of all SI codes actually implemented in their countries. No clear mechanism has been put in place concerning the notification from these national bodies of changes or additions to the overall DVB/ETSI record, as listed in the DVB document. Also, some Member States have promoted national discussion groups on the best suitable definition of SI codes for the national content scenarios (for those non mandatory SI codes of the DVB-SI specification), which may be converted into National Standards.

5.3.4   The DVB Maintenance process of the DVB-SI specification

Since the development of the DVB-SI specification, a number of issues have been - and are still being - raised concerning either the clarification of the specification itself or addition of new features as a result of market implementation of the DVB-SI. Points signalled by service providers and/or manufacturers include use of EIT schedule and broadcasting of all mandatory elements of the specification.

One should keep in mind the issues raised by stakeholders (and others) may have already been identified by the DVB's relevant subgroup (DVB-GBS). Also DVB has already agreed to support a maintenance process for DVB-SI on a permanent basis. The DVB-GBS group collects any and all issues raised by broadcasters, manufacturers or, in general, DVB Members as a consequence of experience gained through the practical implementation of DVB services. Therefore, the DVB is in fact already engaged in an ongoing standardization work programme through the systematic upgrades of the DVB-SI specification through the ETSI/CENELEC/EBU Joint Technical Committee Broadcast. No major interoperability issues have been raised to the DVB on the usage of DVB-SI which have not been adequately addressed. It is appropriate to mention that most of the SI comments raised by the stakeholders and identified in the present report do affect the broadcast chain or the practical usage of the SI, not addressing points related to specific interactive digital television environments.

5.3.5   Conclusions on Service Information

Although some stakeholders comment that the DVB-SI standard contains too many degrees of freedom, and consequently offers too many options for interpretation and usage, the continuous process within DVB, upgrading and complementing the specification, is considered sufficient to ensure a proper implementation of DVB-SI in an unambiguous manner. Some aspects of current considerations of DVB-SI features have been signalled in the previous clauses. Annex C highlights the situation in Europe concerning ongoing initiatives and available specifications covering standardization efforts related to SI usage.The recommended work programme concerning SI should target the following actions:

- DVB should continue its specification and maintenance processes related to DVB-SI, through the ETSI/CENELEC/EBU Joint Technical Committee Broadcast. In this effort, the DVB-GBS group (the DVB-SI experts group) should bear in mind the frequent needs of niche solutions suitable for certain business scenarios. As the operational implementation of the DVB-SI may raise a number of common/individual practices adopted by implementers (broadcasters, manufacturers, including non-DVB members), DVB should pursue a more active position (either by itself or in close coordination with others) by implementing a systematic survey and checking on how SI is actually being used; this should occur in addition to the regular mechanisms adopted by DVB based on voluntary contributions from its Members. DVB should actively check and investigate the practical implementation of SI similar to the approach adopted earlier (e.g. with respect to basic interoperability and compatibility between DVB transmitters and receivers). DVB should pursue cooperation from other organizations which have already conducted some partial surveys (EICTA/DIGITAG for terrestrial operators, ECCA for some cable operators, etc.). moreover, EBU and DVB should complete the development of common mechanisms to facilitate the delivery of listings information for EPGs and PVRs, specially addressing horizontal markets.

- The issues found by DVB-SI implementers, which have been successfully solved, should be documented by permanently updating the Guidelines document [12]. A Forum of interactive Digital Television applications developers would help to maintain a best practice approach providing reference for easier usage of DVB-SI in relation to iTV. Similarly as with the surveys and research on the usage of DVB-SI, EC studies should also be initiated to stimulate the sharing of best practices on implementation of DVB-SI. These Guidelines should be elaborated for the receivers, for the broadcasters and for the application and service providers.

  - For the receivers they should define a recommended set of minimum functionalities and service information decoding requirements.

  - For the broadcasters, they should identify the minimum information to be broadcasted along with the allocation of codes to broadcasters e.g. such as the original network identifier and the transport stream identifier.

  - For application and service providers the guidelines should indicate the minimum data that should be properly decoded by receivers so that they can implement application and services that can run properly on receivers.

  These guidelines could also define a categorization of receivers based on the profile concept as per functional receiver specifications. As a complement to the guidelines, stakeholders may voluntary define:

  i)   a testing environment including a set of testing specifications for conformance and interoperability testing, following ISO related methodology (such testing could include a set of testing laboratories working as third party testers accredited according to ISO applicable standards, and using processes based on validated testing equipment; some network operators, e.g. cable operators already use a number of "test environments" to test their equipment);

ii)   a <u>certification scheme</u>, which can be set up in order to endorse the compliance against minimum requirements. These include the nomination of accreditation or qualification bodies, in accordance with ISO Guide 65 (EN45011) [25]. The scheme may be similar as those adopted for other technologies such as Bluetooth or Wi-Fi.

This activity should also target consensus among National Standards developed by Member States to define, for its national markets, common SI codes, which are not required to be implemented/used by the European DVB-SI standard.

- Ensure coordination among Regulatory Bodies, particularly for those entities that have decided to set up national registries for allocation of SI codes. The practices of the involved national bodies should be reported to DVB and the information on those registries should be widely available to any broadcasters, service providers, interactive applications developers and manufacturers. The Independent Regulators Group (IRG) and/or the European Regulators Group (ERG) should be involved in the debate of national SI registries to ensure solutions adopted by Member States remain coherent and harmonized at a European level. Both groups should decide on the division of the work.

5.4   APIs, execution engines and presentation engines

The API, or execution engine, constitutes an interface between the resources in a digital receiver (such as storage, smart card readers or the return channel) and broadcasted applications. It enables an application to exploit a receiver's resources in a standard way e.g. to execute a command, entered by the user through an interface (e.g. the remote control).

The use of an API allows broadcasters or service providers to offer a variety of different applications without having to incorporate detailed low level knowledge on the use of a receiver's resources into every application. Additionally, it enables broadcasting, reception and usage of applications, without the broadcaster or service provider having to take into consideration the different hard and software characteristics underlying the API implementation, across various brands and types of receivers in that market (be it that the limitations of the underlying hard and software in the receiver and the capabilities of the respective network will have to be taken into account). For these reasons, APIs play a central role with respect to interoperability.

5.4.1   Deployment and standardization of APIs

Currently, several APIs (e.g. OpenTV, MediaHighway, or Liberate) are used across a variety of digital interactive television markets in Europe and across a variety of different networks (e.g. cable, terrestrial or satellite). Frequently, different APIs are applied by different broadcasters or service providers, even in the same regional market (e.g. the UK and Ireland, Scandinavia or the Benelux). This means that in these markets, interoperability between applications and receivers exists within the domain, managed and serviced by a single service provider or broadcaster, addressing a specific population of interactive receivers, but usually not outside that domain.

Producing and maintaining separate populations of receivers equipped with different APIs (or alternatively a single population of receivers equipped with all APIs), according to many manufacturers is not commercially viable when these receivers are expected to be sold directly to end-users (similar to other types of CE-equipment). Moreover, producing and transmitting applications and content targeting a variety of APIs is an economic burden for a number of interactive broadcasters as well. For these reasons the variety in API platforms according to many stakeholders is one of the major barriers to the flow of interactive content and the growth of a (European-wide) digital interactive television market; consequently, these stakeholders regard the deployment of a single standardised API as a possible solution to this problem.

Most of the APIs deployed in existing interactive digital television markets however rely on proprietary technology and are not available from multiple vendors. They are not standardized, or specified by an industry consortium. Therefore, in order to offer an alternative to deployment of a variety of APIs in one market and to stimulate the development of horizontal digital interactive markets, DVB has developed the Multimedia Home Platform (MHP) as an open and generic API platform. MHP is now deployed across a number of markets as well, in addition to the deployment of proprietary APIs.

It addition to standardizing an API on a European level, cooperative effort from several industry consortia lead to the adoption of the GEM [26] specification as an ITU recommendation in March 2003, implying industry consortia from the three main digital TV markets (i.e. Europe, the US and Japan) managed to agree on a single execution engine, based on MHP (although it should be mentioned several issues relating to conformance testing and IPR licensing will need to be addressed before deployment of this specification is possible). Effectively, this turns MHP into a world wide API standard for digital interactive television.

5.4.2   Open issues related to API standardization

The recommendations of the CENELEC report do not indicate a requirement for additional standardization activity with respect to APIs. This implies that stakeholders who intend to establish interoperability in their respective markets by means of a standardized API are confident the current level of standardization in this field provides them the tools to reach this goal. However, feed-back from many stakeholders currently operating or broadcasting digital interactive television services shows this should not be interpreted as industry wide consensus on the deployment of MHP; stakeholders intending to improve interoperability through other means (e.g. by deploying a portable content format) are merely equally confident that for their purposes no additional standardization activity in the field of APIs is required.

Despite this initial response from stakeholders, recent developments indicate additional work may nevertheless be necessary. Reasoning behind this is the fact that there is market evidence supporting increased interest in MHP from broadcasters as well as service operators, potentially leading to a number of market situations in the near future where coexistence between existing APIs and MHP, if not migration from these existing APIs to MHP, will be an issue. Addressing these migration issues may cause the need for additional tools and possibly additional standardization activity in the field of APIs.

Taking into account the requirement that it should be possible to address interoperability issues at the receiver ("bottom-up") as well as at the broadcast ("top-down") end of the chain, interactive digital receivers equipped with a standardized API must technically be capable of running applications and content targeting existing APIs. On the other hand a broadcaster or service provider should be able to adapt the transmission of interactive content in such a way that receivers equipped with a standardized API as well as those equipped with another API deployed in that market are capable of running this content, without the requirement to adapt the receivers in any way. While the latter will be discussed in clause 5.5, the first issue is addressed by the "plug-in" mechanism embedded in the MHP specification.

5.4.3   The MHP plug-in mechanism

Both versions of the MHP specification currently available (i.e. 1.0.3 and 1.1) offer the possibility to run non-MHP applications and content as well. In the case of MHP 1.0.3 this is achieved by broadcasting an application-version of the respective API, while in MHP 1.1 this is achieved through an interoperable plug-in of that same API (offering some increased functionality). In both cases, there is a requirement for the broadcaster or service provider to include the signalling for both the MHP and the other API's version of the application into the broadcast stream. This means in both cases there is an additional economic and technical burden on the broadcaster or service provider. Despite these constraints, the use of the plug-in concept may nevertheless be desirable in those cases where broadcasters, service providers or even manufacturers would want to facilitate coexistence between APIs already deployed in a certain market and MHP, or would want to facilitate migration towards MHP.

In markets where broadcasters or service providers deploying an existing API wish to give their applications access to resources in MHP-equipped receivers that are not available through the existing API (e.g. return channel access), the use of the interoperable plug-in concept available in MHP 1.1 is necessary. However, although the MHP 1.1 specification as such has been finalized and included in the Commission's List of Standards [5], there are pending issues, such as the discussion on the harmonization of presentation engines and the conclusion of the conformance testing regime, that need to be finalized in order to achieve a level of stability for the specification required for widespread implementation.

Despite the availability of the plug in mechanism, there are however a number of technical and commercial issues challenging its feasibility. First, although the plug-in mechanism itself is specified in MHP, a plug-in version of an existing API can only be developed by, or with the consent of, the proprietor of that API; as this aspect of the MHP plug-in mechanism is not within the scope of the present document, it cannot be further addressed here. Second, regarding the technical and economic implications, it would be unlikely to assume a broadcaster or service provider will deploy a plug-in based version of an API it already using, unless there is a clear justification to do so. Third, the level of complexity associated with developing and deploying plug-ins and the plug-in mechanism may lead to other solutions (also targeting increased interoperability) being preferred, pending the specifics of a market environment.

This means that although additional work enabling the widespread deployment of MHP 1.1 (allowing the use of the interoperable plug-in mechanism) is necessary, it is questionable whether this would actually lead to deployment of the plug in mechanism on a reasonable scale, thus justifying prioritization of this work. There are however other issues, as the following clauses will show, that may justify this priorization.

5.4.4   Presentation engines

APIs use a "procedural language" and offer a relatively detailed level of programmability and control, consequently giving broadcasters and application developers a relatively high level of flexibility with respect to features and functionality they can build into interactive applications. Because of these characteristics, APIs in principle can be applied to support any type of interactive application, whether relatively simple (e.g. a "super-teletext" application) or relatively sophisticated (e.g. a full-featured EPG).

However, in situations where this detailed level of programmability and control is not required, presentation engines, using a "declarative language", offer an alternate approach to the delivery of interactive services, offering more speed and flexibility of application development. By providing a simpler paradigm at the expense of the detailed control and programmability provided by a typical execution engine, they are suitable, for example, to simply present interactive content on screen in an enhanced broadcast mode. Presentation engines therefore may be preferred in situations where the hardware resources of receivers or the technical or economic characteristics of the broadcast network do not allow the use of sophisticated applications requiring the use of an API.

5.4.5   Current usage of presentation engines

Under similar market circumstances, the deployment and operation of interactive services based on presentation engines tends to require smaller amounts of financial and technical resources throughout the overall broadcast chain. Therefore, enhanced broadcast, which is currently regarded as a commercially more attractive mode in interactive TV by a significant number of stakeholders, is sometimes deployed via a presentation engine rather than through an API. Often the objective is to facilitate a first step, providing a more gradual migration towards full interactive broadcast, requiring the use of an API. In its simplest form a presentation engine can deliver a "super-teletext" experience.

Additional support for this type of approach also emerged from the growing concern among a number of stakeholders, that the absence of a (standardized) presentation engine may lead to an increased number of (relatively inexpensive) digital receivers without any interactive capabilities (a.k.a. zapper-boxes) showing up in the market. The currently price difference between these zapper boxes and boxes equipped with an API (e.g. MHP), together with the relatively low appeal of interactive applications could lead to an increased number of digital viewers without interactive capabilities, possibly making non-interactive boxes the "default standard" in certain markets.

As advocated by some stakeholders, the use of a (standardized) presentation engine could decrease this risk, as requirements in terms of hard and software resources in receivers underlying such a presentation engine are currently almost similar to those underlying an average zapper-box. On the other hand, it is not unlikely, considering regular price development cycles in electronic equipment, differences between the hardware design underlying a "zapper box" and a receiver equipped with an API (e.g. MHP) may become economically insignificant within a relatively short period of time, or - as some stakeholders recently stated - are already insignificant.

5.4.6   Additional considerations

In addition to the type of presentation engine that is capable of functioning without the presence of an API (as described above), presentation engines in the shape of an application or a plug-in (often referred to as a browser) sitting on top of an API have appeared in the market. Some content formats may support decoding by both stand-alone presentation engines and those delivered as an application or plug-in.

As presentation engines are (and may be) applied in some markets to support a limited range of digital interactive television services, the CENELEC Report recommends that presentation engines be evaluated as to whether any (and if so which) of the alternatives be standardized in order to support overall interoperability, as standardization efforts are currently ongoing with respect to "stand-alone" as well as with respect to "non-stand-alone" presentation engines.

Before doing this however, some additional clarification is needed. When considering current and future market requirements, recent developments among relevant stakeholders and industry consortia, interoperability aspects, and the variety in (versions of) presentation engines applied, the following assumptions should underlie further standardization activity in this field:

- the variety in available presentation engines raises the question whether to standardize 0, 1 or many; balancing market requirements, possible (future) regulatory requirements and available resources for producing standards, leads to the conclusion the market could benefit from having the opportunity to implement a single standardized stand-alone presentation engine and a single standardized non-stand alone presentation engine, however;

- the absence of a standardized non-stand-alone presentation engine does not constitute an interoperability issue as such, as it concerns an application (that essentially can be tailored to any platform it is downloaded to); it may however support availability and dissemination of interactive content in certain markets;

- interoperability aspects related to a stand-alone presentation engine are essentially similar to the aspects related to existing APIs; therefore neither the absence of, nor the requirement for a standardized stand-alone presentation engine constitutes and additional critical work item to be included in this Work Programme;

- the start of a new standardization process intended to deliver these standards is not expected to deliver useful results within the timeframe required by the market or - to the extent applicable - by the regulatory framework;

- in the case a stand-alone presentation engine is standardized, it should be specified how coexistence with and migration of applications and content towards MHP can be assured; as this does not establish a direct interoperability issue however, it should not be included in the Work Programme as a critical item.

5.4.7   Analysis of ongoing standardization processes

With respect to non-stand-alone presentation engines, efforts by various fora such as. DVB, CableLabs, ATSC and the ITU have generated a process where industry consortia and branch organizations are working to agree on the specification of a single standardized presentation engine in combination with a single standardized execution engine (MHP); this may also lead to the integration of presentation and execution engine into a single standard.

The most likely candidate for this is ACAP, resulting from CableLabs' and ATSC's harmonization effort on OCAP and DASE. ACAP, which was accepted as a "candidate standard" by ATSC, will be made available to DVB in order for it to evaluate the possible replacement of its DVB-HTML presentation engine in the MHP 1.1 specification. It should however be noted ARIB has also proposed its BML specification for consideration in this harmonization process. Therefore, there is insufficient certainty at this point in time to determine whether harmonization efforts with respect to presentation engines will actually lead to a positive and useful result within a reasonable amount of time.

With respect to stand-alone presentation engines, the broadcast profile of the MHEG-5 ISO-standard is being worked on in ETSI, with the intention of publishing it with the number ES 202 184. The first phase of this process is expected to deliver a standardized presentation engine, capable of operating without the support of an API or execution engine, during the first half of 2004. The timeframe, as well as the characteristics of the deliverable, appear to match the relevant market requirements in this respect.

A recent evaluation of MHP and MHEG-5 coexistence and migration requirements has raised some issues with respect to the MHP specification. Parallel to the MHEG-5 standardization process, these requirements have been recognized by DVB and are currently being addressed. However, at this point in time it is not yet clear whether this will imply changes to the 1.0.3 version or to the 1.1 version of the MHP specification. Although it makes a considerable difference with respect to the timely availability of the required deliverables which version of the specification may need to be adapted, the fact that this does not involve a direct interoperability issue means there is no requirement to list this activity among the critical work items in the Work Plan.

5.4.8   Conclusions

The analysis of recommendations on API and presentation engine related standardization activity contained in the CENELEC Report, as well as the analysis of the regulatory requirements and the most recent relevant developments lead to the definition of 3 non-critical work items for the standardization Work Plan in support of digital interactive television:

    i)   the standardization of a non-stand-alone presentation engine;

    ii)   the standardization of a stand-alone presentation engine; and

    iii)   the synchronization between a standardized stand-alone presentation engine and MHP.

All three work items can be addressed by incorporating ongoing specification and standardization processes as non-critical items into the Work Programme, i.e. the global harmonization of non-stand-alone presentation engines by DVB, ATSC, ARIB and ITU, the standardization of MHEG-5 by ETSI and the process of synchronizing MHEG-5 and MHP by DVB. In addition, many different issues that do not themselves establish critical interoperability issues could be addressed through finalizing the work related to the 1.1 version of the MHP specification. Therefore this work is included in the Work Programme as a critical item.

Finally, despite the "non-critical" status of most of these work items it should be kept in mind that the use of multiple presentation engines, although not causing direct interoperability issues, may generate severe barriers to the production and dissemination of interactive content, as it generates a barrier for smaller content producers, the user experience may be poorer due to longer software loading times, additional bandwidth may be necessary and content will have to be authored to different formats.

5.5   Portability of services

5.5.1   Background

Information-based iTV applications can potentially exploit digital television, Internet, and computer technologies for the delivery of Information Society services. To do so, they require significant resources and infrastructure which lie outside the conventional television broadcast chain. Furthermore, different receivers may offer different features sets (e.g. high-speed return path, multiple tuners), which specific applications may exploit. Consequently, the combination of a specific network's set top box and infrastructure capabilities must be taken together to fully describe a complete iTV platform. Variation between iTV platforms, including differences in APIs, can impede a content provider's ability to distribute an iTV service across multiple platforms. Some stakeholders accommodate multiple platforms via re-authoring, or through the use of content creation tools that can output multiple platform formats. Other stakeholders have indicated that neither re-authoring nor support for multiple output formats is commercially feasible in their market environment.

Requirements initially identified in the CENELEC Report [3] suggested that techniques to support the portability of services across multiple platforms would benefit the overall interoperability of interactive television services. Such portability could be achieved by focusing on standardizing the description of interactive television services, rather than considering the details of how the service is actually realized on a particular receiver. Such an approach would support the co-existence of existing platforms with newer deployments, and would also encourage the adaptation of existing services to new platforms and markets.

A useful concept, which has emerged since, is that of the Portable Content Format, or PCF. Portable content formats aid interoperability for a wide range of applications by decoupling the service provider from the detailed characteristics of different networks and platforms. They allow interactive services and their associated assets to be described in a platform-independent way, and specifically assist in delivery of services to dissimilar platforms.

Unlike specifications for execution or presentation engines, which relate to specific platform behaviour and implementation, PCFs describe the desired user experience without assuming the availability of any particular underlying engine, which actually makes the format "portable" between different execution and presentation engines. The resulting description, once delivered to a given network, can then be transformed into content suitable for delivery to a specific platform. It is this transformation step that fundamentally distinguishes a service derived from a PCF from one original authored for a particular platform.

In addition to helping service providers, PCFs are also useful for network operators who need or want to support a mixed population of receivers. Such a mixture could result from the acquisition of existing networks, a desire to offer different products at different value points, or arise from the desire to migrate their content and infrastructure to a newer platform without being limited to a simple superset of the existing one. Evidence from related consumer markets indicate that technology development cycles for new generations of products can be substantially shorter than typical consumer replacement cycles. A new platform or service may therefore need to coexist with an installed base of multiple generations of different predecessors over a period of several years.

In view of this background, the standardization of PCFs addresses urgent needs from stakeholders operating in markets characterized by significant populations of digital receivers equipped with already existing APIs or presentation engines, and therefore should be regarded as a critical work from those markets" perspective. For markets where this is not the case, the standardization of PCFs consequently does not establish a critical work item.

5.5.2 Characteristics of portable content formats

A portable content format should allow a service provider to fully describe an interactive service once, and be able to make it available across a large proportion of the available target platforms with minimal additional work. However, no two platforms are alike; each may have different associated middleware, receiver resources, or information infrastructure, and services may exploit different platform capabilities in varying degrees.

Even with these variations, a review of existing applications shows that there is significant commonality between user experiences across a range of platforms despite the numerous detailed differences between them. Portable content formats exploit this fact by describing the intended experience from the user's perspective rather than that of the platform.

A key feature of a PCF is the ability to automatically translate from a platform-independent format into one suitable for a specific target. This translation step would typically be performed by transforming (transcoding) the input portable content format at the network edge, with delivery of the output either directly to the target platform's interactive engine (execution or presentation), or possible via a client-server model using a small "micro" browser application sitting on top of a platform's interactive engine. Other approaches are possible, giving networks and service providers some flexibility in how they support PCF-based services on a given platform.

It should be noted that the use of PCF applications does not preclude the use of other services on a given network. PCF-based services can be deployed in parallel with existing non-PCF services, as no fundamental changes are required to the target interactive device to support PCF. Consequently PCF support is predominately an exercise "outside the receiver", although the party (or parties) handling the conversion on a given network will have to implement appropriate conversion infrastructure and software. The figure below is a example illustrating the delivery of the same PCF content to two different networks.
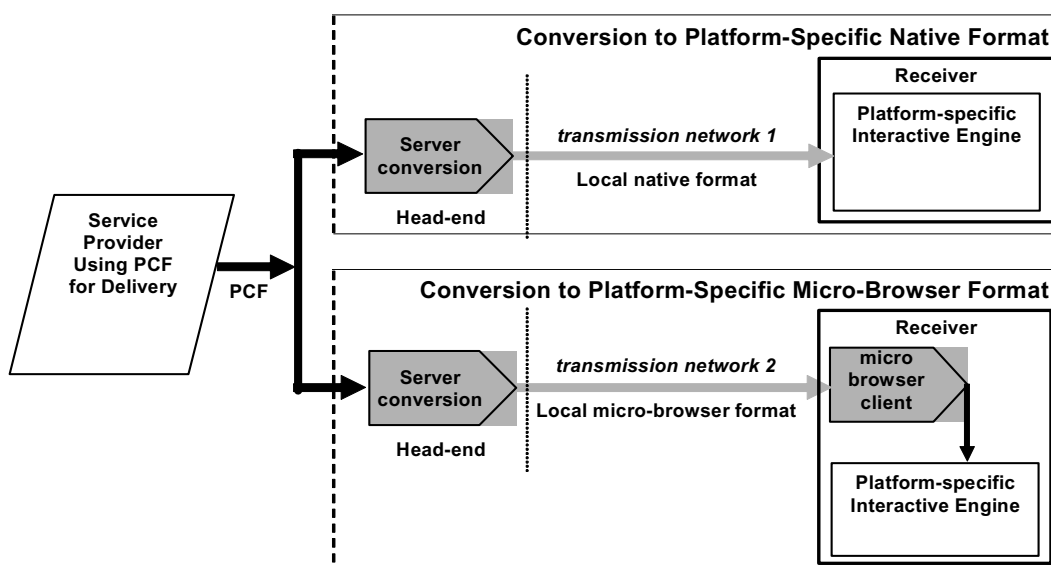

Figure 3

5.5.3   Applicability

Despite many ongoing standardization efforts it is not unlikely that a large variety of (presentation) engines will remain in the market, possibly establishing a barrier to the development of interactive content and services, as described in section 5.4.8. A PCF may help to circumvent this barrier by creating portability between engines, yet it is also important to consider the scope of what is practically achievable.

Notwithstanding the advantages, PCFs are unlikely to be used for all applications across all devices. Fundamental limitations of a particular platform may make it difficult or impossible to support the full range of services available on a different platform. For example, while some receivers may support video scaled to an arbitrary size, others may only allow full and quarter-screen viewing. Other examples include the handling of overlaid text and graphics and audio output capabilities. For these reasons interoperability of applications largely relying on "non-portable" functionality (embedded in one of the layers below the layer where the PCF is active) cannot be addressed through current PCF formats.

Nevertheless, based on feedback from stakeholders with experience in this area, a significant fraction of interactive services could be described using a well-designed PCF. Even for the remaining services, a substantial fraction of a given service could benefit from PCF based authoring, ultimately reducing the amount of work needed to move the service to a new platform. Also, it is possible that future versions of PCFs will be able to further take into account the capabilities of underlying APIs and presentation engines.

5.5.4   Conclusion

PCFs offer multi-platform portability of services covering a range of applications, and they enable the deployment of new platforms without disrupting existing systems. Support for multiple PCFs on the same platform is possible, but would require extra implementation effort on the part of network operators wishing to do so.

At the time of the CENELEC Report, there were no known examples of standardized PCFs specifically targeted at interactive television. Today, the situation is quite different.

The DVB is likely to finish their commercial requirements for a portable content format by the end of Q1 2004, with work on the corresponding technical specification expected to begin in during the second quarter of 2004. Work is expected to be completed in Q1 of 2005.

The Society of Motion Picture and Television Engineers has published SMPTE 397M [27], a portable content specification aimed at iTV services. At least one non-European broadcaster is implementing a content delivery system using this standard.

BSkyB is already using an extended version of WML (a W3C standard administered by OMA) as a PCF on its UK and Irish direct-to-home satellite platform. BSkyB is putting forward an extended version of WML, known as "WTVML", for standardization through ETSI.

We recommend that the DVB, as part of its commercial and technical due diligence, take account of results from SMPTE, and any other PCF candidate standards that become available during the course of its work, with the expectation that the resulting DVB specification will be put forward to ETSI.

5.6   Overall conclusions review and analysis

Several conclusions can be drawn from the analysis of the recommendations in the CENELEC Report and the more recent developments in the field of digital interactive television. Some of these are relevant in respect of further standardization work and some are relevant with respect to other activity (e.g. regulatory intervention or maintenance activity) aiming to improve interoperability.

Historic and economic reasons explaining the differences in digital interactive market development across Europe have generated differences in the penetration of digital television services and usage of interactive applications. Established mature markets exist next to emerging markets and, according to circumstances, stakeholders may choose (or chose) to adopt a "vertical" approach to market development or a horizontal one.

Specifications, standards and guidelines included in the interim version of the List of Standards [5] establish a basis for supporting the objectives and requirements of the Framework Directive [4]; however, in order to increase its effectiveness, and to address interoperability in all markets, additional work will be necessary on standards and specifications, completing the set of tools already available. The toolbox proposed by the present document is expressly designed to address these different market requirements and stakeholders perceptions as well as to allow flexible migration toward and development of a more interoperable market providing greater customer choice.

This toolbox, consisting of additional standards, specifications and guidelines (or their extension to cover additional requirements), which is complementary to the set of (standardized) tools currently available to implementers of interactive digital television or services, is likely to support increased interoperability in a number of markets. Its solutions address different "layers" in the broadcast chain such as the physical layer (functional receiver specifications), the transport layer (clarifications on the usage of SI) or the service layer (presentation engines and portable content formats).

Although it is obvious not all solutions individually support the complete spectrum on digital interactive television (i.e. enhanced broadcast, interactive broadcast and Internet access), the toolbox as a whole does address the complete spectrum and allows multiple combinations of solutions working in specific layers or parts of the broadcast chain, enabling tailored solutions for addressing interoperability issues in most market environments. The toolbox has the potential to facilitate migration from existing legacy systems to a harmonized interoperable solution, but has also the potential to mature fragmented regional markets. In this respect, successful cooperation of market players adopting a combination of solutions from the toolbox will be beneficial to consumers; on the other hand, a lack of cooperation could also negatively affect consumers' interests.

Nevertheless, distinctions between certain types of markets can be identified when discussing combinations of solutions that are most likely to generate positive results for all stakeholders in terms of the dissemination of interactive content and increased interoperability. Generally speaking, emerging (horizontal) markets strongly driven by (public) broadcasters may benefit most from adopting a standardized API in combination with standardized baseline receiver specifications. Established (vertical) markets, strongly driven by (private) service providers however may benefit most from adopting a PCF in combination with the APIs or presentation engines (albeit standardized or non-standardized) already in use.

Obviously, there are more elements causing differences in market situations, such as the dominant network, the dominant type of interactive services, the state of digital television penetration, the level of competition or the overall market size. In many situations it may not be possible to classify a market in an unambiguous way due to a mixture of different circumstances, and due to the fact that (in most cases) dynamic, rather than static circumstances need to be addressed. For this reason, the present document refrains from pre-defining a specific set of solutions as the best way to address a specific digital interactive television market.

With respect to the actual standardization Work Programme, a distinction can be made between work items (i.e. deliverable specifications, standards or guidelines) that are "critical" to the goal of increased interoperability, those that are "non critical", and those that deal with regulatory or maintenance issues.

Critical items are those work items that have a direct substantial effect on increased interoperability issues, are strongly required by specific individual digital interactive markets (e.g. the standardization of a PCF format for those markets that are characterized by large populations of digital receivers equipped with different existing APIs or presentation engines) and for which there is a demonstrated and urgent market requirement.

Non-critical items are likely to support further interoperability and dissemination of interactive content in the near future in some markets (e.g. the standardization of a non-stand-alone presentation engine) but do not represent substantial issues that need to be addressed by the industry in view of major or urgent interoperability issues in respect of the objectives in the regulatory framework.

Regulatory or maintenance issues are those issues that do not require additional standardization but involve other types of activity (such as additional research into the actual usage of specifications) or other organizations (such as national or European regulatory bodies).

Much of the standardization work that is "critical" to the improvement of interoperability has already been started, mainly in ESOs and industry consortia such as DVB, or in industrial associations like EICTA, ECCA and others. However, while some of the work items are likely to generate the required deliverables within a short interval beyond the timelines indicated in the Framework Directive [4], most work items are not likely to be completed within that timeframe.

Not all issues can be addressed in the Work Programme. For example, the analysis of interoperability issues relating to the use of the DVB-SI specification has not demonstrated a need for development of additional standards. There is however a requirement for DVB to play a more active role in the synchronization of the usage of the specification. Moreover there is a clear requirement for harmonization of national regulatory bodies and national standardization bodies with respect to the allocation of SI codes within their particular jurisdiction as well as for the relevant European authorities to harmonize their practices on a European level.

Finally, the analysis shows that the Work Programme, for several reasons, will not be able to address all interoperability issues across all European digital interactive television markets. Some issues, such as the inability of certain populations of "legacy" receivers or zapper-boxes to run another API (whether standardized or not) if introduced in the same market, cannot be addressed.

6   Standardization Work Programme

The following clause lists the work items that have been identified and described in the previous clauses in a systematic way. In doing so, it specifies the deliverable as well as the organization that is recommended to produce the respective specification or standard, or take the lead in the required activity.

In addition, the timelines for the delivery are listed, as well as the status (e.g. is it critical or non-critical in view of interoperability? Should it be regarded as a non-standardization or a regulatory issue?) and issues associated with a work item (e.g. economic viability) are mentioned.

At the end of this clause, an effort is made to create a complete overview of the work items, their status and a timeline for their delivery, indicating which work items should be prioritized in order to optimize support for increased interoperability.

It should be noted the following clauses constitute the recommendations for a standardization Work Programme in support of digital TV and interactive services; they should not be interpreted as a commitment from stakeholders to provide the efforts described herein.

6.1   General issues

It should be understood standardization processes are - in most cases - based on voluntary contributions from, and adoption by stakeholders. Therefore concrete market requirements underlying standards are necessary for their future deployment, and demonstrated interest to work on issues is consequently required to include items into this Work Programme.

An important issue also is the internal and external coherence of a set of specifications, standards and guidelines that together make up a toolbox supporting interoperability in digital interactive television services and the free flow of information and content (as described in clause 5.1). Therefore, a conscious effort has been made to define work items that lead to specifications or standards that are neither mutually exclusive, nor technically block standards already available and deployed in the market.

The strategy adopted to support these two principles: i) focuses on different sections of the broadcast chain (see for an example clause 5.5.2); and ii) divides the delivery process into different layers ranging from the physical layer (e.g. functional receiver specifications) up to the services layer (e.g. PCF). Rather than recommending one or multiple standards in the same layer of the delivery process, the Work Programme sets out to define solutions working in different layers that can be applied - if required in a specific environment - in combination with each other.

6.1.1 Functional receiver specifications

With respect to functional receiver specifications, the analysis in the previous clauses led to the conclusion that baseline receiver specifications are required for the major delivery infrastructures, i.e. terrestrial, cable and satellite.

Table 1

		Delivery of baseline receiver specifications for usage in terrestrial, cable, satellite and xDSL networks
1	Deliverable	Development of a baseline specification for digital interactive STBs applied in digital terrestrial networks.
	Objectives	Ensure a minimum profile at customers' premises that broadcasters, service providers and content developers can tailor their interactive services to.
	Producer	EICTA, in cooperation with DigiTAG, EBU and relevant national organizations; organizations should pursue coordination of efforts.
	Timeline	30/06/05
	Status	Non-critical
	Issues	Process is ongoing, baseline receiver specification for non-interactive STBs is already available; relevant input could be provided by Nordig, ANIEL and the DTG
2	Deliverable	Development of a baseline specification or baseline specifications for digital interactive STBs applied in digital cable networks. This activity will include typical broadcast-driven cable systems and other two ways telecom-driven broadband cable systems and DOCSIS-based infrastructures, thus, likely resulting in several sub-deliverables including likely more than one standard.
	Objectives	Ensure a minimum profile at customers" premises, suitable for usage in horizontal as well as in vertical market environments, broadcasters, service providers and content developers can tailor their interactive services to. These activities may finally result in a single standard or more than one standard if there are founds to be a variety of commercial requirements or differing market conditions across Europe.
	Producer	EICTA, ECCA and relevant national organizations should pursue coordination of activities, as soon as possible. Additional specifications, if needed, can be produced by ETSI AT and TM6.
	Timeline	30/06/05
	Status	Critical
	Issues	Currently, several views on the development of a baseline specification exist, due to different opinions on market models or dynamics that need to be supported by the specification. This needs to be addressed in conjunction with the baseline specification itself. According to many stakeholders however, a specification/specifications is/are urgently required.
3	Deliverable	Development of a baseline specification for digital interactive STBs applied in digital satellite networks.
	Objectives	Ensure a minimum profile at customers" premises broadcasters, service providers and content developers can tailor their interactive services to.
	Producer	EICTA; satellite operators, service providers and ESOA could provide relevant input.
	Timeline	30/06/05
	Status	Non-critical
	Issues	Much practice with respect to free-to-air satellite receivers is already available in the market
4	Deliverable	Completion of a baseline specification for digital interactive STBs Interfaces to include xDSL as return path to complement other delivery media. Updates of the DVB-IRD Interfaces to add Ethernet optional connectors are required.
	Objectives	Ensure a proper guidance is provided to interactive digital television service providers, broadcasters and manufacturers on the optimum interfaces for IRDs working with a return channel technology operating on xDSL networks.
	Producer	DVB
	Timeline	30/12/04
	Status	Non-critical
	Issues	Although some work has been done related to the implementation of return channel based on xDSL networks (e.g. by DVB), no actual work has been completed in a consistent manner as per other infrastructures (PSTN, GSM, etc.).

In addition to the above list of deliverables associated with functional receiver specifications, it has been noted that a number of initiatives are being developed either in DVB or ETSI to tackle the provision of IP TV services or interactive digital television services using telecommunications networks with xDSL technologies. The standardization Work Programme second phase should bear in mind these initiatives and make any necessary correction to the above list by adding, if necessary, additional work items to complete the overall standardization Work Programme.

In view of the coordination role of the JTC Broadcast with respect to the activities carried out under standardization mandate M/331 [2] (also covering this Work Programme), it is recommended that this body identifies which ESOs will be invited to carry out the actual standardization of baseline receiver specifications produced by the organizations identified in the table above, notwithstanding the rights of these or any other organizations to produce specifications themselves and to decide whether or not to propose their specifications to standardization bodies.

6.1.2   Service Information

There are 3 areas defined with respect to the use of DVB-SI that need to be addressed in the context of this Work Programme. Neither one of these issues can be characterized as a standardization activity but nevertheless is expected to support increased interoperability in digital interactive television services.

Table 2

		Clarifications with respect to the usage of DVB-SI
5	Deliverable	Maintenance of the DVB-SI specification and active research into the usage of SI in the market.
	Objective	Allow best common practices to be adopted in order to synchronize usage across different markets, broadcasters and service providers.
	Producer	DVB
	Timeline	Permanent process
	Status	Non-critical
	Issues	DVB currently has a maintenance process in place, relying on input from the market. The maintenance role of the organization in this process should be activated; this process could also address supporting PVR devices using DVB transport streams, considering other available ETSI specifications (specification effort have already been started in DVB-GBS). EBU and DVB should complete the development of common mechanisms to facilitate the delivery of listings information for EPGs and PVRs, specially addressing horizontal markets.
6	Deliverable	Inclusion of findings from (activated) DVB maintenance process into TR 101 211 [12].
	Objective	Develop best-practice for easier use of the DVB-SI specification with respect to interactive applications.
	Producer	DVB
	Timeline	Permanent process
	Status	Non-critical
	Issues	Guidelines should be elaborated for receiver manufacturers, broadcasters and application/service providers; following this, stakeholders could set up test environments and certification schemes.
7	Deliverable	Coordination among national and European regulatory bodies and national standardization organizations on the allocation of SI codes.
	Objective	Make information on national regulators" SI practice and registries available to all broadcasters, service providers, manufacturers and application developers and ensure European coherence between practices adopted on a national level.
	Producer	National regulatory bodies of EU/EFTA Member states in coordination with ERG and IRG. Also, close coordination among National Standardization Organizations should ensure a harmonized development of national versions of DVB-SI codes.
	Timeline	Permanent process
	Status	Regulatory, Coordination of National Standardization Organizations (Non-critical on interoperability issues but risks to further contribute to fragment European market).
	Issues	Division of work between ERG and IRG will need to be defined between the two bodies.

6.1.3   APIs, execution engines and presentation engines

Activity in this domain should focus on the ongoing processes aiming to specify stand-alone and non-stand-alone presentation engines as well as on the process aiming to finalize the work related to the 1.1 version of the MHP specification.

The latter issue strictly speaking cannot be characterized as a critical issue in terms of enabling further interoperability, as available standards (e.g. MHP 1.0.3) and mechanisms can be applied to achieve almost similar effects with respect to interoperability. However, MHP 1.1 plays a central role in enabling a number of processes related to interoperability and the specification is listed by the European Commission [5], leading to the recommendation to treat this as a critical issue after all.

Table 3

		Further work on the MHP 1.1 execution engine	
8	Deliverable	Stable version of MHP 1.1 specification including operational arrangements and maintenance framework.
	Objective	Enable the use of the interoperable plug-in mechanism for those stakeholders that see a genuine market requirement, enable the roll-out of a standardized API platform with a standardized native presentation engine build in and enable migration to and coexistence with MHEG-5.
	Producer	DVB
	Timeline	31/12/04
	Status	Critical
	Issues	In principle plug-ins can be produced for all legacy API systems as the interface for this is defined in MHP. This however does not imply that it is equally technically complicated for each legacy system or equally commercially desirable for the relevant players in a specific market to apply this mechanism.

Although supportive to the further development of digital interactive television services and the free flow of interactive content, the standardization of stand-alone and non-stand-alone presentation engines cannot be characterized as a critical issue in terms of enabling further interoperability. Therefore the work items are not listed as critical items. It should however be regarded in respect of the timing of the MHEG-5 standardization process coexistence and migration requirements may need to be addressed on relatively short notice.

Table 4

		Standardization of presentation engines	
9	Deliverable	MHEG-5 broadcast profile
	Objective	Deliver a standardized solution enabling those stakeholders aiming to deploy enhanced broadcast services only through applying a technical solution with limited capabilities but requiring limited resources.
	Producer	ETSI
	Timeline	30/06/04
	Status	Non-critical
	Issues	Standardization process is well underway.
10	Deliverable	Implementation of coexistence and migration requirements in the MHP 1.0.3 or the MHP 1.1 specification.
	Objective	Enabling coexistence between MHEG-5 and MHP and facilitating migration from MHEG-5 towards MHP allowing migration from enhanced broadcast services to full interactivity in a horizontal market environment.
	Producer	DVB
	Timeline	30/03/05
	Status	Non-critical
	Issues	In case evaluation of the coexistence and migration requirements shows adaptations are only necessary with respect to the 1.0.3 version of the MHP specification, the timeline may be considerably shorter.
11	Deliverable	Synchronization of the existing DVB-HTML native MHP 1.1 plug-in presentation engine with the ACAP ATSC candidate standard.
	Objective	Enabling stakeholders aiming to deploy a standardized API to implement a complete standardized solution, including the presentation engine on top of that API.
	Producer	DVB in cooperation with ATSC, ARIB and the ITU.
	Timeline	31/12/04
	Status	Non-critical
	Issues	Although synchronization of presentation engines between the US and Europe according to stakeholders is likely to happen and technically feasible, global harmonization may not be possible on relatively short notice. This may eventually lead to a variety of presentation engines or browsers being deployed, however in itself this would not establish an interoperability issue.

6.1.4 Portability of services

Activity in several parts of the world has been deployed to standardize a portable content format for example resulting in a SMPTE standard. In Europe this process is well underway in DVB; in addition, formats can be expected to be put forward by individual stakeholders as well (e.g. BSkyB). As the use of a PCF is regarded by many stakeholders as an economically viable way increasing interoperability of content in a "multiple-platform" environment and recent developments among stakeholders demonstrate an urgent requirement for such a specification, it is recommended the process in DVB generating this specification is listed among the critical work items.

Table 5

Standardization of a Portable Content Format		
12	Deliverable	Standardized Portable Content Format.
	Objective	Enable portability of most interactive content and services between receiver populations equipped with standardized or non standardized APIs and/or presentation engines either by transcoding at the broadcast end of the chain or by transmitting a browser supporting the PCF.
	Producer	DVB
	Timeline	31/03/05
	Status	Critical only for those markets where large quantities of receivers equipped with existing API or presentation engine technology are deployed.
	Issues	PCF standards have been - and will be - put forward in spite of the process in DVB. Due account of these standards should be taken in the specification process.

It is recommended the JTC Broadcast decides on the actual standardization of the PCF specification being produced by DVB, and points out the ESO required to deal with this.

6.2 Summary

In table 6 the 12 work items described in the previous clauses are listed in the categories "critical", "non-critical" and regulatory or maintenance issues. It is recommended that critical work items should be given priority as they are expected to deliver specifications or standards that will directly improve interoperability between interactive content and services in a number of markets.

Non-critical items are expected to generate standards and specifications that will encourage further growth of digital interactive content and services across a number of markets in Europe by synchronizing usage of specific technical concepts, but do not establish a direct barrier to interoperability since alternatives are - in a technical sense - mostly available.

Finally, regulatory and maintenance issues do not generate standards or specifications but constitute issues that will need continuous attention for a certain period of time that cannot be identified here. It would be helpful however if the first results of these processes could be available on short notice.

Table 6

Time line	Critical work items	Non-critical work items	Maintenance issues
2004 Q1-2			Maintenance of the DVB-SI specification and active research into the usage of SI in the market
			Inclusion of findings from (activated) DVB maintenance process into TR 101 211 [12]
	Coordination among national and European regulatory bodies on the allocation of SI codes		
		MHEG-5 broadcast profile	
2004 Q3-4		Synchronization of the existing DVB-HTML native MHP 1.1 plug-in presentation engine with the ACAP ATSC candidate standard	
	Stable version of MHP 1.1 specification including operational arrangements and maintenance framework		
		Development of a baseline specification for the use of xDSL as return channel	
2005 Q1	Standardized Portable Content Format		
		Implementation of coexistence and migration requirements in the MHP 1.0.3 or the MHP 1.1 specification.	
2005 Q2	Development of a baseline specification/specifications for digital interactive STBs applied in digital cable networks		
		Development of a baseline specification for digital interactive STBs applied in digital terrestrial networks	
		Development of a baseline specification for digital interactive STBs applied in digital satellite networks	

7 Further recommendations

The previous clause of this Technical Report contains the summarized and systematically structured recommendations for a standardization Work Programme supporting interoperability between digital interactive television services. The regulatory, technical and commercial background and rationale underlying it can be found in clauses 4 and 5, and carefully reflects a wide range of views and contributions from a significant number of stakeholders, put forward during a period of several months in the autumn of 2003, and publicly debated during two Open Meetings.

Despite these efforts to create a Work Programme reflecting a consensus position among the vast majority of said stakeholders, interoperability between digital interactive television services undoubtedly will remain a sensitive issue: stakeholders across Europe may hold different - and sometimes opposing - views, resulting from the different economic or technical background in which they originate or operate.

For those involved in execution of the second phase of the mandate from the European Commission [2] - which encompasses the actual delivery of the standards, specifications and other items described in the Work Programme - this wide range of views and positions should be noted. Moreover, considering the background of the establishment of this Work Programme, it is not unlikely the ESOs and industry organizations carrying out this second phase will require additional support to:

    i)   secure coherence between the various solutions;

    ii)   to monitor and encourage the timely completion of the deliverables; and

    iii)   to maintain the required level of consensus among stakeholders.

In this respect it should be mentioned that several stakeholders (e.g. cable and terrestrial network operators) have expressed their concerns as to whether the interests from all organizations or constituencies can actually be safeguarded adequately, for example in situations where cooperation among different trade organizations (potentially having different - or even opposing - interests) is required. Although this is a matter that does not concern interoperability between digital interactive television services itself, it should be kept in mind that ongoing convergence may increase these problems.

Moreover, maintaining the right balance between mandatory and optional parts of specifications and standards for digital television, and defining the proper forums to discuss and manage this balance, will be an additional challenge. Decreasing the lowest common denominator (and consequently increasing the degrees of freedom) in order to meet the rapidly progressing technological development may have entirely different effects across different trades that have to work with the same standard or specification.

Further, establishing and maintaining interoperability between digital interactive television services is a dynamic and ongoing process, as technological and market development will push forward new interactive service concepts and new ways in which consumers will seek to apply these new opportunities (e.g. related to PVR or IP TV). As convergence between broadcast and IP based services is likely to increase the speed of this development, additional interoperability issues are likely to emerge rather sooner than later (some of these have already been pointed out by the present document).

Although the execution of this standardization Work Programme will establish a basis for increased interoperability across most digital interactive markets in Europe, it is questionable whether this basis will remain sufficient to support the effective implementation of article 18 of the Framework Directive for a considerable period of time. Most stakeholders regard interoperability as a process rather than a characteristic. Innovations in platforms, services, and business models may require stakeholders to update existing approaches, or develop new strategies over time. For this reason, it may be advisable to consider processes to support the evolution of interoperability goals and techniques as the market for interactive television services develops.

Annex A:
Roadmap for the standardization of digital interactive television receivers

	Initiatives and specifications			Issues	Recommended Standardization Work Programme
	Initiatives		Standards		
Terrestrial	EICTA E-BOOK, based on DigiTAG, Nordig, UK D-Book, Aniel UK d-Book NORDIG Unified, 4 profiles		IEC 62216-1 [16]	On top DVB specifications: refinement, augmentation and option-selection	Complete Terrestrial specifications for relevant scenarios Consider consumers' requirements with special attention to elderly and people with disabilities needs
Cable	ECCA commercial requirements EICTA Cable-Book NORDIG; cable Finnish			On top DVB specifications: refinement, augmentation and option-selection	Develop Suitable Cable specification, or specifications if there are funds to be a variety of commercial requirements or different market conditions across the EU Consider Consumers requirements with special attention to elderly and people with disabilities needs
Satellite	Vertical platform specifications Generic physical layers and connections specifications		DVB Interfaces IRDs	On top DVB specifications: refinement, augmentation and option-selection	Complete DVB-Interfaces to cover iDTV relevant scenarios Consider Consumers requirements with special attention to elderly and people with disabilities needs Develop satellite receiver specification for Free-To-Air Reception
xDSL					Complete DVB specifications for xDSL set-top-box return channel) Pay attention to evolution of provision of IP TV and other IP-based services and, if necessary, develop functional receiver specifications for delivery of iDTV over xDSL networks
Assistive service requirements			EN 300 743 [24] V1.2.1; DVB Subtitling		Consider methods for delivery of Digital Signing (low bit rate channels avatars, etc)

Annex B:
Description of DVB Service Information structure

The PSI data is structured as four types of tables. The tables are transmitted in sections:

Program Association Table (PAT): For each service in the multiplex, the PAT indicates the location (the Packet Identifier (PID) values of the Transport Stream (TS) packets) of the corresponding Program Map Table (PMT). It also gives the location of the Network Information Table (NIT).

Conditional Access Table (CAT): Provides information on the CA systems used in the multiplex; most of the information is private (not defined within the DVB-SI nor in the MPEG-PSI) and dependent on the CA system. The non-private part of the information includes the location of the EMM stream, when applicable.

Program Map Table (PMT): Identifies and indicates the locations of the streams that make up each service, and the location of the Program Clock Reference fields for a service.

Network Information Table (NIT): The location of the NIT is defined in the ISO/IEC 13818-1 [23] specification, but the data format is outside the scope of this standard. It is intended to provide information about the physical network. The syntax and semantics of the NIT are defined in the DVB-SI.

In addition to the PSI, data is needed to provide identification of services and events for the user. The coding of this data is defined in the DVB-SI. In contrast with the PAT, CAT, and PMT of the PSI, which give information only for the multiplex in which they are contained (the actual multiplex), the additional information defined within the DVB-SI can also provide information on services and events carried by different multiplexes, and even on other networks. This data is structured as nine tables:

Bouquet Association Table (BAT): Provides information regarding bouquets. As well as giving the name of the bouquet, it provides a list of services for each bouquet, and can link to other information.

Service Description Table (SDT): Contains data describing the services in the system e.g. names of services, the service provider, etc, and can link to other information.

Event Information Table (EIT): Contains data concerning events or programmes such as event name, start time, duration, etc. and can link to other information; the use of different descriptors allows the transmission of different kinds of event information e.g. for different service types.

Running Status Table (RST): Gives the status of an event (running/not running). The RST updates this information and allows timely automatic switching to events.

Time and Date Table (TDT): Gives information relating to present time and date. This information is given in a separate table due to the frequent updating of this information.

Time Offset Table (TOT): Gives information relating to the local time offset and daylight savings. This information is given in a separate table due to the frequent updating of the time information.

Stuffing Table (ST): Used to invalidate existing sections, for example at delivery system boundaries.

Selection Information Table (SIT): Used only in "partial" (i.e. recorded) bitstreams. It carries a summary of the SI information required to describe the streams in the partial bitstream.

Discontinuity Information Table (DIT): Used only in "partial" (i.e. recorded) bitstreams. It is inserted where the SI information in the partial bitstream may be discontinuous.

Annex C:
Roadmap for the standardization of SI in digital interactive television services

| | Available initiatives and specifications | | Issues | Recommended Standardization Work Programme |
	Initiatives	Standards		
Technical components		IEC PSI - SI	Continuous identification of issues	Continue Maintenance of DVB-SI Continue Maintenance of DVB-SI Guidelines Launch pro-active surveys, checks to identify SI implementation issues Create Forum of Interactive applications developers to develop DVB-SI specifically suitable for iDTV and share experiences
	DVB-SI	EN 300 468 [11]		
	DVB-SI guidelines	TR 101 211 [12]		
Regulatory components	National authorities registeries of SI codes		Broadcasting Mandatory SI codes	Harmonize criteria for National Registries of DVB-SI Coordinate National Standardization Organizations on DVB-SI matters Consider involvement of ERG/IRG to coordinate National Registries Public availability of DVB-SI registries
		ETR 162 [13] Allocation Codes		

Annex D:
Bibliography

Digital TV Group: "Baseline functional specification for DTT receivers for the UK".

Suomen Kaapelitelevisioliito ry: "Requirements for MHP compliant interactive CATV Set-Top Boxes for the Finnish market".

History

Document history		
V1.1.1	February 2004	Publication