>> IPTV: White Paper <<

Profiles for IPTV Services and Home Devices

Working Group: >IPTV<
of the German TV-Platform

DEUTSCHE TV-PLATTFORM

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Management Summary

The IPTV market in Germany is a new vertical market with three main provider as well as some smaller provider. In order to facilitate the development of new markets, it's generally helpful that all market players focuss on a same business target.

The aim of the IPTV Working Group in the "German TV Platform", author of this paper, was to

- analyse the situation of the DSL-based IPTV market, without consideration of Satellite and Cable Networks
- define common application interfaces
- and to specify the use of common technology

Fulfilling that target the complexity in production and operation will decrease for all parties. Additionally, it is important for Broadcasters that their content is displayed consistently over all platforms and all end devices.
In the course of the working process we found it possible to use several outcomes from the IPTV Paper for other distributions means such as satellite and cable.

This document is not an exhaustive specification nor does it limit the functionality of the actual HNED products. This also means that it allows to implement additional methods, routines and standards on top of the recommendations of this document.

The present White Paper describes

- Regulatory requirements for program listing, EPG, navigation and protection of minors
- Basic requirements of IPTV systems according to provider, broadcaster, Home Network End Device (HNED) manufacturer for
  - interoperability
  - content protection
  - signal quality
- Basic architecture
- Linear transmission of TV and Radio services
- Interactive services
- Content control and protection
- PVR handling
- Video on Demand
- Classification of Home Network End Device (HNED) into three profiles of different funtional levels

Where international or national standards or regulatory requirements were given, the author followed those. Otherwise, open issued were defined.

We would like to stress that all market partners involved declared that they favor an open and harmonised market. One concrete output thereof is the agreement on the browser technology CE-HTML to be used for conventional TV-Services. The next step for the German TV Platform therefore is to present a CE-HTML based Teletext successor for the German TV market at IFA 2009. A second step for the German TV-Platform will be to investigate the developments in the WEB TV market.

The IPTV working group of the German TV-Platform is composed of members of all parts of the IPTV value chain.

- Public Broadcasters (IRT, ZDF)
- Private Broadcasters (RTL Group, Pro7SAT.1, Premiere)
- IPTV Service Provider (Deutsche Telekom, Hansenet, Arcor)
- Manufacturer (Loewe, Metz, Grundig, Panasonic, Samsung, Toshiba, Philips, Sharp, Thomson, Technisat)
- Communications Solutions Provider (Alcatel-Lucent)
- Semiconductor and Computer Industry (intel, Micronas, STM)
- Software Supplier (Microsoft)
- Network Solution Provider (Nacamar)
- Research (Fraunhofer FOKUS)
- Regulatory Authority (LfM, Federal Network Agency)
- Satellite Provider (Astra, Eutelsat)
- EPG Provider (PPS)

Content

1. Scope

This document aims at defining a profile for DSL-based IPTV HNEDs [1] and services that are to be used in an open market. We do not intend to provide a full HNED specification, but a minimum set of requirements regarding interface specifications.

This implies that there is usually no close relationship between a network operator or service provider and the manufacturer of the HNEDs. All resources of the HNEDs described in this document are designed to be used by all service providers on equal terms.

As there is no specific entity to control the parameters of all services and HNEDs, a high degree of harmonization and interoperability is necessary to guarantee good performance in the market.

The market partners involved in the present White Paper agree that harmonization shall be mainly based on DVB/ETSI standards. However, standards available from other bodies may also be used as far as reference is made by DVB/ETSI documents, or otherwise considered as useful.

The standards brought forward in this document are to be used on a voluntary basis, there shall be no obligation of use, as other standards are evolving the market.

For the purpose of this document, we consider the IPTV value chain as defined hereunder in Figure 1.

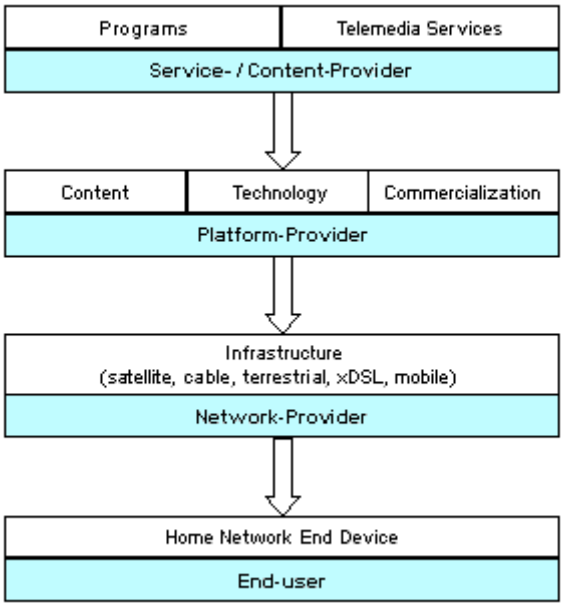

Figure 1: Value chain

1 In this document HNED (Home Network End Device) is used synonym for IPTV receiver or decoder in accordance to DVB-IPTV

The diagram above (figure 1) gives an abstracted view of the roles in the digital value chain and does not imply any definition of the actual actor (e.g. companies or legal entities). In this regard, a specific actor might cover multiple elements or just fractions of the value chain. Each role of the value chain can be spread over multiple actors (e.g. typically multiple content providers distribute via multiple platforms into multiple networks).

In the context of this document, the partners of the value chain are defined as follows:

Service-Provider: An organization that provides certain communication services, storage services or processing services, or any combination of the three. Examples are a local or long distance telephone company, Internet service provider (ISP), application service provider (ASP) and storage service provider (SSP).

Content-Provider: An organization or individual that creates informational, educational or entertainment content (aka “material”) for any type of (audiovisual) media. A content provider may or may not provide the software used to access the material.

Platform-Provider: An organization which aggregates programs and Telemedia (linear and non-linear audiovisual services) from one or more content-provider and/or own content to a service bundle addressed at end-users (consumers). Platform providers generally add supplementary services such as Electronic Program Guides (EPG). Platform provider is also generally responsible for encryption if this is requested from the content-service-provider or by the business model of the Platform-provider. End-user relation and end-user management is typically under control of the Platform-Provider.
(see also Annex A)

Network-Provider: An organization that delivers telecommunication services over different network infrastructures suches like satellite, cable, terrestrial, xDSL and/or mobile.

End-User: Consumer of the services provided.

2. References

This document incorporates, by dated and undated reference, provisions from other publications. These normative references are cited at appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revisions of any of these publications apply to this specification only when incorporated in it by amendment or revision. References by ISBN numbers to books shall be considered as dated references. For undated references the latest edition of the publication referred to applies.

[1] **ETSI TS 102 034** : “Digital Video Broadcasting (DVB); Transport of MPEG-2 Based DVB Services over IP Based Networks"

[2] **ETSI TS 102 539**: "Digital Video Broadcasting (DVB); Carriage of Broadband Content Guide (BCG) information over Internet Protocol (IP)"

[3] **ETSI TS 300 468**: "Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems "

[4] **ETSI TS 101 812** "Digital Video Broadcasting (DVB); Multimedia Home Platform (MHP) Specification 1.1.3" [currently available as DVB Blue Book A068r1]

[5] **ETSI TS 300 472**: "Digital Video Broadcasting (DVB); Specification for conveying ITU-R System B Teletext in DVB bitstreams "

[6] **ETSI EN 301 775** “Digital Video Broadcasting (DVB);Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams”

[7] **ETSI TS 102 543** "Digital Video Broadcasting (DVB); Globally Executable MHP (GEM) Specification 1.2"

[8] **ETSI TS 183 063** Telecommunications and Internet converged Services andProtocols for Advanced Networking (TISPAN); IMS-based IPTV stage 3 specification

[9] **ETSI RTS 182 027** Telecommunications and Internet converged Services and Protocols for Advanced Networking (TISPAN); IPTV Architecture; IPTV functions supported by the IMS subsystem

[10] **CEA-2014-A** CE HMTL

[11] **ETSI TS 102 825-3** DVB-CPCM Usage State Information

3. Definitions and Abbreviations

3.1. Definitions

Additional definitions for this document:

EPG	Electronic Programme Guide: application which is designed specially to guide through the programme of one or more services
HNED	Home Network End Device: Device that is connected to a home network and which typically terminates the IP based information flow.

Table 1: Definitions

3.2. Acronyms and Abbreviations

ADSL2+	Asymetric Digital Subscriber Loop 2 +
AIT	Application Information Table
API	Application Programing Interface
APS	Analog Protection System
BCG	Broadcast Content Guide
CA	Conditional Access
CGMS-A	Copy Generation Management System – Analog
CI	Common Interface
CPCM	Copy Protection, Copy Management
CSS	Cascading Style Sheet
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name Service
DOM	Document Object Model
DRM	Digital Rights Management
DVB	Digital Video Broadcast
DVB-SI	DVB-Service Information
DVI	Digital Visual Interface
EIT	Event Invormation Table
EPG	Electronic Program Guide
ETSI	European Telecommunication Standards Institute
GUI	Graphical User Interface
HD	High Definition
HDCP	High-Bandwidth Content Protection
HDMI	High Definition Multimedia Interface
HDTV	High Definition TV
HNED	Home Network End Device
HTML	Hypertext MarkUp Language
IETF	Internet Engineering Task Force
IP	Internet Protocol
ITU	International Telecommunication Union

LAN	Local Area Network
LCN	Logical Channel Number
MPEG	Moving Picture Expert Group
nPVR	Network Personal Video Recorder
NTP	Network Time Protocol
OITF	Operator Interface
PAT	Program Association Table
PMT	Program Map Table
PVR	Personal Video Recorder
QoS	Quality of Servcie
RTP	Real Time Protocol
RTSP	Real Time Streaming Protocol
SD	Single Definition
SD&S	Service Discovery and Selection
SDTV	Single Definition TV
STB	Set Top Box
STP	SD&S Transport Protocol
TISPAN	Telecommunications and Internet converged Services and Protocols for Advanced Networking
TS	Transport Stream
UDP	User Data Protocol
USB	Universal Serial Bus
VBI	Vertical Blanking Interval
VDSL2	Very High Digital Subscriber Loop 2
VoD	Video on Demand
VPRT	Verband Privater Rundfunk und Telemedien e.V.
XHTML	Extensible Hypertext MarkUp Language

Table 2: Acronyms and Abbreviations

4. Regulatory Requirements

4.1. Current Regulatory Framework for Telecommunication

The following regulatory requirements apply according to Telecommunication Law, and must be respected by the market participants concerned:

Art. 24 in conjunction with Annex VI Section 1 of Directive 2002/22/EC of the European Parliament and of the Council of 7 March 2002 on universal service and users' rights relating to electronic communications networks and services (Universal Service Directive), as well as Art. 5 (1) b and Art.6 in conjunction with Annex I of Directive 2002/19/EC on access to, and interconnection of, electronic communications networks and associated facilities (the Access Directive) as transposed into the German Telecommunications Law (Telekommunikationsgesetz, TKG), in Section 4, §§ 48 through 50.

The regulatory intention of above mentioned legal provisions is to assure inter-operability for consumer digital television equipment, digital interactive television services, application programming interfaces and conditional access systems.

4.2. Broadcasting Regulation

In addition, the following specific German broadcasting regulation applies and must be respected by the market participants concerned:

Systems controlling the selection of television programs and function as user interfaces have to be non-discriminatory and accessible for all services according to the German Interstate Treaty on Broadcasting (Rundfunkstaatsvertrag – RStV). User interfaces, application programming interfaces and conditional access systems have to comply with the current legal requirements as stipulated in the Interstate Treaty on Broadcasting and in the media law of the respective federal States of Germany.

Both broadcasting and telecommunication law must be respected by the market participants concerned.

5. Basic Requirements for IPTV Systems

5.1. Broadcasters Requirements

5.1.1 Interoperability

To achieve interoperability between different IPTV-platforms, standardized solutions shall be used as far as possible.

5.1.2. Area of Distribution

Distribution of services shall only be allowed in the contractually agreed area.

5.1.3. Signal Quality

The signal quality shall not be inferior than the original signal delivered by the broadcaster at any time. To achieve this, the transmission shall use Quality of Service (QoS) techniques with allocated bandwidth unless broadcaster and platform operator agree on different terms.

5.1.4. Access

The Platform operator shall grant access to all services via navigators on a non discriminatory and comparable basis to his customers. Services of ARD/ZDF shall be provided unscrambled and conforming to standards in order to support a wide range of terminal equipment. Platform operator shall allow broadcasters to use the return-path for interactive services on non discriminatory terms.

5.1.5. Signal Protection

Precondition is simultaneous, unmodified and complete transmission of all video-, audio- and other service-related content (e.g. Teletext) and signalling-information. Only unavoidable delays caused by technical reasons such as transcoding or network-transmission shall be acceptable. Platform operator will prohibit systems that allow ad-skipping.

Programs shall always be displayed in full SD (720x576i) or HD (1280x720p or 1920x1080i) resolution. Changes such as framing or overlays need to be agreed by the broadcaster, except neutral navigation- or service-information.

Prior consent of the broadcaster is needed for the reception of TV-services on a PC.

5.1.6. Zapping time

Delays for change of services shall be as short as technically feasible and shall not be used for any keying or overlays by the platform operator.

5.1.7. Protection of Content

If broadcasters require to control and secure their content, platform operators are obliged to use a CA/DRM-system. CE manufacturers shall be able to implement the CA/DRM-system on non discriminatory terms. The customer shall be able to use his terminal equipment with all IPTV-platforms of all IPTV-providers. This can be achieved by the usage of detachable modules (CI) or other solutions.

The configuration of the DRM-system shall be specified individually per content / programme by the broadcaster. It shall be possible to completely deactivate the DRM-system upon request by the broadcaster with content remaining unscrambled in this case.

The following components need to be secured by the CA/DRM-System:

- Digital interfaces of SD-/HD-HNEDs (DVI, HDMI, USB, LAN, etc.) and especially connections to external storage devices.
- HNEDs with integrated hard disks (PVR)
- PVR-systems with network- (provider-) based storage of content (nPVR)

Standardized signalisation of content rights and DRM-rules is required by the broadcasters. nPVRs shall fulfil the same requirements in terms of content protection as local PVRs. Content distribution in home networks of the customers shall be supported according to the content rights and DRM-rules set by the broadcaster.

5.1.8. Interactive Services

Generally, a browser shall be used to enable similar interactive services on different platforms (e.g. cable, satellite, terrestrial und IPTV). The browser shall support a minimum set of features in all implementations.
It is a precondition for the launch of interactive services by broadcasters that all services are displayed with the same features in the same way over all platforms.

5.1.9. Listing of Services

All services should be listed on a neutral and non discriminatory basis in navigators and EPGs according to Interstate Treaty on Broadcasting and Application Rules.
First proposals for concrete implementation of such requirments have been submitted jointly by ARD, ZDF and VPRT („Gemeinsame Erklärung der Arbeitsgemeinschaft der öffentlich-rechtlichen Rundfunkanstalten der Bundesrepublik Deutschland (ARD), des Zweiten Deutschen Fernsehens (ZDF) und des Verbandes Privater Rundfunk und Telemedien e.V. (VPRT)“).

5.2. Home Network End Device (HNED-) Manufacturers Requirements

5.2.1. Interoperability

To achieve interoperability between the different IPTV-platforms, unified and standardised solutions have to be used. This applies not only to the German market but also for the European market. The manufacturer of HNEDs should be able to produce devices functionning in all IPTV networks considered by this white paper. Harmonisation of the different solutions and standards shall be the aim of this White Paper.

5.2.2. Access

Non-discriminating access to all content in the IPTV network has to be granted by means of established and comparable GUI navigation systems. In order to gain a significant market share, the programs shall be standard compliant. If scrambling is necessary, it shall be realised over a CI-mechanism or a DRM-software solution which has to be unique within the scope of this white paper. No user data is allowed to be recorded or transmitted via the return channel.

5.2.3. Signal quality

The HNED shall receive video, audio, all program-related additional data and all signalling information simultaneously. Except for unavoidable delays caused by transcoding and network retention, no time offset is acceptable.
The content shall always be transmitted as a full frame and in full resolution (720x576, 1280x720p or 1920x1080i pixel). Change of the visual video presentation like framing or other overlays shall not be allowed. Neutral navigation- and program-information are exceptions from the rule.

5.2.4. Content Protection

If CPCM-systems are necessary, the implementation shall be non-discriminatory- for the manufacturer of the HNED. If more than one SW DRM system is possible within the scope of this white paper, compatibility with different IPTV networks shall be ensured by a CI module. The manufacturer of the HNED only needs to implement one DRM system to be compatible in all IPTV networks. It should be possible to record content and to distribute it within the home network. If content protection is required for such use, the same DRM and CI solution as mentioned above should be applicable.

5.2.5. Interactive Services

For interactive IPTV services, a standardised HTML-Browser should be applied, as future HNED need a browser for access of internet based services (webTV) as well. The interactive services have to be presented equally on the different possible HNEDs and shall be based on HTML-browsers.

5.3. IPTV Platform Operator Requirements

The following information gives an overview of the most important requirements of the IPTV platform operators.

5.3.1. Interoperability

Customers shall be able to use their home network end device (HNED) when changing their IPTV platform-provider and hence, the service platform. The use of the full-service package of a provider shall only be possible with HNED devices certified by the provider and on his platform. Interoperability is however limited to the basic HNED functions.. Interoperability within the various IPTV platforms can only be guaranteed for such HNEDs having been certified by the platform operator offering these devices and fulfilling certain standards listed in the present paper.

In order to ensure interoperability of HNEDs within the various IPTV platforms, standardized solutions shall be applied. Consequently, the hardware platforms of the HNEDs must be standardized. On this basis, platform operators can ensure that the basic HNED functions are provided. Due to the broad impact of standards and technical developments, these requirements shall apply not only to the German market, but also to the European market.

The goal shall be to harmonize the HNED platforms. As this issue is currently being discussed by a wide range of working groups, we also recommend harmonization of the various bodies and working groups. Essentially, the following groups are affected:

- DVB project (DVB-IPTV)
- ETSI TISPAN
- IETF
- Open IPTV Forum
- CA/DRM working group of the Federal Network Agency's (BNetzA) ATRT committee
- Deutsche TV-Plattform – "IPTV" working group

5.3.2. Signal Quality

The signal quality for a transmission shall remain invariable over time and meet the requirements of broadcasters and/or content right owners. For signal transfer, which may involve transcoding, the quality of the signal feed is extremely important. For this reason, it is necessary to define quality standards to be met by the broadcasters, which will guarantee an adequately high quality of the source signal.

Quality of Service measures can be taken by the platform operator in order to safeguard signal quality. One such measure could involve the use of technology to provide subsequent delivery of lost transport stream or IP packages.

5.3.3. Access to Services

The HNED enables the end customer to access the IPTV services. By default, the platform operators apply different technologies, e.g. for the HNED operating system, the client software and the content protection system. The necessary software is transferred to and installed on the HNED upon provisioning to the customer (initial installation).

Non-discriminatory access to TV programs via an electronic program guide (EPG) and navigation systems is to be provided on the HNED for the end customer.

5.3.4. Signal Transfer

The TV programs shall be made available via IP as MPEG2 A/V transport stream in accordance with ISO/IEC Standard 13818-1 and the DVB-IPTV standard (ETSI TS 102 034). Further features of DVB-IPTV are still being developed and yet not standardized. It shall not be mandatory for a DVB-IPTV-compatible SD&S server to be a component of the IPTV platform.

The signal transfer may be restricted to customers of the respective IPTV platform.

As a minimum, the essential components of the program signal (video, standard audio, service information EIT actual p/f, video text) shall be transferred. Unavoidable technical delays and impact on quality, e.g. due to transcoding and network runtimes, are permissible when the signal is retransmitted.

The additional data accompanying the program shall include the following data and standards:

DVB-TXT	Teletext	EN 300 472
DVB-VBI	WSS, VPS, Teletext	EN 301 775
DVB-SI	SI data	EN 300 468

Table 3: Accompanying data

The following service information (DVB-SI) data tables shall be transferred as a minimum requirement:

EIT	Event information table	EIT p/f actual
PAT	Program association table	
PMT	Program map table	

Table 4: DVB-SI tables to be included

As an option, the feed may be delivered via an alternative transmission path in order to provide access to special-interest, regional or radio programs. This also applies to the additional data accompanying the program.

5.3.5. Content Protection

Suitable systems shall be used in order to protect access to content and satisfy the requirements of the broadcasters / content right holders. Selection of the system to be used shall take into account the requirements of the rights holders (live TV and VoD). Deactivation of the DRM system shall also be possible in order for the program signals not to be encrypted. The use of separate systems for live TV and VoD is not cost-effective and shall be avoided.

In general, encryption shall be possible via one or more standardized technologies. It shall be possible for an IPTV platform operator to decide on a system according to requirements and use cases. In the event that a provider chooses or is compelled to abandon a CI interface, CAM module or smartcard for its HNED, it shall be possible to use an embedded / downloadable content protection solution.

Usability of various software-based technologies should be achieved through a modular system architecture for the HNED, enabling download and replacement of the CA/DRM in a similar way to changing a CAM module (“software CI”). The basis of such a system could be a security processor offering all necessary cryptographic algorithms. The modular structure of the system enables interoperability of the HNED with other platforms. It shall be made possible upon switching of provider/platform to change the CA/DRM system and continue to use the HNED with the new provider (with restrictions). The modular solution to be chosen shall be an international or at least a European standard. The respective standardization bodies (DVB, ETSI, ITU and IETF) are working on appropriate solutions. Concepts should be matched to bring forward one collaborative solution.

Furthermore, the HNED shall support encryption systems established on the market in such a way as to allow these systems to be used without specific adjustments to the operator’s IPTV platform. This requires the development of corresponding standards by the manufacturers of encryption systems and set-top boxes.

5.3.6. Indication of Rights of Use

Currently, the settings of the platform operator’s CA/DRM system are defined by broadcasters and content rights owners. Corresponding information (e.g. set out in the retransmission contract with the IPTV service operator) are provided to the platform operator in order to configure his systems according to the individual channels. This configuration is normally carried out via a platform management tool and a database in which the rules for each channel are stored.

In the future, these settings need to be established in a dynamic and event- or content-specific way. The scope of the rights of use for IPTV platforms shall therefore correspond to the requirements for the other distribution channels (DVB-S/C/T).

For event-specific configuration, the broadcaster must provide the content protection information for the respective program in real time to the platform operator. The platform operator then has to transfer this information without any changes in content to the HNED. The HNED evaluates the rights of use and operates according to these rules. For example, such a signaling can deny the recording of a specific program by the integrated PVR. Broadcaster requirements for linear program distribution can be found in Section 9 of this document.

The signalization pathway can be broken down into the following two sections:

1. Broadcaster → platform operator (e.g., through DVB-SI)
2. Transfer of rights of use via the operator's IPTV platform to the HNED (e.g., based on the DRM system used)

The HNED evaluates the rights of use signaled and enforces the use of content within the authorized domain. The DVB-CPCM standard is envisaged by the DVB consortium for the signaling of rights of use to a HNED. CPCM was developed with the involvement of content right owners and takes into account all relevant use cases and rights of use at the time of writing the specification. However, the IPTV working group of Deutsche TV-Platform recently pointed out to the persons in charge that use cases need to be amended.

The signaling of these rights of use within the DVB transport stream is not yet standardized. For transport of the full Usage State Information CPCM does not specify the format to be used, but rather refers to the use of the CA systems. However, this approach is entirely unsuitable for the platform operators. The platform operators are not granted access to the Entitlement Control Messages (ECM), which contain the rights of use in encrypted form.

Nevertheless, the platform operator must be able to read these messages in order to equip its own DRM system with unchanged rights of use. The broadcasters therefore could use a standardized encryption method for the signalled content rights in order for the platform operators to decrypt and convert the content rights into different DRM systems.

The selected format shall satisfy the requirements of the broadcasters and content rights holders and enable the desired business models. The use of various formats is not an option in the opinion of the IPTV platform operators. As a result, innumerable converters would be needed on both sides, which would lead to an error risk.

An encrypted form shall be chosen for signaling of rights of use in order to prevent manipulation of the transmission path. This applies to the transfer of content from the IPTV platform to the HNED. Manipulation of signaling on the way from the broadcaster to the IPTV platform is inconceivable, as the systems are entirely controlled by both parties.

For the use of DRM systems, which combine content protection and signaling of rights of use, it is not possible to signal usage rights if the deactivation of the protection mechanism is requested.

5.3.7. Distribution Area

As the distribution of content is generally restricted to a specific geographical area according to license agreements, the IPTV platform provider must ensure that there is no reception outside the given territory. Technical measures can be derived for the authentication of the broadband connection and the customer's HNED.

5.3.8. Interactive Services

In the future, a uniform, standardized software interface shall be used for the various IPTV platforms to enable interactive services, based on web technologies. This will allow services to be offered across platforms. A corresponding interface satisfying the requirements does not yet exist and must still be developed. DVB-MHP is currently not regarded as an appropriate mean to implement interactive services.

For the introduction of interactive services, interactive applications must be executed and presented on the different HNED devices as similarily as possible. Also such applications shall operate in the same or at least a similar way (given that the HNED devices provide same features).

The approval of such applications by the platform operators is necessary in order to enable accurate and fault-free execution of interactive services and for commercial safeguarding.

5.3.9. Data Security

All system and customer-specific data must be transferable by software download or smartcard dispatch, irrespective of the devices.

6. Basic Architecture

6.1. IPTV Network

6.1.1. Network Infrastructure

The most basic requirement for supplying IPTV services regarding the network can be described as “IP connectivity”. Regardless of the underlying technologies, the transport of IP packets is the basic requirement. However, IP transport alone is not enough for meeting the requirements of service providers and broadcasters. A prioritization of the transport of IPTV IP packets is essential to facilitate a quality service. In using such a technology, IP packets containing IPTV transport stream or other data are flagged with a higher priority than other packets and thus are handled differently by network components. Another quality of service (QoS) mechanism is the recovery and resending of lost packets counteracting losses of picture, sound or other data in the UDP data stream.

Further key characteristics of IPTV systems are for example bi-directional communication and customer authentication through the network terminating device (modem / router).

6.1.2. Customer Connection

Basic requirement for reception of IPTV services (not Internet television or "Web-TV") in the customer residence is a broadband connection. Common Connections for IPTV are currently ADSL2+, VDSL2, (Wireless, Fibre to the Home). Satellite and Cable Networks is not considered in the scope of this paper. Common connection bandwidths of IPTV services are today 6, 16, 25 and 50 mbps. Connections without bandwidth management and a minimum guaranteed bandwidth (6 MBit/s: approx. 4.5 MBit/s for TV plus overhead for additional services) should be avoided for IPTV, but can be used in a best effort approach. To fulfill the requirements of certain broadcasters, in particular with regards to end-to-end packet loss, QoS mechanisms should be applied.

There is no defined minimum bandwidth for IPTV today but characteristics, features and use cases are directly linked to the bandwidth of the connection. Considering quality requirements (mainly video) of TV broadcasters, the applied codecs and transport overhead a minimum requirement for one SD channel at a time could be determined. However, there should be no specification for a single channel because bitrates depend on individual solutions and required quality.

6.2. IPTV Customer Premises Equipment

6.2.1. Service Connection Infrastructure

Customer premises equipment generally consists of a modem and a broadband router or a combination of those in one devices. Modern routers do also offer WLAN, but in most cases without QoS.

To close the gap between the telephone / broadband equipment and the HNED, e.g. wireless 5 GHz WLAN bridges with QoS, Polymeric Optical Fiber, POF and/or Powerline PLC can be used, among others.

6.2.2. IPTV HNED

In terms of interoperability issues to be defined later on and for economic reasons it is necessary to define certain HNED set of features first. These can allow one or more levels of interoperability depending on development costs, whereas only the basic interoperability level should become an obligation, if at all. Service providers are free to offer a HNED of their choice to their respective costumers.

The distribution of IPTV HNEDs that are not interoperable with services of competing operators shall still be legitimate to allow for low system development costs and in order not to discriminate service operators.

Examples for HNED profiles can be:

- Basic HNED: Support of SD&S, channel selection based on SD&S info, decoding and presentation
- Basic HNED Plus: Basic HNED AND "light browser" for basic interactive services OR an extended navigation service for e.g. VOD like e.g. VoD, etc.
- Interactive HNED: Basic HNED AND MHP OR browser API

Technical requirements (e.g. hardware parameters) shall be defined for each profile and outline the HNED performance. In addition, HNEDs may be equipped with further hardware (e. g. hard disk drive, DVB-C/S/T tuner, WLAN interface), DRM, in-home streaming.

7. Linear Transmission of TV and Radio Services

The transmission of linear TV and Radio services bases on the DVB-IPTV standard [1]. This chapter intends to give some additional suggestions for implementation.

7.1. IP Interface and Streaming Protocols

7.1.1. IP Interface

The IP Interface shall physically allow attaching an RJ 45 Ethernet plug. More details concerning the Ethernet layer can be found in chapter 7 of the DVB-IPTV standard [1] ("Transport of MPEG-2 TS").

All address allocation shall be based on DHCP. The following guidelines should be followed for DHCP:

The set-top box (STB) must always boot using DHCP. The older BOOT protocol must never be used, as it does not work in routed environments and does not provide a valid Vendor Class Identifier (VCI).It shall use DHCP for both normal booting and for initial installation, if required.

When the STB performs DHCP, it shall use a unique and meaningful VCI, so that the DHCP server can identify the set-top box model and handle it appropriately.

If the DHCP client on the STB fails to obtain a network address within 60 seconds, the STB boot process should display an error message. The error message should suggest checking the network connection. The boot process should continue retrying DHCP, with the error message displayed, until DHCP succeeds.

Besides the basics of the IP address, netmask, gateway, and DNS, the DHCP request from the set-top box requests the domain name, time server, log server, root path, and NTP server IP address for use by the system. Any of these parameters returned by the server shall be saved. The other information gathered by the DHCP client shall also be saved to a text file using a NAME=VALUE format for other software to use.

The real time clock for the HNED shall not rely on any TDT/TOT possibly contained in the MPEG2-TS, but on the Simple Network Time Protocol as it is foreseen in chapter 8.2.1 of [1] (“Real-Time Clock or other applications with an accuracy of 100 ms”).

The HNED cannot rely on time services with higher precision.

7.1.2. Streaming Protocols

Both UDP and RTP streaming may be used in IPTV networks and shall be covered by the HNED. In the case of RTP extension fields may be used. They must be correctly skipped when extracting the MPEG2-TS.

7.2. Service Discovery

Service Discovery shall be generally based on the mechansim defined in TS 102 034.

7.2.1. Entry point detection

The HNED cannot fully rely on the entry point mechanism as defined in chapter 5.2.4 of the DVB-IPTV standard [1] (“Service discovery entry points").

While performing the steps defined by the standard, the HNED might detect SD&S records which are syntactically OK, but which do not fit to the actual service offering in his network. Such a misfit can be detected by the HNED when the services announced by the SD&S records are not available.

In any case the HNED shall provide the option to manually enter the IP address or an URL of the entry point for http access of the SD&S records.
The port number for these records shall always be the default value 3937.

7.2.2. Protocols

IPTV networks must support the http protocol for SD&S delivery in any case and optionally also the multicast via STP protocol as defined in [1].

BiM compression will not be applied to the SD&S records.

7.2.3. Supported Records

7.2.3.1. Service Provider Discovery Record

The meaning of "service provider" in this context is the provider of the content offer. It has the same meaning as the "service provider" in the context of the DVB-SI standard [3].

7.2.3.2. Broadcast Discovery Record

Only the "TS - Optional SI" version of this record will be used. This means that no SDT, BAT or EIT schedule can be expected in any MPEG2-TS and all service related information will only be provided by the records defined in TS 102 034.

7.2.3.3. Package Discovery Record

The Package Discovery Record can be used to group particular services into one entity. The Package Discovery Record does not assist at discovering new services. All services included in a Package Discovery Record must be identified through the Broadcast Discovery Record. The use of the Package Discovery Record shall not be mandatory for the HNED.

7.2.3.4. Broadband Content Guide Record

The Broadband Content Guide Record allows discovering the locations of content guides. Content guides are listing the available content. The Broadband Content Guide Record shall be offered by providers as specified in chapter 5.2.6.6 of ETSI TS 102 034 (DVB-IPTV standard) with the following constraint: Discovery and processing shall be mandatory only for guides for live (broadcast) content. A provider discovered through this shall carry the BCG information over the Internet Protocol (IP) as specified in ETSI TS 102 539.

7.2.4. Logical Channel Number (LCN) function

The LCN function as currently provided by TS 102 034 does not support the provision of a "global" LCN as required by the market. Only LCN lists per bouquet are supported in the current version.

Adding further LCN options to the standard are to be discussed with DVB.

7.3. Video and Audio Coding for TV Services

7.3.1. Video Coding

7.3.1.1. SDTV services

For SDTV services the support of H.264 MainProfile@Level3.0 up to 4 Mbit/s shall be mandatory.
Optionally, MPEG-2 Video or other codecs can also be supported.

7.3.1.2. HDTV services

The support of HDTV shall be optional.
For HDTV services, the support of H.264 HighProfile@Level4, Bitrates decodable up to 15 Mbit/s shall be mandatory.

7.3.2. Audio Coding

The support of MPEG1 Layer 2 is the current audio codec. Dolby Digital Bit Stream Out (AC-3) and HE-AAC can be used optionally. In the course of the development of efficient codecs progresses, other codecs (e. g. Dolby Digital Plus, AAC Plus) can be applied in the future.

7.4. Radio Services

The HNED shall decode Radio Services which are transmitted in the same way as TV services and use the same DVB-IPTV mechanisms. Alternatively (especially for niche radio stations or due to economical reasons) other streaming mechanisms, transport protocols and codecs can be used for transmission. To give an example, the following technologies are relevant today as well as in the future:

Transport Protocols: RTP/RTSP, HTTP (MMS optional) 2
Audio Codecs: MP3, HE-AAC, (WMA optional)

7.4.1. Signalling & Recording

Radio services will be signaled as part of the SD&S records. The broadband content guide may also include data for radio services. If the HNED supports recording functions, they should also be usable for radio services.

7.4.2. Audio Coding

The HNED shall decode Radio Streams which are transmitted in MPEG2-TS format and the same coding options as TV soundtracks. Other transport formats and audio codecs e.g. MP3, HE-AAC (WMA optional) can be used additionally.

7.5. Broadband Content Guide

DVB has developped a special content guide solution for IPTV named the Broadband Content Guide (DVB-BCG). Per definition the BCG is a Content Guide which is delivered over a bi-directional IP network. The BCG carries metadata information in the TV-Anytime XML format and specifies metadata tags for programme, service and other information.

2 Microsoft Media Server Protocol

Metadata for the TV and radio services is made available via the "Broadband Content Guide" (BCG) [2] based on the TV-Anytime standards.

The BCG records are usually carried in the IPTV network BiM coded and via Multicast. The full BCG will probably be split up into several Multicast streams in order to avoid streams requiring too much bandwidth.

Usage of the BCG should not be an obligation to the full extent of the specification. A subset of the parameters should be seen as basic requirement. These are derived from the metadata set of DVB-SI (see Table 5).

DVB-SI Element	Source	TV-Anytime Element as provided by the BCG	Comment
Title	short event descriptor	Title	
Description	extended descriptor	Synopsis	
Short Description	short event descriptor	ShortSynopsis	
Parental rating	parental rating descriptor	ParentalGuidance	
ServiceID & EventID	event_information_section	CRID	
Aspect ratio	component descriptor	AspectRatio	
number of channels	component descriptor	NumberOfChannels	
Audio language	component descriptor	LanguageCode	
DVBGenres	content descriptor	Genres	DVB Content CS
Series	content descriptor	EpisodeOf / MemberOf	
black/white	content descriptor	Color	
live broadcast	content descriptor	IsLive	
Subtitle language	subtitling descriptor	SubtitlingLanguage	
data broadcast / application	data broadcast descriptor	MediaType	
Start time	event_information_section	PublishedStartTime	
Not contained in DVB-SI	Not contained in DVB-SI	PublishedEndTime	calculated
Duration	event_information_section	Duration	
DVBLocator	Not contained in DVB-SI	ProgramURL	

Table 5: Mapping of Event Information

7.6. Teletext & Subtitles

7.6.1. "Static Teletext"

7.6.1.1. Teletext Tunneling

In the standard Teletext Tunneling mode, all teletext pages are carried within the MPEG2-TS of the corresponding service according to [5]. HNED shall be able to decode those teletext pages.

7.6.1.2. Teletext via API

The API for interactive services should be used for advanced teletext services and improved presentation options.
Specific signalling can be used to link appropriate services to the teletext button if required.

7.6.2. Subtitles

7.6.2.1. Teletext subtitles

Subtitles may be carried within the MPEG2-TS of the corresponding service according to the standard teletext streaming format [5]. Synchronous decoding and display according to the MPEG PCR/PTS mechanism are important.

7.6.2.2. DVB subtitling

DVB subtitling may be used as an alternative approach to transmit subtitles.

8. Interactive Services

8.1 Architecture

There are two technical approaches to realize interactive services:

The first is fully based on the MHP 1.1.3 standard and allows for technically advanced applications with full JAVA capabilities.

The second has been chosen to allow the implementation of HNED a lower degree of complexity; it allows the usage of a "standalone" HTML browser without full MHP implementation. This option is described below; and does not require the implementation of a Java VM.

8.2. Signalling and Application Lifecycle

Interactive services related to one or more services are signalled in an AIT which is carried in the same MPEG2-TS as the corresponding service(s).

HTML- and/or MHP-applications shall be started and stopped according to AIT signalling as defined in chapter 10 in [4]. The only descriptors in AIT applications_descriptors_loop relevant to this specification are defined in 10.10.1 and 10.10.2. in [4].

Basic lifecycle rules:

- signalling of applications on broadcasting services is done via broadcast AIT or SD&S
- only applications signalled in the AIT are allowed to run in the context of the corresponding service (embedding of video, …)
- when an application tunes to a service and is included in its AIT then the tuning is performed and the application remains active. If the new service signals an autostart application then this application is not started.
- when an application tunes to a service and is not included in its AIT then the tuning is performed and the application is killed. If the new service signals an autostart application then this application is started.
- when an application running on a service starts another application which is not signalled in the AIT of this service then the application is started but the service context has to be cancelled (logical tuning to a "null" or "default service"). The new application can then via tuning put itself into a new service context (if not signalled on the new service it will be killed)

8.3. Transport Protocols for HTML- and MHP-Applications

Interactive services related to one or more services are signalled in an AIT which is carried in the same MPEG2-TS as the corresponding service(s).
Standard AIT signalling is used for transmitting the related URLs via the broadcast channel.

8.3.1 Bidirectional IP Connection

For bidirectional IP communication channels, standard http and https protocols are used to carry applications.

8.3.2 DSM-CC via Broadcast channel

IPTV networks will not use the DSM-CC carousel mechanism within the MPEG2-TS for the transport of any application or data. Only http requests on web servers via the IP interaction channel will be used to load data.

The only exception is the carriage of DSM-CC stream events which will be used for transmitting time critical information via the MPEG2-TS.

As a consequence, full implementation of DSM-CC is only required for decoders with a broadcast frontend.

8.4 HTML profile

The HTML profile used by the services is based Open IPTV Forum Declarative Application Environment (DAE) specification based on the CE-HTML standard (ANSI/CEA-2014.A) plus the additions defined by the Open IPTV Forum.

The minimum requirements for the browser are given by a compliance list which is still under discussion and will be published later.

Scalable Vector Graphics will not be used for the time being.

9. CA / DRM Functions

The CA/DRM system is not specified in this document. We assume that no standardization is available for these systems and different CA/DRMsystems will be implemented in the IPTV market.

Therefore, this chapter contains only some basic requirements for CA/DRM systems in order to allow a minimum of interoperability among such systems.

9.1. IPTV Content Provider Requirements for CA/DRM functions

9.1.1. DRM Control by Content Provider

All DRM functions have to be controlled by the corresponding content provider. It must be possible to apply DRM control for each type of content and service individually – e.g. VoD services and/or linear services.
The interface to control the DRM system is either based on the DRM signalling as described in chapter 9.2 or specified separately between content provider and operator of the DRM system.
In case the content provider signals no DRM requirements, the HNED shall deactivate all DRM protection mechanisms like Macrovision or HDCP.

9.1.2. DRM Functions

In order to avoid unauthorised retransmission or copying of content, a state of the art DRM system shall be integrated. Some content right owners insist on approving a certain DRM system used by the contracting party, i.e. the service operator or broadcaster.

9.1.2.1. Analog Video Output

In case the HNED has analog video output (Scart, composite or component cinch jacks, S-Video), the analog copy protection mechanisms have to be implemented. Besides the commonly used Macrovision Analog Protection System (APS) the open source Content Generation Management System Analog (CGMS/A) is also required by many content rights owners today.
Besides basic video output protection requirements some right holders request an outage of certain video interfaces or in terms of HD content or a downscale to PAL resolution.
The following protection status for analog video outputs are currently required:

Affected Outputs	Protection Status
Analog SD Video (Composite, Component YPbPr/Wideband RGB through all jacks)	Macrovision APS on/off
Analog SD Video (Composite, Component YPbPr/Wideband RGB through all jacks)	CGMS/A setting upon signaled state
Analog HD Video (Component YPbPr/Wideband RGB through all jacks)	Macrovision APS on/off
Analog HD Video (Component YPbPr/Wideband RGB through all jacks)	CGMS/A setting upon signaled state
Analog HD Video (Component YPbPr/Wideband RGB through all jacks)	Downscale to PAL 625/25i or PAL 625/25p
Analog HD Video (Component YPbPr/Wideband RGB through all jacks)	Switch off

Table 6: protection status for analog video outputs

9.1.2.2. Digital Video Output

If the HNED has an uncompressed digital video output (DVI, HDMI), High-Bandwidth Digital Content Protection system (HDCP) shall be implemented. Other digital interfaces that could be used as a video output (which does not mean file transfer), e.g. FireWire, USB, LAN are only allowed in the HNED if they support Digital Transmission Content Protection (DTCP or 5C) and can apply this technology to such outputs upon requirement of content right owners or broadcasters. File transfer through such or other interfaces shall not be allowed in general. Sole exception for USB and FireWire shall be permission for file transfer reflecting a product feature (e.g. right to transfer content to a portable device). Such a right shall be given through an appropriate DRM rule and shall be controlled by the rights owner or broadcaster.

Furthermore, it shall be possible to switch off compressed digital video interfaces completely for a certain content (even though DTCP is supported by the HNED) by right owners or broadcasters.

The following states for digital video outputs are required from a current perspective:

Affected Outputs	Protection Status
Uncompressed Digital Video (HDMI/DVI)	HDCP on/off
Compressed Digital Video (USB, FireWire, LAN)	DTCP on/off
Compressed Digital Video (USB, FireWire, LAN)	Switch off

Table 7: states for digital video outputs

The usage rights and restrictions of such digital video interfaces shall be controlled through the DRM and/or signalling means as defined in chapter 9.2).

9.1.2.3. PVR Handling

IPTV HNEDs (i. e. set top boxes) can be equipped with a Personal Video Recorder (PVR) that allows recording of live TV programming whereas permanent recording (PVR recording) takes place on behalf of the customer. On the other hand, non-permanent recording (timeshift recording) may be initiated by the HNED automatically. Usually, timeshift recorded content is lost upon a channel change as the recorder starts recording the newly selected channel. On some services, timeshift recordings can be converted into PVR recordings. Rights of use in terms of recording and replaying can be restricted.

HNEDs with integrated PVRs shall store content in an unencrypted form except if any restricting DRM function as listed below is set in order to prevent circumvention of the DRM. DRM control information shall be transmitted and stored in the IPTV network in a properly secure way for each content. Such control information and the decoder DRM implementation must at least support the following DRM functions controlled by the broadcaster:

- No recording restriction at all
- No recording allowed at all
- Recording allowed, play back only with start/stop/pause/rewind functions, prevention of skipping and prevention of fast forwarding

- Recording allowed, play back only with start/stop/pause/rewind functions, prevention of skipping and limitation of the fast forward-speed configurable 2x, 4x, 8x with visible content during fast forward
- Play count restrictions (play back allowed n times)
- Limited retention period of recordings at least 90min (timeshift), 24 hours, 3 days, 7 days, 30 days, 90 days.

These functions reflect the general rights holder requirements currently known.

9.1.2.4. Copy Control Functions

If the HNED allows copying of content (e.g. on DVDs) the DRM system shall allow at least to implement the following functions:

- Copying allowed
- Copying allowed n times
- Copying not allowed

9.1.2.5. Protection Of Minors

According to German legislation, specific mechanism for the protection of minors must be considered for broadcast services, VoD services, Near VoD services (NVoD) and TV broadcast storage features (e.g. local or network PVR, time shift or time shift restart).

The HNED shall therefor support the protection of minors as specified by specific national law applicable for the service provider.

In general, according to Art 5 of the Interstate Treaty on the Protection of Human Dignity and the Protection of Minors in Broadcasting and Telemedia, content impairing the development of children and adolescents (“Jugendbeeinträchtigende Angebote”) must be transmitted in a way that the relevant age groups do not normally see or hear such content. Therefore, content rated “FSK-16”[Freiwillige Selbstkontrolle] can only be broadcasted between 10 pm and 6 am and “FSK-18” between 11 pm and 6 am.

However, for digitally transmitted commercial television content the state media authorities have specified by means of concordant statutes the terms under which a broadcaster fulfils his obligations by protecting a broadcasting programme through technical means used exclusively for this purpose (“Jugendschutz Vorsperre”):
The broadcaster shall ensure that access for the user is possible only for the duration of the respective broadcasting program or the respective film.

Therefore, if a provider foresees appropriate technical means, the broadcasting of FSK 16 content is possible without time limitation and the broadcasting of FSK 18 content is permitted from 8 p.m. to 6 a.m. Such technical mechanism must foresee a personal 4 digit pin code, which is generally assigned individually by the service provider to the full age user upon subscription. The unlocking of the protected content only last for the time of the relevant programme: at the end of the schedule the pin code must be typed again in case the following programme is also FSK16 or FSK18.

Other content classified as “endangering minors” (“jugendgefährend”)- typically erotic services are only allowed to be distributed through non linear service (“Telemedia”) to adults within a “Closed User Group”, under the condition of a reliable age verification and personal identification/ authentification procedure through technical protection mechanism.

Therefore, the HNEDs should implicitely be able to support the protection of minors as specified by national law applied by service providers.

The following laws are currently applicable for the protection of minors in Germany and must therefore be taken into account for distribution of content on the German market:

- **State Treaty about the protection of human rights and minors in broadcasting and Telemedia,** from 10th - 27th pf September 2002, in force since 1st of April, 2003 (Staatsvertrag über den Schutz der Menschenwürde und den Jugendschutz in Rundfunk und Telemedien), last amended through the 9th revisional State Treaty on broadcasting (9. Rundfunkänderungsstaatsvertrag) http://www.alm.de/347.html,
- **Application Rules for the implementation of the protection of human rights and minors in private digital programs** (Satzung zur Gewährleistung des Jugendschutzes in digital verbreiteten Programmen des privaten Fernsehens) from 25th of November, 2003 http://www.alm.de/347.html, and
- **Common Directives of the Regulatory Institutions of the Länder for the implementation of the protection of human rights and minors** (Gemeinsame Richtlinien der Landesmedienanstalten zur Gewährleistung des Schutzes der Menschenwürde und des Jugendschutzes) from 8th/9th March 2005, in force since 2nd of June 2005 http://www.alm.de/347.html

If no signal for the protection of minors is provided by the broadcaster, there is no protection mechanism in general. For this case it must be possible for the service provider to protect an entire program, based on a configuration set by the service provider.

9.2 Content Rights Signalling

Content rights signalling means the transport of usage rights as to a certain content or channel from the broadcaster to the customer's HNED.

The usage rights can be transmitted in clear from broadcaster to the headend of the IPTV service operator via the SI-Data in the DVB-transport stream. Within the IPTV network the usage-rights shall be transmitted in a secure way via the CA/DRM-system of the IPTV service operator.

The usage rights are generated by the broadcaster and pushed through the platform transparently (without alteration). This procedure is only relevant for TV programming. It is important to have such a mechanism to set content usage rights or restrictions dynamically, event specific and in real time. Further requirements within the DRM are directed by the rights owners but in most cases have a static character (i.e. setting for all content or whole channels).

The same usage-rights used for live TV programming shall be applied for on demand content assets.

The signaling within DVB-SI data must be done in the EIT upon a commonly used standard. The standard signaling is intended to feed the IPTV-headends and to be used to inform the user's HNED about his rights. The advantage of using such a standard is having the same interfaces on the IPTV network operator's as well as on the broadcaster's side.

DVB started development of a content protection signalling solution named Content Protection And Copy Management (CPCM) that takes into account content right owner requirements particular from the major studios. DVB-CPCM requires an implementation into HNEDs in order to work. CPCM will probably be finalized by DVB until 2010. In DVB-CPCM „Usage State Information“ (USI - DVB-USI: ETSI TS 102 825-3) is alredy defined which covers parts of the usage-rights described in 9.1. and can be used but needs to be extended.

9.3. Private Broadcaster Requirements for CA/DRM Functions

9.3.1. Private Broadcasters Requirements for CA/DRM Functions

According to the Association of Private Broadcasters and Telemedia (VPRT), with the new transmission modes via IPTV technologies, and in particular with the transmission over the Internet Protocol on closed networks (and based on territorial restriction), interoperability is necessary.

The private broadcasters call for an effective protection of their content on all transmission modes in the digital world and for a single European encryption algorithm, creating at least the same legal security as the Common Scrambling Algorithm.

Conditional access systems enable to manage the usage of digital content overall types of end devices and permit to protect content against unauthorized use and access, and must therefore be used in IPTV networks.

It is important for all program providers that their content, programs and services are offered over consistent standardized interfaces (single content handling) in all IPTV platforms, in order for the content to be easily delivered and offered.

The future technology of network- and platform-operators must achieve interoperability in order to enable the deployment of a wide range of devices (competition between terminals).

A standardized conditional access/digital rights management system would therefore be necessary and would allow creating market security for all market participants.

9.3.2. Common Scrambling

CA/DRM systems should allow the use of the Common Scrambling Algorithm for simulcrypt transmission in order to create interoperability of the HNED. Regarding the current regulatory framework other approaches are currently under discussion in the CA/DRM working group of the technical regulatory committee of the German Federal Network Agency (Bundesnetzagentur, ATRT).

9.3.3. Common Interface

In addition, we recommend equipping the HNED with a common interface allowing to add new/other CA/DRM systems. Such common interface shall be secure (new DVB standard) and can be based on either PCMCIA.

10. Video on Demand

Video on Demand enables the user to autonomously initiate a video playout according to his individual needs (e.g. time and content needs).

By nature, in the IPTV environment VoD content is generally streamed or progressively downloaded as unicast or multicast (e.g. for push download) to a limited set of endpoints (i.e. not broadcast), upon individual request. The source of the VoD content resides in the network i.e. the VoD assets are delivered out of the network and not locally from a home media server in the customer's premises. The VoD service can be offered either via the internet or with dedicated resources of a managed service in the access network.

Near VoD is therefore not a VoD, but a linear broadcast service. Although local sources such as HD recorders or home video servers allow imitating a VoD-similar behaviour this is not regarded technically as VoD service.

VoD allows for trick play functionality such as pause, fast forward/backward, slow motion etc. unless otherwise controlled by a CA/DRM system.

VoD content can be offered as standalone service or linked to other content (e.g. broadcasts, multimedia content or portals). Therefore, the variety of VoD can cover feature films, TV shows, informational clips, teasers, news, music etc.

VoD services can have the following operating modes:

- IPTV platform provider operates the entire VoD service
- IPTV content provider operates the entire VoD service (QoS can not be accomplished)
- Combination of both (e.g. the VoD store front is provided by the content provider and the VoD assets are delivered by the platform provider for the purpose of enabling QoS)

The use of CA/DRM and payment systems shall be defined between the content provider and platform operator.

10.1. Presentation Of Video On Demand Offers

The choice of the presentation method of VoD content depends on the context in which it is offered:

- Part of the BCG's/EPG's channel lineup (refer to chapter 7.5. of this document).
- A specific VoD menu for one or multiple content providers (optionally with individual look & feel).
- Linked to broadcast content by a multimedia application (launch a VoD linked to a broadcast program upon user request).
- Linked to information services and portals like rich teletext, HTML content and alike.

A HNED may implement all or just a subset of these or future options.
It is assumed that many Video on Demand offers will be presented via HTML or MHP applications or as XML content which is interpreted by the HNED's runtime environment.
Ii is not regarded as necessary to support the "Content on demand discovery record" as specified in [1] as necessary. It must be possible to selectively protect VoD content by CA/DRM.
HNEDs only able to access/decode VoD content are not covered by this paper.

10.2. Content formats

The content formats necessary for linear TV must also be applicable for VoD. Support for additional formats (e.g. formats like real, wmv or flash video) is optional.

10.3. RTSP support

RTSP/RTP shall be supported by the HNED for VoD as described in chapter 6 of [1] ("RTSP Client"). Support for additional streaming protocols (e.g. protocols like mms) is optional.

Annex A: New in the Value Chain: The "Platform"

Die "Plattform" als neues Element der Wertschöpfungskette

A.1. Grundlagen, Hintergründe, Entstehung

In der analogen Welt waren in der Wertschöpfungskette die Ebene und der Begriff der "Plattform" nicht erforderlich und auch noch nicht bekannt.

Zwischen den Programmveranstaltern als Inhalteanbietern und den Netzbetreibern, die für die Verbreitung sorgen, bestanden unmittelbare vertragliche Beziehungen. Das galt in gleicher Weise für Sendernetzbetreiber (z. B. T-Systems), Kabelnetz-betreiber (z. B. KDG) und Satellitennetzbetreiber (z. B. SES Astra). Dabei wurde für jedes Programm ein Kanal/Transponder benötigt. Es handelte sich also um eine „Eins-zu-Eins“-Übertragung.

In der digitalen Welt sind zum einen neue Infrastrukturen für die Übertragung hinzu-gekommen (z.B. DSL-Netze, UMTS-Netze), zum anderen hat sich die Leistungsfähig-keit der klassischen Infrastrukturen Satellit, Kabel und Terrestrik eklatant vergrößert. Damit sind neue Herausforderungen und Aufgaben innerhalb der Wertschöpfungskette entstanden, die neue Funktionen notwendig machen und damit neue Akteure auf den Plan rufen (s. Bild).

Die Wertschöpfungskette wird um eine neue Ebene erweitert.

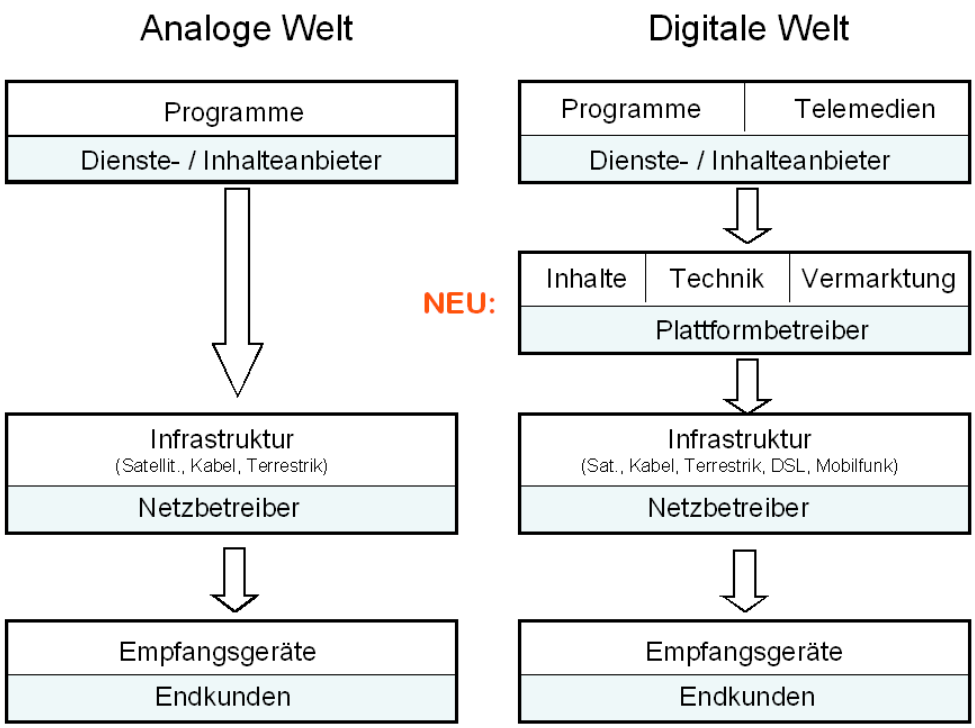

Figure 2: Entstehung und Einbettung der "Plattform" in die Wertschöpfungskette

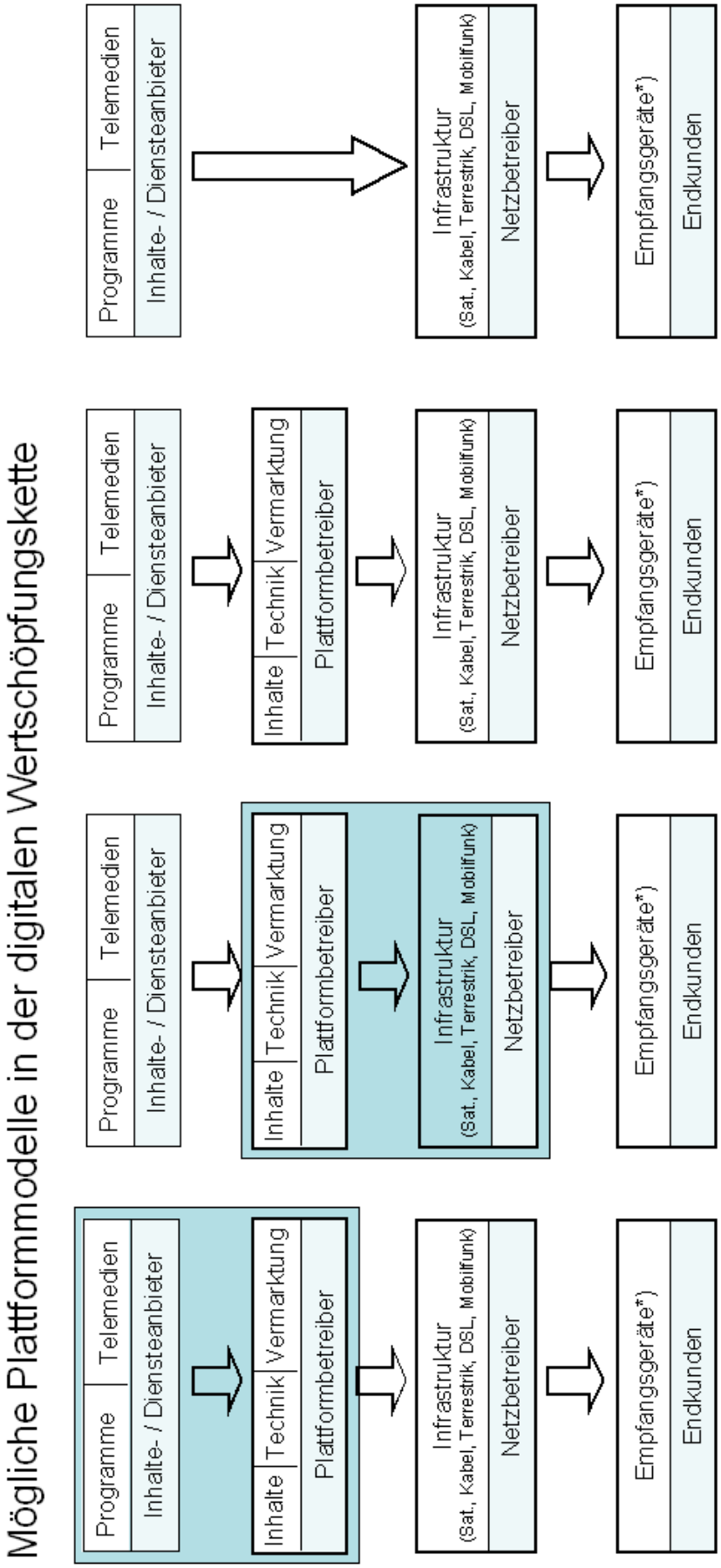

Figure 3: Platform Models in the digital Value-Chain

Die digitale Umgebung bietet vielfältige neue Möglichkeiten: So können z.B. Programme der unterschiedlichsten Anbieter zusammengefasst und dem Kunden als einheitliches Paket angeboten werden; es gilt, Navigatoren bzw. Elektronische Programmführer einzufügen, es muss ein Multiplexing und gegebenenfalls eine Verschlüsselung stattfinden u.v.a.m.

Diese Aufgaben werden in der Regel nicht immer von den klassischen Akteuren der analogen Welt direkt wahrgenommen. Je nach Geschäftsmodell ist ein Plattformbetrieb notwendig. Mit dem Plattformbetrieb entsteht gewissermaßen eine neue Funktion, die die verschiedenen Bereiche zusammenfasst und die klassischen Stufen der Wertschöpfungskette integriert.

A.2. Der Begriff der Plattform

Eine Plattform übernimmt also die Integration der Wertschöpfungskette und Ihre Vermarktung und bietet dem Endkunden ein durchgängiges Angebot. Sie kann darüber hinaus Support-Aufgaben wie z.B. Zugangskontrolle, Billing, usw erfüllen..

Grundsätzlich lassen sich die folgenden Funktionsbereiche unterscheiden:

- Inhalte
- Technik
- Vermarktung

Plattformbetreiber sind in der Regel gewinnorientierte Organisationen, die Programme und Telemedien eines oder mehrerer Inhalteanbieter sowie gegebenenfalls eigene Inhalte und Dienste zu einem Gesamtangebot zusammenfassen, im Bedarfsfall eine Verschlüsselung durchführen und einen elektronischen Programmführer ergänzen. Das sich daraus jeweils ergebende Signal wird einem oder mehreren Netzbetreibern im Rahmen vertraglicher Regelungen zur Verbreitung zur Verfügung gestellt oder vom Plattform-/Netzbetreiber selbst verbreitet. Im Rahmen der Endkundenbeziehung führt der Plattformbetreiber zudem das gesamte Kundenmanagement (Marketing, Betreuung, Abrechnung) durch.

A.3. Betreiber einer Plattform

Der Betrieb einer Plattform kann durch einen neuen (prinzipiell neutralen) Akteur in der Wertschöpfungskette erfolgen (s. Bild Seite 2, 3. Spalte). Ebenso kann ein Dienste- bzw. Inhalteanbieter selbst diese Funktion übernehmen (Bild Seite 2, linke Spalte) oder der Netzbetreiber (2. Spalte). Sofern die klassischen Methoden noch greifen (wie heute bei DVB-T), kann auf den Plattformbetrieb natürlich auch verzichtet werden (rechte Spalte).

In der Praxis ist das Modell des neutralen Plattformbetreibers heute (in Deutschland) selten. Für IPTV und Kabel ist heute das zweite Modell (Bild Seite 2, 2. Spalte) vorherrschend. Modell 1 (linke Spalte) trifft man vor allem bei der Übertragung über Satellit an. Im Fall von netzgebundenen Infrastrukturen wie IPTV, zunehmend aber auch Kabel ist, um Quality of Service und effiziente Ressourcennutzung zu ermöglichen, eine enge Zusammenarbeit zwischen Plattform- und Netzbetrieb unabdingbar und sollte daher möglichst aus einer Hand erfolgen (Modell 2).

Die verschiedenen Plattformen konkurrieren mit ihren Angeboten beim Konsumenten und können unterschiedlich strukturiert sein.

Die Auswahl der Technik wird durch die angestrebte Marktstruktur bestimmt.
Im Falle eines vertikalen Marktes mit geschlossenen Benutzergruppen wird der jeweilige Plattformbetreiber eine proprietäre technische Plattform wählen.

Im Falle eines horizontalen Marktes, in dem verschiedene Plattformen miteinander konkurrieren, sind harmonisierte technische Endgeräte-Plattformen von entscheiden der Bedeutung. Daher sollten einheitliche, standardisierte Lösungen für die verschiedenen Infrastrukturen gewählt werden. Nur so kann die Interoperabilität von Inhalten/Diensten und Endgeräten gewährleistet werden.

Was die technische Ausgestaltung der Endgeräte-Plattform angeht, ist es von entscheidender Bedeutung, dass offene (vorzugsweise standardisierte) Systeme verwendet werden und dass bestimmte Schnittstellen einheitlich sind. Das erweitert die Wettbewerbsmöglichkeiten und die Interoperabilität aus der Sicht des Verbrauchers wird verbessert. Damit wird zugleich die Grundlage für einen Massenmarkt gelegt.

A.4. Regulierung

Das Plattformkonzept hat in den 10. Rundfunkänderungsstaatsvertrag Eingang gefunden. Die Landesmedienanstalten sind beauftragt, hierzu die regulatorische Umsetzung mit Hilfe einer neuen Zugangs- und Plattformsatzung auszuarbeiten. Die aktuell vorliegende Entwurfsfassung der Zugangs- und Plattformsatzung zielt mit ihrer Definition, nach der „Anbieter einer Plattform ist, wer Rundfunk und vergleichbare Telemedien auch von Dritten mit dem Ziel zusammenfasst, diese Angebote als Gesamtangebot zugänglich zu machen oder wer über die Auswahl für die Zusammenfassung entscheidet“ (§ 2, Abs. 1), aus regulatorischer Sicht primär auf das oben skizzierte Modell 2. Berührt werden allerdings unter speziellen Bedingungen auch Modell 1 und Modell 3.

Annex B: Changes

The table lists all major changes made in this first release of the document compared to the draft version earlier distributed.

version Nr.	date	changes compared to version x.x	explanation
1.0	Dec. 2008	**. /.**	first issue