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SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS

IPTV multimedia services and applications for IPTV – IPTV terminal devices

IPTV terminal devices: Basic model

Recommendation ITU-T H.721

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IPTV terminal devices: Basic model

Summary

Recommendation ITU-T H.721 describes and specifies the functionalities of the Internet protocol television (IPTV) terminal devices for the IPTV basic services defined in Recommendation ITU-T H.720. This Recommendation is targeted at IPTV terminal devices capable of receiving linear television (TV) service and video-on-demand services, with additional data content (such as text) using a managed content delivery network. The service definition takes into consideration conditions on content delivery such as quality of service (QoS). The expected types of IPTV terminal devices are set-top boxes and digital TV sets with embedded IPTV capabilities.

The second edition introduced support for high efficiency video coding (HEVC), dynamic adaptive streaming over HTTP (DASH), MPEG-4 audio lossless coding (ALS), MPEG-4 advanced audio coding (AAC), DTS-HD, timed text markup language (TTML), MPEG media transport (MMT) and several corrections and clarifications.

The third edition introduces support for new technologies such as timestamped fragmented time-length-value (TFT).

History

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FOREWORD

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Recommendation ITU-T H.721

IPTV terminal devices: Basic model

1 Scope

This Recommendation describes and specifies the functionalities of the Internet protocol television (IPTV) terminal devices for IPTV basic services defined in [ITU-T H.720] over a dedicated content delivery network, which takes into consideration conditions on content delivery such as quality of service (QoS). The expected types of terminal devices are set-top boxes (STBs) and digital television (TV) sets with embedded IPTV capabilities.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[ITU-T H.222.0] Recommendation ITU-T H.222.0 (2021) | ISO/IEC 13818-1:2021, *Information technology – Generic coding of moving pictures and associated audio information: Systems*.

[ITU-T H.262] Recommendation ITU-T H.262 (2012) | ISO/IEC 13818-2:2013, *Information technology – Generic coding of moving pictures and associated audio information: Video*.

[ITU-T H.264] Recommendation ITU-T H.264 (V9) (2021), *Advanced video coding for generic audiovisual services*.

[ITU-T H.265] Recommendation ITU-T H.265 (V2) (2021), *High Efficiency Video Coding*.

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3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 accessibility feature [ITU-T Y.1901]: An additional content component that is intended to assist people hindered in their ability to perceive an aspect of the main content. Examples: captions for the hard of hearing, subtitles in various languages, sign-language interpretation video and descriptive audio.

3.1.2 acquisition [ITU-T Y.1901]: The process of obtaining content by the end-user.

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NOTE – For content with accessibility features, this means that the content will be available in a form that can be used by the end-user.

3.1.3 captions [ITU-T Y.1901]: Captions provide a real-time on-screen transcript of the dialogue as well as any sound effects.

NOTE – This service can be provided by means of either textual or graphical supplementary content. The captions and the dialogue are usually in the same language. The service is primarily to assist users having difficulty hearing the sound. Ideally, users may have some control over the position and size of the presentation. Different speakers are distinguished, usually by different colours.

3.1.4 certificate revocation list (CRL) [b-ITU-T X.509]: A signed list indicating a set of certificates that are no longer considered valid by the certificate issuer. In addition to the generic term CRL, some specific CRL types are defined for CRLs that cover particular scopes.

3.1.5 channel [ITU-T Y.1901]: Content formatted as a selectable set of data and transported as part of a data stream.

3.1.6 content delivery network (CDN) [b-ITU-T F.750]: A network optimized for delivering digital content.

3.1.7 content protection [ITU-T Y.1901]: Ensuring that an end-user can only use the content they have already acquired in accordance with the rights that they have been granted by the rights holder.

3.1.8 content provider [ITU-T Y.1910]: The entity that owns or is licensed to sell content or content assets.

3.1.9 end-user [ITU-T Y.1910]: The actual user of the products or services.

NOTE – An end-user consumes the product or service. An end-user can optionally be a subscriber.

3.1.10 key [b-ITU-T X.800]: A sequence of symbols that controls the operations of encipherment and decipherment.

3.1.11 IPTV terminal function (ITF) [ITU-T Y.1901]: An end-user function associated with a) receiving and responding to network control channel messages regarding session set-up, maintenance, and tear-down; and b) receiving the content of an IP transport from the network and rendering.

3.1.12 IPTV terminal device [ITU-T Y.1901]: A terminal device which has ITF functionality, e.g., a STB.

3.1.13 linear TV [ITU-T Y.1901]: A television service in which a continuous stream flows in real time from the service provider to the terminal device and where the user cannot control the temporal order in which contents are viewed.

3.1.14 metadata [ITU-T Y.1901]: Structured, encoded data that describe characteristics of information-bearing entities to aid in the identification, discovery, assessment, and management of the described entities.

NOTE – EPG metadata has many applications and may vary in depth from merely identifying the content package title or information to populate an EPG to providing a complete index of different scenes in a movie or providing business rules detailing how the content package may be displayed, copied, or sold.

3.1.15 multimedia [b-ITU-T J.148]: The combination of multiple forms of media such as audio, video, text, graphics, fax, and telephony in the communication of information.

3.1.16 network provider [ITU-T Y.1910]: The organization that maintains and operates the network components required for IPTV functionality.

NOTE 1 – A network provider can optionally also act as service provider.

NOTE 2 – Although considered as two separate entities, the service provider and the network provider can optionally be one organizational entity.

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3.1.17 re-transmission broadcast service [ITU-T Y.1901]: A service in which content is provided from various broadcasting environments including, but not limited to, terrestrial, satellite and cable, and retransmitted into IP network simultaneously or otherwise.

3.1.18 rights [b-ITU-T X.1191]: Referring to the ability to perform a predefined set of utilization functions for a content item; these utilization functions include permissions (e.g., to view/hear, copy, modify, record, excerpt, sample, keep for a certain period, distribute), restrictions (e.g., play/view/hear for multiple number of times, play/view/hear for certain number of hours), and obligations (e.g., payment, content tracing) that apply to the content and provide the liberty of use as granted to the end user.

3.1.19 service [ITU-T Y.1901]: A set of functionalities enabled by a provider for end-users.

NOTE – Example provisioned functionalities include IP connectivity with managed quality of service, video-on-demand.

3.1.20 service and content protection (SCP) [ITU-T Y.1901]: A combination of service protection and content protection.

3.1.21 service navigation [ITU-T H.720]: The process of presenting information that allows the end-user to discover, select and consume services.

3.1.22 service protection [ITU-T Y.1901]: The process of ensuring that an end-user can only acquire a service, and, by extension, the content contained therein, that he or she is entitled to receive.

3.1.23 service provider [b-ITU-T M.1400]: A general reference to an operator that provides telecommunication services to customers and other users either on a tariff or contract basis. A service provider may or may not operate a network. A service provider may or may not be a customer of another service provider.

NOTE – In the context of IPTV systems, typically, the service provider acquires or licenses content from content providers and packages this into a service that is consumed by the end-user.

3.1.24 subscriber [b-ITU-T M.3050.1]: The subscriber is responsible for concluding contracts for the services subscribed to and for paying for these services.

3.1.25 subscription [b-ITU-T Q.1741.3]: A subscription describes the commercial relationship between the subscriber and the service provider.

3.1.26 subtitles [ITU-T Y.1901]: Subtitles provide a real-time on-screen transcript of dialogue for the purpose of language translation or to clarify speech that is unclear.

NOTE – This service can be provided by means of either textual or graphical supplementary content. The subtitles and the dialogue are usually in different languages. The assumed audience for subtitling is hearing people who do not understand the language of the dialogue.

3.1.27 terminal device (TD) [ITU-T Y.1901]: An end-user device which typically presents and/or processes the content, such as a personal computer, a computer peripheral, a mobile device, a TV set, a monitor, a VoIP terminal or an audio-visual media player.

3.1.28 type-length-value (TLV) multiplexing scheme [b-ITU-R BT.1869]: A multiplexing scheme that multiplexes variable-length packets without fragmentation, where the type and the length of packet in a TLV container are indicated by the type field and the length field, respectively.

3.1.29 trick mode functionality [ITU-T Y.1901]: The ability to pause, rewind or forward stored content.

3.1.30 user interface (UI) [b-ITU-T F.902]: Software and hardware components through which a user can interact with a system.

3.1.31 video-on-demand (VoD) [ITU-T Y.1901]: A service in which the end-user can, on demand, select and view a video content and where the end-user can control the temporal order in which the video content is viewed (e.g., the ability to start the viewing, pause, fast-forward, rewind, etc.).

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NOTE – Viewing may occur sometime after the selection of the video content.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 electronic content guide (ECG): A service navigation application used especially for streamed and downloaded content. ECG deals with metadata unlike service information used in terrestrial broadcasting.

3.2.2 electronic program guide (EPG): A service navigation application which is used especially for scheduled linear programs. (This definition is adapted from [ITU-T Y.1901].)

NOTE – In some traditional broadcast services, EPG is defined as an on-screen guide used to display information on scheduled live broadcast television programs, allowing a viewer to navigate, select and discover programs by time, title, channel, genre. This traditional definition does not cover "catalogues" for on-demand and download services (sometimes called electronic content guide (ECG)) and bidirectional interactive services (sometimes called IPG) for end-user interaction with a server or head-end. Some EPGs utilize web-pages, or teletext to realize this function.

3.2.3 IPTV TD-basic model: IPTV basic model terminal device as defined in this Recommendation.

3.2.4 portal: A portal presents information from diverse sources in a unified manner and provides a way to attach the communication services.

3.2.5 service navigation application: A user interface (application) which is intended to provide information on available services, including content, which may be accessed by end-users for service navigation.

3.2.6 timestamped transport stream (TTS): A packet format of the transport stream that adds a 32-bit field containing a counter value of a 27 MHz clock synchronized with the MPEG system clock to control a relative time entered into a decoder.

NOTE – TTS is specified in section 8.1.4 of [ARIB STD-B24].

3.2.7 fragmented TLV packet: The fixed-length packet that consists of the header and the body. The body is a fragmented stream that are made by the type-length-value (TLV) multiplexing scheme. The fragmented TLV packet length is 188 bytes. The header length is 3 or 4 bytes. The first byte of the header is 47_{HEX} [ITU-T J.288]. This TLV multiplexes MMT data, time, etc.

3.2.8 timestamped fragmented TLV (TFT): A packet format of the fragmented type-length-value (TLV) packet that adds a 32-bit field containing a counter value of a 27 MHz clock synchronized with the MPEG system clock to control a relative time entered into a decoder as timestamped transport stream (TTS).

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAC	Advanced Audio Coding
AC-3	Audio Compression number 3
AES	Advanced Encryption Standard
ALS	Audio Lossless coding
API	Application Program Interface
APSK	Amplitude Phase-Shift Keying
AV	Audio-Visual
AVC	Advanced Video Coding

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BML	Broadcast Markup Language
CDN	Content Delivery Network
CRID	Content Reference Identifier
CRL	Certificate Revocation List
CSA	Common Scrambling Algorithm
DASH	Dynamic Adaptive Streaming over HTTP
DEMUX	Demultiplexer
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DRM	Digital Rights Management
DTS	Decoding Timestamp
DVI	Digital Visual Interface
EBU	European Broadcasting Union
ECG	Electronic Content Guide
ECM	Entitlement Control Message
EPG	Electronic Program Guide
ERI	Entry Resource Information
ES	Elementary Stream
FEC	Forward Error Correction
FIFO	First In, First Out
FQDN	Fully Qualified Domain Name
HDCP	High-bandwidth Digital Content Protection system
HDMI	High-Definition Multimedia Interface
HEVC	High Efficiency Video Coding
HTML	Hypertext Markup Language
HTTP	Hypertext Transfer Protocol
HTTPS	Hypertext Transport Protocol over Secure socket layer
ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IPTV	Internet Protocol Television
IPTV TD	Internet Protocol Television Terminal Device
ITF	IPTV Terminal Function
LAN	Local Area Network
LED	Light Emitting Diode
LIME	Lightweight Interactive Multimedia Environment
LLI	Licence Link Information
MAFR	Multimedia Application Framework

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MFU	Media Fragment Unit
MLD	Multicast Listener Discovery protocol
MMT	MPEG Media Transport
MMTP	MPEG Media Transport Protocol
MPU	Media Processing Unit
MUX	Multiplexer
NCI	Network Content Control Information
NCL	Nested Context Language
NGN	Next Generation Network
NIT	Network Information Table
NPT	Normal Play Time
NVRAM	Non-volatile Random Access Memory
PCR	Program Clock Reference
PKI	Public-Key Infrastructure
PLL	Phase-Locked Loop
PMT	Program Map Table
PSI	Program Specific Information
PSK	Phase-Shift Keying
PTS	Presentation Timestamp
QoE	Quality of Experience
QoS	Quality of Service
RA	Router Advertisement
RACF	Resource and Admission Control Functions
RAM	Random Access Memory
RF	Radio Frequency
RGB	Red, Green and Blue
ROUTE	Real-time Object delivery over Unidirectional Transport
RTP	Real-time Transport Protocol
RTSP	Real-Time Streaming Protocol
SADS	Service and Application Discovery and Selection
SCP	Service and Content Protection
SDP	Session Description Protocol
SDTV	Standard Definition Television
SI	Service Information
SNA	Service Navigation Application
SNTP	Simple Network Time Protocol
SSL	Secure Socket Layer

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STB	Set-Top Box
TCP	Transmission Control Protocol
TD	Terminal Device
TFT	Timestamped Fragmented TLV
TLS	Transport Layer Security
TLV	Type-length-value
TS	Transport Stream
TTML	Timed Text Markup Language
TTS	Timestamped Transport Stream
UDP	User Datagram Protocol
UHD	Ultra High Definition
UI	User Interface
URI	Uniform Resource Identifier
URL	Uniform Resource Locator
VGA	Video Graphics Array
VoD	Video-on-Demand
XML	extensible Markup Language

5 Conventions

In this Recommendation:

– The keywords "is required to" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

– The keywords "is prohibited from" indicate a requirement which must be strictly followed and from which no deviation is permitted, if conformance to this Recommendation is to be claimed.

– The keywords "is recommended" indicate a requirement which is recommended but which is not absolutely required. Thus, this requirement need not be present to claim conformance.

– The keywords "is not recommended" indicate a requirement which is not recommended but which is not specifically prohibited. Thus, conformance with this Recommendation can still be claimed even if this requirement is present.

– The keywords "can optionally" indicate an optional requirement which is permissible, without implying any sense of being recommended. This term is not intended to imply that the vendor's implementation must provide the option and the feature can be optionally enabled by the network operator/service provider. Rather, it means the vendor may optionally provide the feature and still claim conformance with this Recommendation.

– Requirements in "Optionality" column in tables are identified using the following conventions [ITU-T Y.1901]:

  - Mandatory requirement is identified to R;
  - Recommended requirement is identified to RR;
  - Optional requirement is identified to OR.

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6 Introduction

This Recommendation is targeted at IPTV terminal devices capable of receiving linear TV services, including retransmission of conventional broadcasting, and video-on-demand (VoD) service, defined in clause 7, over a content delivery network (CDN), which takes into consideration such conditions on content delivery as QoS. It also supports several recent new technologies to enhance the service capability of basic IPTV terminal device such as high efficiency video coding (HEVC), dynamic adaptive streaming over HTTP (DASH), MPEG media transport (MMT), etc.

This Recommendation provides a high-level description of functionalities for common communication, configuration of the receiving environment for a service provider, service navigation, acquisition of linear TV service, acquisition of VoD service, functionalities which constitute the IPTV basic model terminal device (hereafter referred to as IPTV TD-Basic model).

7 Services and key features of an IPTV basic model terminal device

7.1 Services of an IPTV TD-Basic model

7.1.1 Linear TV

Linear TV service envisaged by an IPTV TD-Basic model is a multicast service in which programs are arranged in a temporal order based on the concept of channels. Linear TV service provides the viewing experience comparable to digital terrestrial and satellite broadcasting. In one typical flow of the service, the contents from content providers are delivered through a content delivery network (i.e., a dedicated network to the service provider) to the end-user via multicast. It is also possible that a service provider plays the role of a content provider as well and creates its own content and delivers the content via multicasting.

The monomedia, multiplex formats and streaming methods used in linear TV services refer to the specifications listed in Table 1.

NOTE – Compliance of media mentioned in this clause (e.g., preferred, mandatory, optional) is for further study.

Table 1 – Specifications used for formats and streaming methods used in linear TV services

Method	Format	Specification(s)
Monomedia	Video MPEG-2	[ITU-T H.262]
	Video ITU-T H.264 (AVC)	[ITU-T H.264]
	Video ITU-T H.265 (HEVC)	[ITU-T H.265]
	Audio MPEG-2 AAC	[ISO/IEC 13818-7]
	Audio MPEG-1 Layer II	[ISO/IEC 11172-3]
	Audio MPEG-4 AAC	[ISO/IEC 14496-3]
	Audio MPEG-4 HE AAC v1	[ISO/IEC 14496-3]
	Audio MPEG-4 ALS	[ISO/IEC 14496-3]
	Audio Dolby AC-3	[ETSI TS 102 366]
	Audio DTS-HD (Note 1)	[ANSI/SCTE 194-1]
	ARIB captioning	[ARIB STD-B24]
	ARIB TTML captioning	[ARIB STD-B62]
	ATSC closed captioning	[CEA-708]

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Table 1 – Specifications used for formats and streaming methods used in linear TV services

Method	Format	Specification(s)
	EBU teletext subtitles	[ETSI EN 300 472]
	DVB subtitling	[ETSI EN 300 743]
Multiplex format	MPEG-2 TS	[ITU-T H.222.0]
	TTS (Note 2)	[ARIB STD-B24]
	TFT	See Annex A
Streaming	RTP	[IETF RFC 3550] [IETF RFC 2250]
NOTE 1 – Refer to [ANSI/SCTE 194-2] when using MPEG-2 TS for multiplexing. NOTE 2 – When supported, the use of this solution should be signalled within the service description metadata.		

7.1.2 Video on-demand

Video-on-demand is capable of offering the consumption of a particular content, from its beginning or from any temporal position of the content, by the end-user's request.

A typical case of the service is that as a result of the end-user's choice of video content from a content list displayed on the IPTV TD, a request to play the video content is transmitted to the content server, to which the content server would return, via unicast streaming, the selected content from its beginning or from the specified position. The IPTV TD is recommended to support trick plays (e.g., variable playback speed control, fast-forward play, rewind play, pause, resume and chapter jump based on a present chapter information) [ITU-T Y.1901].

The monomedia, multiplex formats and streaming methods used in the VoD services refer to the specifications listed in Table 2.

NOTE – Compliance of media mentioned in this clause (e.g., preferred, mandatory, optional) is for further study.

Table 2 – Specifications used for formats and streaming methods used in VoD services (see Note 1)

Method	Format	Specification(s)
Monomedia	Video MPEG-2	[ITU-T H.262]
	Video ITU-T H.264 (AVC)	[ITU-T H.264]
	Video ITU-T H.265 (HEVC)	[ITU-T H.265]
	Audio MPEG-2 AAC	[ISO/IEC 13818-7]
	Audio MPEG-1	[ISO/IEC 11172-3]
	Audio MPEG-4 AAC	[ISO/IEC 14496-3]
	Audio MPEG-4 ALS	[ISO/IEC 14496-3]
	Audio DTS-HD (Note 2)	[ANSI/SCTE 194-1]
	ARIB Captioning	[ARIB STD-B24]
	ARIB TTML captioning	[ARIB STD-B62]
	ATSC closed captioning	[CEA-708]
Multiplex format	MPEG-2 TS	[ITU-T H.222.0]
	TTS	[ARIB STD-B24]
	MP4	[ISO/IEC 14496-14]

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Table 2 – Specifications used for formats and streaming methods used in VoD services (see Note 1)

Method	Format	Specification(s)
	MMT	[ISO/IEC 23008-1]
Streaming	RTP, RTSP	[IETF RFC 3550] [IETF RFC 2250] [IETF RFC 2326]
	DASH (Note 1)	[ISO/IEC 23009-1]
NOTE 1 – Compliance of mentioned media (e.g., preferred, mandatory, optional) is for further study. NOTE 2– Refer to [ANSI/SCTE 194-2] when using MPEG-2 TS for multiplexing.		

7.1.3 Service navigation

The IPTV TD-Basic model assumes the following means of service navigation and content selection:

– **Content selection using remote controller**: After linear IPTV service is selected among the service categories (e.g., linear TV, VoD, web service) using the category selection buttons, the end-user can select a desired channel by giving a particular numeral for that channel on the number buttons, or by operating the up-down buttons to navigate the available channels. The remote controller can provide a convenient way to select a channel with a one-touch button presetting channel information.

– **Content selection by EPG**: It is expected that after linear IPTV service is selected among the service categories (e.g., linear TV, VoD, web service) using the category selection buttons, the end-user can view an EPG on the display by operating the EPG related buttons on the remote controller. The end-user can directly view or reserve a desired program or a channel by operations on the displayed EPG.

– **Content selection by ECG**: The IPTV TD-Basic model can optionally display an ECG. ECG on the display of the terminal provides functionalities like EPG (e.g., search and list the available VoD content, and choose and view the desired content) by operating the remote controller.

– **Content selection by portal**: The IPTV TD-Basic model can optionally display a portal by getting access to a particular service provider's portal site. End-users can navigate (i.e., select, acquire and consume the desired content) through the multimedia portal formatted by the service provider as well as the two methods mentioned above.

7.1.4 Interactive services

It is expected that each service provider will provide its own portal service. The portal service provides the same type of service as the so-called web service on the Internet. It is different from a conventional web-service in the following points:

– It has presentation functions comparable to those on the TV provided by the data broadcasting in a digital broadcasting service;

– It has the control functionalities of a linear TV service and of a VoD service.

Hyperlink functionality between portal sites and within a portal site may be provided. Web security can be provisioned by server authentication via secure communication such as TLS/SSL.

The unique identifier of an IPTV TD can be associated with a particular end-user. Therefore, the IPTV TD identification may be used as a client identifier for service and content protection (SCP) functionalities. Moreover, a simple authentication function may be executed with an authentication key.

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It is also expected that an IPTV TD can control the way content is viewed, e.g., access control by age authentication or password authentication (also known as parental control), by displaying the information on the video screen, limitation of content playback or displaying thumbnail images.

7.1.5 Public interest services

Some examples of community and accessibility services that may be required by the local customer-base or regulations include the following.

7.1.5.1 Closed caption, subtitles, audio description and sign language interpretation

These features may be provided alongside with all of the above-mentioned basic services with accessibility [b-FSTP-TACL].

7.2 Features of IPTV TD-Basic model

7.2.1 Network attachment and service discovery

This is the process which enables end-users to connect to a particular service and to consume a linear TV service or a VoD service, after connecting their IPTV TD to the network. The details of the service discovery are found in [ITU-T H.770].

By the provisioning operation including network attachment, the IPTV TD automatically obtains the initial information for consumption. When the process is finished, end-users can access to all the IPTV services available. If a promotional linear TV channel is also provided on the network, then such a service is also obtainable.

7.2.1.1 Terminal device attachment and initialization

Network layer protocols to be used are IPv4 specified by [IETF RFC 791] and/or IPv6 specified by [IETF RFC 2460]. When end-users obtain an IPTV TD-Basic model, they need to connect the IPTV TD to the network terminal device via a physical connection (e.g., an Ethernet cable, wireless LAN, see Table 3 for applicable protocols).

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Table 3 – Protocols for terminal device attachment and initialization

Protocol	Specifications
IP, ICMP	[IETF RFC 791] [IETF RFC 792]
IPv6, ICMPv6	[IETF RFC 2460] [IETF RFC 2461] [IETF RFC 2462] [IETF RFC 4291] [IETF RFC 4443]
DHCP	[IETF RFC 2131] [IETF RFC 3315] [IETF RFC 3646] [IETF RFC 3736]
DNS	[IETF RFC 1034] [IETF RFC 1035] [IETF RFC 2181] [IETF RFC 2671] [IETF RFC 3596]

7.2.1.2 Service provider description entry points

When the IPTV TD attaches to the network, it has to know where to get the description of the IPTV service providers available to access. This description is called service provider discovery information. It is recommended that an IPTV TD be provisioned with an entry point to access the service provider discovery information server. The entry point (i.e., the server location) can be a multicast or unicast address.

It is expected that the IPTV TD-Basic model connects to such a server by referring to the entry point which is acquired by the terminal device by a specific method, which is outside the scope of this Recommendation.

7.2.1.3 Service provider discovery and service attachment

Service provider discovery information provides the IPTV TD with the information concerning the service platforms available on the network. It is required that a service provider discovery information server provides XML-encoded service provider discovery information.

After obtaining the server location such as the IP address and accessing a service provider discovery information server, the IPTV TD acquires the service provider discovery information file. One of the typical acquisition methods is HTTP by using the uniquely specified uniform resource identifier (URI). The IPTV TD in turn acquires service provider information, which includes the location of services to attach in the file. The IPTV TD then selects a particular IPTV service to attach, based on the information provided therein. In case of a linear TV service, the service provider information provides necessary information for obtaining the metadata for EPG, etc. The details and description of the discovery procedures and data formats mentioned in this clause are included in [ITU-T H.770].

At this stage, IPTV TD is also required to support mechanisms of selection of programs and channels (e.g., displaying EPG, getting access to the portal, obtaining metadata for VoD). In case of getting access to the portal, promotional VoD content may be available to the IPTV TD.

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Table 4 contains a list of applicable specifications.

Table 4 – Specifications used for service provider discovery and service attachment

Method	Format	Specification(s)
Multiplex format	MPEG-2 TS	[ITU-T H.222.0]
	TTS	[ARIB STD-B24]
	MMT	[ISO/IEC 23008-1]
Streaming	RTP, RTSP	[IETF RFC 3550] [IETF RFC 2250] [IETF RFC 2326]
Multicast	IGMPv2	[IETF RFC 2236] [IETF RFC 3228]
	IGMPv3	[IETF RFC 3376]
	MLDv2	[IETF RFC 4604]
Unicast	HTTP	[IETF RFC 2616]

7.2.2 Security

The IPTV TD-Basic model is required to support the following two categorized security items after establishing the network layer connections to receive IPTV services.

– **Service security items**

Service security functionalities mainly authenticate whether the terminal is a legitimate IPTV TD and authorizes the usage of services. SCP functions of IPTV TD realize the following items:

- Establishment of the secure communication channel by the mutual authentication with server-side SCP functionalities.
- Communicate with the certificate revocation list (CRL) server for update and management of the CRL.

– **Content protection items**

Content protection functionalities are integral to IPTV services and handle the content usage conditions and decryption keys necessary for the consumption of contents.

- Management and acquisition of rights and keys from the server side SCP functionalities.
- For linear TV service, extraction of the descrambling key from entitlement control message (ECM) and its provisioning to the renderer.

Connections between IPTV TD and the security-related application servers are required to use TLS/SSL as the protocol for communicating security-related information, including privacy. As always-on connections are conceivable, it is recommended to consider security threats on IPTV TD through the network.

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Table 5 contains a list of applicable security specifications.

Table 5 – Specifications used for IPTV TD-Basic model service security

Security element	Method	Specification(s)
Secure communication	SSL/TLS	[IETF RFC 2246] [IETF RFC 2818]
Encryption algorithm	AES	[b-FIPS-197]
	CSA	[b-DVB-CSA]

These security modules can allow various implementations. IPTV TD can include the security modules as its internal functionalities. IPTV TD can also optionally implement the mechanism to download the security modules so that the module update is facilitated [ITU-T Y.1901].

7.2.3 Privacy

To take into account the cases where the ownership of IPTV TD is transferred to a different end-user or it is discarded, IPTV TD is required to have the capability to initialize and delete the private information stored in the non-volatile random access memory (NVRAM) such as flash memory.

Moreover, IPTV TD is required to have the capability to delete the configuration involving private information set-up by the end-user and to initialize to the factory setting.

It is recommended to ensure that this capability be not mistakenly operated and unintentionally activated (e.g., the limitation for remote operation by the end-user).

7.2.4 Quality of service (QoS)

7.2.4.1 Streaming

In streaming delivery of the content, packet losses and clock mismatch due to asynchronous communication may cause video and audio quality degradation. Service providers and IPTV TD are recommended to implement the following measures in order to make prolonged and stable playback possible.

7.2.4.2 Forward error correction (FEC)

IPTV TD, as well as the content delivery server, can implement what is recommended in [ITU-T H.701], with an appropriate consideration of the quality of communication network, to ensure a sustainable and stable delivery of streamed content.

7.2.4.3 Clock synchronization and jitter removal

IP transmission is based on asynchronous communication, and therefore the transmission of explicit clock information is difficult. In order to realize a sustained and stable playback, a mechanism for clock synchronization between the sender and the receiver is important. The solutions for this purpose are described in Appendix I.

8 IPTV terminal device functional architecture

The functional architecture of IPTV TD-Basic model is shown in Figure 8-1. The expected types of IPTV terminal devices are set-top boxes and digital TV sets with embedded IPTV capabilities [ITU-T H.720].

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