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SERIES J: CABLE NETWORKS AND TRANSMISSION OF TELEVISION, SOUND PROGRAMME AND OTHER MULTIMEDIA SIGNALS

Secondary distribution of IPTV services

Enablement of current terminal devices for the support of IPTV services

Recommendation ITU-T J.702

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Enablement of current terminal devices for the support of IPTV services

Summary

Recommendation ITU-T J.702 describes an IPTV terminal device (IPTV TD) that enables a migration path for the support of basic IPTV services, for current terminal devices used for other TV delivery services. This Recommendation identifies architectures and functions needed for the IPTV TD to support basic IPTV services, and is intended to meet immediate demands of current TV delivery services to rapidly deploy basic IPTV services.

Source

Recommendation ITU-T J.702 was approved on 29 October 2008 by ITU-T Study Group 9 (2005-2008) under Recommendation ITU-T A.8 procedures.

FOREWORD

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1 Scope

This Recommendation describes an IPTV terminal device (IPTV TD) that enables a migration path for the support of basic IPTV services, for current terminal devices used for other TV delivery services. This Recommendation identifies architectures and functions needed for the IPTV TD to support basic IPTV services, and is intended to meet immediate demands of current TV delivery services to rapidly deploy basic IPTV services.

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 F.902] Recommendation ITU-T F.902 (1995), *Interactive services design guidelines*.

[ITU-T G.1080] Recommendation ITU-T G.1080 (2008), *Quality of experience requirements for IPTV services*.

[ITU-T H.750] Recommendation ITU-T H.750 (2008), *High-level specification of metadata for IPTV services*.

[ITU-T J.293] Recommendation ITU-T J.293 (2008), *Component definition and interface specification for the next generation set-top box*.

[ITU-T J.700] Recommendation ITU-T J.700 (2007), *IPTV service requirements and framework for secondary distribution*.

[ITU-T J.701] Recommendation ITU-T J.701 (2008), *Broadcast-centric IPTV terminal middleware*.

[ITU-T X.1191] Recommendation ITU-T X.1191 (2009), *Functional requirements and architecture for IPTV security aspects*.

[ITU-T Y.1901] Recommendation ITU-T Y.1901 (2009), *Requirements for the support of IPTV services*.

[ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture*.

[ITU-T Y.2014] Recommendation ITU-T Y.2014 (2008), *Network attachment control functions in next generation networks*.

[ITU-R BT.1361] Recommendation ITU-R BT.1361 (1998), *Worldwide unified colorimetry and related characteristics of future television and imaging systems*.

[ITU-R BT.2052] Report ITU-R BT.2052 (2005), *Protection of end-users' privacy in interactive broadcasting systems*.

[BBF TR 069] Broadband Forum TR-069 (2004), *CPE WAN Management Protocol*.

[BBF TR 135] Broadband Forum TR-135 (2007), *Data Model for a TR-069 Enabled STB*.

[ETSI TS 102 034] ETSI TS 102 034 (2005), *Digital Video Broadcasting (DVB)*; *Transport of MPEG-2 Based DVB Services over IP Based Networks*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 access control [b-ITU-T X.800]: The prevention of unauthorized use of a resource, including the prevention of use of a resource in an unauthorized manner.

3.1.2 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.

3.1.3 application [b-ITU-T Y.101]: A structured set of capabilities, which provide value-added functionality supported by one or more services.

3.1.4 authentication [b-ITU-T X.800]: See data origin authentication and peer-entity authentication.

3.1.5 authorization [b-ITU-T X.800]: The granting of rights, which includes the granting of access based on access rights.

3.1.6 broadcast [b-ITU-T M.60]: One-way transmission from one point to two or more other points.

3.1.7 data origin authentication [b-ITU-T X.800]: The corroboration that the source of data received is as claimed.

3.1.8 delivery network gateway (DNG) [b-ATIS-0800002]: A device implementing the DNGF.

NOTE – DNG also is commonly referred to as the residential gateway (RG).

3.1.9 end-user (adapted from [b-ITU-T M.3050.1]): The actual user of the products or services.

NOTE – The end-user consumes the product or service. Further, an end-user may or may not be responsible for concluding contracts for the services subscribed to and for paying for these services (i.e., an end-user may or may not be a subscriber).

3.1.10 functional architecture [b-ITU-T Y.2012]: A set of functional entities and the reference points between them used to describe the structure of an NGN. These functional entities are separated by reference points, and thus, they define the distribution of functions.

NOTE 1 – The functional entities can be used to describe a set of reference configurations. These reference configurations identify which reference points are visible at the boundaries of equipment implementations and between administrative domains.

NOTE 2 – This definition is taken from [b-ITU-T Y.2012] and therefore relates to NGN. However, it is also valid for other networks, e.g., networks supporting IPTV.

3.1.11 functional entity [b-ITU-T Y.2012]: An entity that comprises an indivisible set of specific functions. Functional entities are logical concepts, while groupings of functional entities are used to describe practical, physical implementations.

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

3.1.13 key management [b-ITU-T X.800]: The generation, storage, distribution, deletion, archiving and application of keys in accordance with a Security Policy.

3.1.14 peer-entity authentication [b-ITU-T X.800]: The corroboration that a peer entity in an association is the one claimed.

3.1.15 privacy [b-ITU-T X.800]: The right of individuals to control or influence what information related to them may be collected and stored and by whom and to whom that information may be disclosed.

3.1.16 provisioning [b-ITU-T M.2301]: The installation, assignment and commissioning (including bringing-into-service testing) of network resources.

3.1.17 security policy [b-ITU-T X.800]: The set of criteria for the provision of security services.

3.1.18 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.

3.1.19 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.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 content protection: Ensuring that end-users can only use the content they have already acquired in accordance with the rights that they have been granted by the rights holder. Content protection includes protecting contents from illegal copying and distribution, interception, tampering, unauthorized use, etc.

3.2.2 content provider: The entity that owns or is licensed to sell content or content assets.

3.2.3 content tracing: A process to enable the identification of the (arbitrary) origin of content, and/or the responsible party (e.g., the end-user), to facilitate subsequent investigation in the event of unauthorized use of content, for example, content copying or redistribution.

NOTE – Content tracing information may be attached to content either as metadata, or as a forensic watermark.

3.2.4 delivery network gateway functions (DNGF): Set of functions that mediate between the network and service provider domains and the IPTV terminal function (ITF).

NOTE – A device implementing the DNGF is commonly referred to as the residential gateway (RG) or delivery network gateway (DNG).

3.2.5 entitlements: Refer to authorization level(s) including conditional access information that a subscriber can use to access certain IPTV services in his/her IPTV TD.

3.2.6 IPTV TD: A terminal device which has ITF functionality, e.g., a set-top box (STB).

3.2.7 IPTV terminal function (ITF): The client-side function(s) 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.

3.2.8 linear TV: 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.

3.2.9 metadata: 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.

3.2.10 rights: Refer to the ability to perform a pre-defined set of utilization functions on a content item. These utilization functions include the permissions (e.g., to view/hear, copy, modify, record, excerpt, sample, keep for a certain period, distribute), constraints (e.g., play/view/hear multiple times, play/view/hear certain number of hours) and obligations (e.g., payment, content tracing) that apply to the content and provide liberty of use granted to the end-user.

3.2.11 service: A set of functionality enabled by a provider for end users; for example, providing IP connectivity with managed quality of service, providing an IPTV service, providing a content on demand service, etc.

3.2.12 service and content protection: A combination of service protection and content protection, or a system or implementation thereof.

3.2.13 service protection: Ensuring that an end-user can only acquire a service, and, by extension, the content contained therein, that they are entitled to receive. Service protection includes protecting service from unauthorized access as IPTV contents traverse through the IPTV service connections.

3.2.14 terminal device (TD): An end-user device which typically presents and/or processes content, such as a personal computer, a computer peripheral, a mobile device, a TV set, a monitor, a VoIP terminal or an audiovisual media player.

3.2.15 trick mode functionality: The ability to pause, rewind or forward stored content.

3.2.16 video on demand (VoD): A service in which the subscriber can view and/or select a stored video content whenever desired.

4 Abbreviations

This Recommendation uses the following abbreviations:

AL-FEC	Application Level FEC
ARQ	Automatic Repeat reQuest
BC	BroadCast network
BCAST	Broadcast
CDN	Content Delivery Network
CODEC	Coder-Decoder
CP	Content Protection
CPE	Customer Premises Equipment
DCAS	Downloadable Conditional Access System
DEMUX	Demultiplex
DHCP	Dynamic Host Configuration Protocol
DNG	Delivery Network Gateway
DRM	Digital Rights Management
EAS	Emergency Alert System
ECG	Electronic Content Guide
EPG	Electronic Program Guide
ESG	Electronic Service Guide
FEC	Forward Error Correction
GUI	Graphic User Interface

HDMI	High-Definition Multimedia Interface
HN	Home network
HTML	HyperText Mark-up Language
HTTP	HyperText Transfer Protocol
HTTPS	HyperText Transfer Protocol Security
IETF	Internet Engineering Task Force
IGMP	Internet Group Management Protocol
IMS	IP Multimedia Subsystem
IP	Internet Protocol
IPG	Interactive Program Guide
IPTV	Internet Protocol TV
MIB	Management Information Base
MLD	Multicast Listener Discovery
MPEG	Moving Picture Experts Group
MUX	Multiplex
NACF	Network Attachment Control Functions
NGN	Next Generation Network
NTSC	National Television System Committee
NTP	Network Time Protocol
NW	Network
OD	Output Device
OSD	On-Screen Display
PAL	Phase Alternate Line
PD	Peripheral Device
PID	Packet Identifier
PIN	Personal Identification Number
PPV	Pay Per View
PVR	Personal Video Recorder
QAM	Quadrature Amplitude Modulation
QoE	Quality of Experience
QoS	Quality of Service
RACF	Resource Admission Control Functions
RAL	Resource Abstraction Layer
RAM	Random Access Memory
RF	Radio Frequency
RG	Residential Gateway
RTP	Real-time Transport Protocol

RTSP Real-Time Streaming Protocol

SADS Service and Application Discovery and Selection

SCP Service and Content Protection

SD Service Discovery

SECAM SÉquence Couleur Avec Mémoire

SI Service Information

SM Security Module

SNF Service Navigation Function

SNMP Simple Network Management Protocol

SP Service Protection

SSM Source Specific Multicast

STB Set-Top Box

SVD Subscriber Video Device

TD Terminal Device

TCP Transmission Control Protocol

TFTP Trivial File Transfer Protocol

TLS Transport Layer Security

TS Transport Stream

UDP User Datagram Protocol

UPnP Universal Plug and Play

USB Universal Serial Bus

VCR Video Cassette Recorder

VBI Vertical Blank Interval

XML eXtensive Mark-up 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 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 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 "**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 the specification.

In the body of this Recommendation and its annexes, the words *shall*, *shall not*, *should*, and *may* sometimes appear, in which case they are to be interpreted, respectively, as *is required to*, *is prohibited from*, *is recommended*, and *can optionally*. The appearance of such phrases or keywords in an appendix or in material explicitly marked as *informative* are to be interpreted as having no normative intent.

6 Basic services

Based on requirements and recommendations identified in [ITU-T Y.1901], the basic services that the IPTV TD is recommended to support are defined as follows. For details of service use cases or examples, refer to [b-ITU-T Y-Sup.5].

6.1 Content delivery service

6.1.1 Service navigation

Service navigation is a process of presenting information that allows the end-user to discover, select and consume services.

Service navigation is an integral part of IPTV because it is expected that there are many services possible on IPTV and without service navigation, it is very difficult, if not impossible, to obtain services. A typical means of service navigation is by way of a service navigation interface, a user interface which is intended to provide information on available services, including content that may be accessed by end-users for service navigation. Service navigation interfaces include, but are not limited to, EPG, IPG, ECG, and ESG.

6.1.2 Linear TV

Linear TV is a broadcast TV service that is the same as the classic form of television services that are provided by cable, terrestrial and direct-to-the-home satellite operators, where the programme content is transmitted according to a defined schedule and is intended for real-time consumption by the end-user. The service therefore provides an essentially continuous stream flowing from the content provider to the terminal device.

Linear TV includes (but is not necessarily limited to) the following approaches:

- **Audio and video**: Audio and video (audiovisual) signals are broadcasted and distributed to the downlink without end-user control of the content flow (e.g., without trick play).
- **Audio only**: Audio signals are broadcasted and distributed to the downlink without end-user control of the content flow (e.g., without trick play).
- **Linear TV with audio, video, and data**: These A/V services are combined with interactive data for the related or supplementary information of A/V programs using bidirectional links. The end-user can watch the downlink A/V stream and simultaneously access more detailed or value-added information via the uplink.

6.1.3 Content on-demand

A content on-demand service enables an end-user to select, acquire, and consume from a library of content stored on a remote or local server.

6.2 Interactive services

The IPTV TD is recommended to support an IP-based 2-way communication channel. As described in [b-ITU-T Y-Sup.5], the interactive services may include, but are not limited to, information services, commercial services, entertainment services (e.g., games, karaoke, etc.), learning services, medical services, monitoring services, portal services, and so on. The IPTV TD is recommended to have the ability to communicate with a remote interactive content server via means such as HTTP or HTTPS protocols. Client-side interactive services may also be provided by a resident application.

NOTE 1 – Having a browser indicate direct access to the Internet.

NOTE 2 – Interactive services may include service provider specific customer services, such as subscription, PPV, EPG, etc.

6.3 Public interest services

[ITU-T Y.1901] defines public interest services including:

- Accessibility features, as described in [b-ITU-T Y-Sup.1] and refers to the ITU-T FSTP-TACL telecommunications accessibility checklist [b-ITU-T TP.TACL];
- emergency telecommunications;
- regulatory information services;
- provider selection and number portability.

When relevant national regulations apply, the IPTV TD is required to support national regulations.

7 Functional requirements

7.1 Network attachment

This clause describes the network attachment procedures. When the IPTV TD is attached to the network, the initialization processes will begin to set up the network interface for the IPTV TD and provide necessary access to the initial entry point for service discovery, as described below.

1) In the first stage, the IPTV TD is required to establish layer-2 connectivity.
2) In the second stage, the IPTV is required to obtain an IP address, e.g., using DHCP.
3) In the third stage, the IPTV TD is recommended to obtain a service discovery entry point.

The IPTV TD is recommended to support the methods described in clause 7.1 of [ITU-T J.293] for the above three stages.

Note that there are two cases to consider regarding DHCP. In the first case, DNG supports DHCP server capability and thus acts as a network DHCP server in a home network. In the second case, DNG passes DHCP messages from the network to the terminal device directly.

Alternatively, the network attachment control function (NACF), as described in [ITU-T Y.2014] may be used to provide registration at the access level and initialization of end-user functions (DNG, IPTV TDs) for accessing NGN services.

[ITU-T Y.2014] describes the following functionalities for NACF:

- dynamic provisioning of IP addresses and other user equipment configuration parameters;
- by endorsement of user, auto-discovery of user equipment capabilities and other parameters;
- authentication of end user and network at the IP layer (and possibly other layers). Regarding the authentication, mutual authentication between the end user and the network attachment is performed;
- authorization of network access, based on user profiles;
- access network configuration, based on user profiles;
- location management at the IP layer.

The following clause describes service discovery procedures.

7.2 Service discovery

Service discovery is the process by which an IPTV TD becomes aware of the available IPTV services, and learns the location of and the means for obtaining each available IPTV service.

The IPTV TD is required to obtain the service discovery information.

The IPTV TD is recommended to support IP unicast and multicast for service discovery information distribution.

The IPTV TD is recommended to support service discovery information contained in XML-based text, e.g., DVB-IPI [ETSI TS 102 034], and contained in service information (SI) of the MPEG transport stream. Additional information on SI can be found in Appendix IV.

Appendix V provides an explanatory text of service discovery and examples of the service discovery information structure.

7.3 Service navigation

The service navigation function (SNF) provides functionalities relating to service navigation including the collection of the metadata, construction of a program guide, provision of a user interface, etc.

The IPTV TD is recommended to provide a service navigation capability as part of the resident application functionalities, which uses the metadata provided by the service provider to offer the subscriber the capabilities of content retrieval, information presentation, play, a method to purchase the content, and interactivity.

More broadcast centric services, where any information is distributed by way of one-way transmission from one point to two or more other points, conventionally provide service navigation by service information (SI), which is detailed in Appendix IV.

7.3.1 The functions provided by the SNF

The SNF is required to provide at least one of the following functions if the IPTV TD supports SNF:

– retrieval of specific metadata based on search conditions;
– retrieval of metadata from across different (more than one) service providers;
– display of the listing of available content, or the detailed information on the available content, based on received metadata;
– navigation and the means to allow the end user to purchase the content;
– indication of the contents purchased by the end user;
– navigation to allow the end user to view the purchased contents.

7.3.2 Metadata for service navigation

The metadata described in [ITU-T H.750] is recommended as the means for service navigation.

7.3.3 Caching metadata

The IPTV TD is recommended to retrieve metadata and temporarily store it as cache. The exact implementation of the cache mechanism depends on each terminal device, but its envisaged storing capacity varies from the minimum value of the searched content displayed on a monitor, to the maximum value of all the metadata from all the service providers. The storage device may vary, the RAM may be used to temporarily store metadata in memory, or a hard-disk drive may be used to store it more permanently. For better quality of experience, the IPTV TD is recommended to construct a certain metadata database for SNF locally and provide its management.

The cache management of metadata is recommended to comply with the following points:

– the received metadata from the service provider can be managed as listing;

– the structure of the metadata and the relationship between contents is recommended to be maintained and presented in such a way that a single title in a package, a group of contents, will be properly related as such;

– consistency between the metadata on the service provider and that cached in the terminal device is recommended to be maintained as much as possible. The differences between the metadata on the service provider's server side and that cached in the terminal device should be kept within a reasonable limit, e.g., less than a day;

– the IPTV TD is recommended to always get the newest metadata when it is available and to update the locally cached metadata accordingly;

– when the expiration date of metadata is specified, the IPTV TD is recommended to comply with the date and neither display nor utilize the metadata exceeding the date.

7.3.4 Searching with metadata

SNF on the IPTV TD is recommended to be able to interact with the service provider side (e.g., server of the metadata) as well as with the locally handled metadata in the IPTV TD so that it can provide the user with the search content based on metadata, e.g., by title, genre, cast, keyword, popularity, review.

7.3.5 Parental control

Where some content with age restrictions is envisaged, parental control should be considered, not only for playing the contents, but also for service navigation based on metadata. The IPTV TD is recommended to provide parental control functionality to its SNF.

7.4 Provisioning and management

The IPTV TD in this Recommendation is recommended to support provisioning and management when it is attached to an IP network environment.

Provisioning and management support includes:

• support for dynamic and static provisioning of CPE (DNG, IPTV TD, etc.) with information such as the IP address;

• support for dynamic provisioning changes (such as application-specific configuration) without requiring a CPE reboot, unless explicitly indicated via a management interface (for example, critical software download);

• support for activation and deactivation of clients and application features, such as console interfaces and user guides, setting time zone information, clearing the customer PIN or resetting the CPE;

• ensuring that real-time provisioning and configuration of software does not adversely affect subscriber service.

The CPE can optionally support well-established industry standard protocols for configuration and management, such as:

• The IETF protocol suite:
  – SNMPv2/v3 [b-IETF RFC 2578]/[b-IETF RFC 3411], [b-IETF RFC 3412], [b-IETF RFC 3413], [b-IETF RFC 3414], [b-IETF RFC 3415], [b-IETF RFC 3416], [b-IETF RFC 3417], [b-IETF RFC 3418].
  – DHCP [b-IETF RFC 2131], [b-IETF RFC 2132], DHCPv6 [b-IETF RFC 3315].
  – TFTP [b-IETF RFC 1350].

  - HTTP [b-IETF RFC 2616].
  - Time Protocol [b-IETF RFC 868], NTP [b-IETF RFC 1305], SNTP [b-IETF RFC 1769].
- UPnP [b-ISO/IEC 29341-x].
- Open Mobile Alliance (OMA) Device Management.
- ITU-T M.3000 series for telecommunications management network.
- [BBF TR 069] and [BBF TR 135].

7.4.1 Polling and report-back

The IPTV TD should support polling and report-back messages from the management functions [ITU-T Y.1910] to poll the IPTV TD to collect terminal device internal information relating to configuration, diagnostics, purchasing, etc. The management functions at the server side [ITU-T Y.1910] initiate a process to receive report-back from the IPTV TD. In some cases, the report-back reception process may be initiated also by the IPTV TD, as an "unsolicited report-back".

7.4.2 Accounting and management

An event recording mechanism provides a capability to capture event data for transaction based services (e.g., pay per view). Management functions or IPTV application functions in the server-side functions [ITU-T Y.1910] are intended to report the viewing record appropriately to the accounting functions. IPTV TD is recommended to appropriately interact with these functionalities at the server side, to support the accounting mechanism.

7.4.3 Software download

The code includes software and data (e.g., logo, contents genre table). The code and software downloaded to the IPTV TD may be classified into three types: firmware, middleware and SCP software.

- The IPTV TD is recommended to support software download and upgrade capability via the remote download interface using methods like IP multicast or unicast (e.g., HTTP/TCP/IP).
- If secure downloads are needed, IPTV TD is recommended to support the decryption of encrypted code data.

7.5 IP-based command and control

IP-based control and signalling are required to include:

- a preferred signalling architecture for establishing new sessions, modifying existing sessions, and tearing down sessions;
- feature capabilities of the selected signalling protocol(s), including channel change and trick-mode (VCR) operation including pause, rewind, fast forward, resume, and stop.

Protocols for IP-based command and control are described in clause 9.1.9.

7.6 Security

There are many security concerns and requirements that are addressed to and should be supported by the IPTV TD. [ITU-T Y.1901] should be consulted for a detailed list of security requirements placed on the IPTV TD. Furthermore, clause 6.5 of [ITU-T X.1191] should be consulted for details on security related issues directly affecting an IPTV system.

7.6.1 Service and content protection

Service and content protection (SCP) functions, which consist of IPTV TD's functions and server-side functions, play a central role in the IPTV general security. In particular, service protection (SP) functions enable protection of the service infrastructure as well as controlling access to services and the content therein, while content protection (CP) functions in the TD enable controlling the use of services and content according to licensed uses. The primary purpose of the service protection aspects of the SCP functions is to prevent unauthorized access to service resources and information considered to be confidential by entities in TDs. A secondary purpose of the service protection aspects of the SCP functions is to protect the service infrastructure from damage due to both intentional and/or accidental misuse of TDs.

The IPTV TD is required to support the following functions:

- TD authentication,
- physical tamper-resistance for TD,
- secure means for performing security critical processes in TD.

  NOTE – i.e., key management and media serialization, to abort playback of content in the event of a security related malfunction, detection of tampering, or other indication of misuse.

In addition, requirements related to IPTV terminal security are described in [ITU-T X.1191]. The IPTV TD is recommended to support clause 6.5 of [ITU-T X.1191].

In all cases, the IPTV TD is required to securely inform the SCP functions on the server side of its SCP capabilities, to ensure that the terminal's SCP capabilities required by the content provider are present and operable, prior to descrambling the content.

7.6.2 Privacy

There are many privacy concerns and requirements that are addressed to, and should be supported by, the IPTV TD. [ITU-T Y.1901] should be consulted for a detailed list of privacy requirements placed on the IPTV TD. Furthermore, clause 6.6 of [ITU-T X.1191] should be consulted for detailed privacy related issues directly affecting IPTV systems.

An IPTV terminal device can be a major source of private information. The following items are recommended to be securely handled within the IPTV TD:

- viewing history,
- return/interaction channel usage and audience measurement information,
- history of interactive operation,
- personal profiles and preferences,
- ID number.

In some interactive broadcasting systems, the ID number is used for content copy control, even in free-to-air services. [ITU-R BT.2052].

Audience measurement information gathering is required to consider privacy aspects so as to protect the user/audience identity by e.g., encrypting the user's unique identifier (e.g., MAC or IP Address).

NOTE – Annex A of [ITU-T X.1191] details security and privacy related concerns that may affect an audience rating information service, and should be consulted for more details.

7.7 Video content

7.7.1 Video formats

The IPTV TD is recommended to support commonly used video formats.

Colorimetry of video signals is required to be in compliance with [ITU-R BT.1361] in all video formats.

The IPTV TD can optionally be capable of displaying video and graphics output at the standard video resolutions defined in each region (e.g., NTSC, PAL, SECAM) on the Composite and S-Video outputs.

IPTV TDs that support high definition outputs can optionally be capable of displaying video and graphics output on component and HDMI outputs. The IPTV TD should be capable of converting a specified input decoded picture source format/resolution to an output format/resolution through a combination of video scaling and de-interlacing. IPTV TDs that support high definition outputs can optionally provide native mode video output support so that it automatically changes output resolution formats to match the broadcast format. Native mode video means a common video format which current broadcast receivers use.

7.7.2 Video processing

The IPTV TD should support the following video processing features:

- Independent horizontal and vertical scaling ranging from 1/32 (downscaling) to 32 (upscaling).
- Aspect ratio conversion with letterbox format or side panel format.

Video outputs (RF and baseband) should conform to accepted international standards.

The IPTV TD should support the scaling of a video source for display. In particular, the IPTV TD is recommended to support this functionality due to potential restricted capabilities.

If the region where the IPTV TD is used defines a signal multiplexing format for analogue video output such as VBI (vertical blanking interval) data, the IPTV TD is recommended to be conformant with their regional specification. An example is shown in Appendix II.

7.8 Audio content

7.8.1 Audio formats

The IPTV TD is recommended to support commonly used audio formats.

Some exemplary audio formats that the IPTV TD may support include:

- 5.1 channel audio.
- 2 channel audio.

The IPTV terminal device can optionally be capable of performing audio transcoding, e.g., downgrading of advanced audio coding such as bitstream conversion from AC-3+ to AC-3, on output audio signals. The process of transcoding implies the implementation of the respective decoder (if a single codec is used) or decoders (if two codecs are requested) in the IPTV terminal device. This gives IPTV operators the possibility to avoid simulcasting multiple streams encoded with different schemes. With the decoder in place, the IPTV terminal device can optionally feature a downmix from multichannel to stereo for either all devices or at least those which are not offering the transcoding feature, respectively. The IPTV TD is required to carry out downmixing of the sound, e.g., multichannel to 2 ch stereo, according to the mixing level parameters if they are defined or provided with the stream.

7.9 Codecs

7.9.1 Video

The IPTV terminal device is required to decode video streams as described in Annex B. Appendix I also provides a list of other video codecs.

7.9.2 Audio

The IPTV terminal device is required to decode audio streams as described in Annex B. Appendix I also provides a list of other audio codecs.

7.9.3 Caption

The IPTV terminal device is required to decode caption streams.

7.10 Diagnostics

The IPTV TD is recommended to support monitoring capabilities that will provide diagnostic information about its configuration and operation. This information should be made available both locally (for example, by using on screen display graphics) and over the network. The intent of this capability is to provide information on the terminals' operational and application states such that any terminal device issue can be quickly understood and resolved.

The role-sharing between IPTV TD and DNG is for further study.

Support for the following requirements concerning the diagnostics should be considered:

- The IPTV TD is recommended to support remote diagnostics as specified by the network and service providers.
- The IPTV TD is recommended to provide all requested diagnostic information to the server-side diagnostics functions.

The IPTV TD is recommended to provide diagnostic information about its configuration and operation both locally using on-screen display (OSD) graphics and over the network. The intent of the IPTV TD related diagnostics is to provide a mechanism for identifying the IPTV TD's operational state such that any IPTV TD or network issue can be quickly understood and resolved, preferably remotely.

The IPTV TD diagnostics are split between an IPTV diagnostic application and an IPTV TD client software diagnostic component. The IPTV diagnostic application should implement the diagnostic screens. On-screen display (OSD) for diagnostics should be available regardless of the state of the network or of any application.

8 Network architectures for IPTV TD

IPTV TD is required to be connected using one of the following three network architectures described in [ITU-T Y.1910] for IPTV service delivery.

- "Non-NGN IPTV functional architecture" (Non-NGN IPTV): The Non-NGN IPTV architecture is based on existing network components and protocols/interfaces. The technology components, protocols and interfaces used in this IPTV architecture are already in use and hence this approach is a representation of typical existing IPTV networks and services. This architectural approach can optionally be used as the basis for evolution towards the other IPTV architectures listed below.
- "NGN-based non-IMS IPTV functional architecture" (NGN-Non-IMS IPTV): The NGN Non-IMS IPTV architecture utilizes components of the NGN framework reference architecture as identified in [b-ITU-T Y.2012] to support the provision of IPTV services, in conjunction with other NGN services if required.

- "NGN IMS-based IPTV functional architecture" (NGN-IMS-IPTV): The NGN-IMS based IPTV architecture utilizes components of the NGN architecture including the IMS component to support the provision of IPTV services, in conjunction with other IMS services if required.

9 IPTV terminal device functional architecture

9.1 General functional architecture block diagram

The general functional architecture of IPTV terminal devices is required to comply with the description given in [ITU-T Y.1910]. Figure 9-1 shows the functional architecture block diagram for IPTV terminal devices, with the necessary functional components.

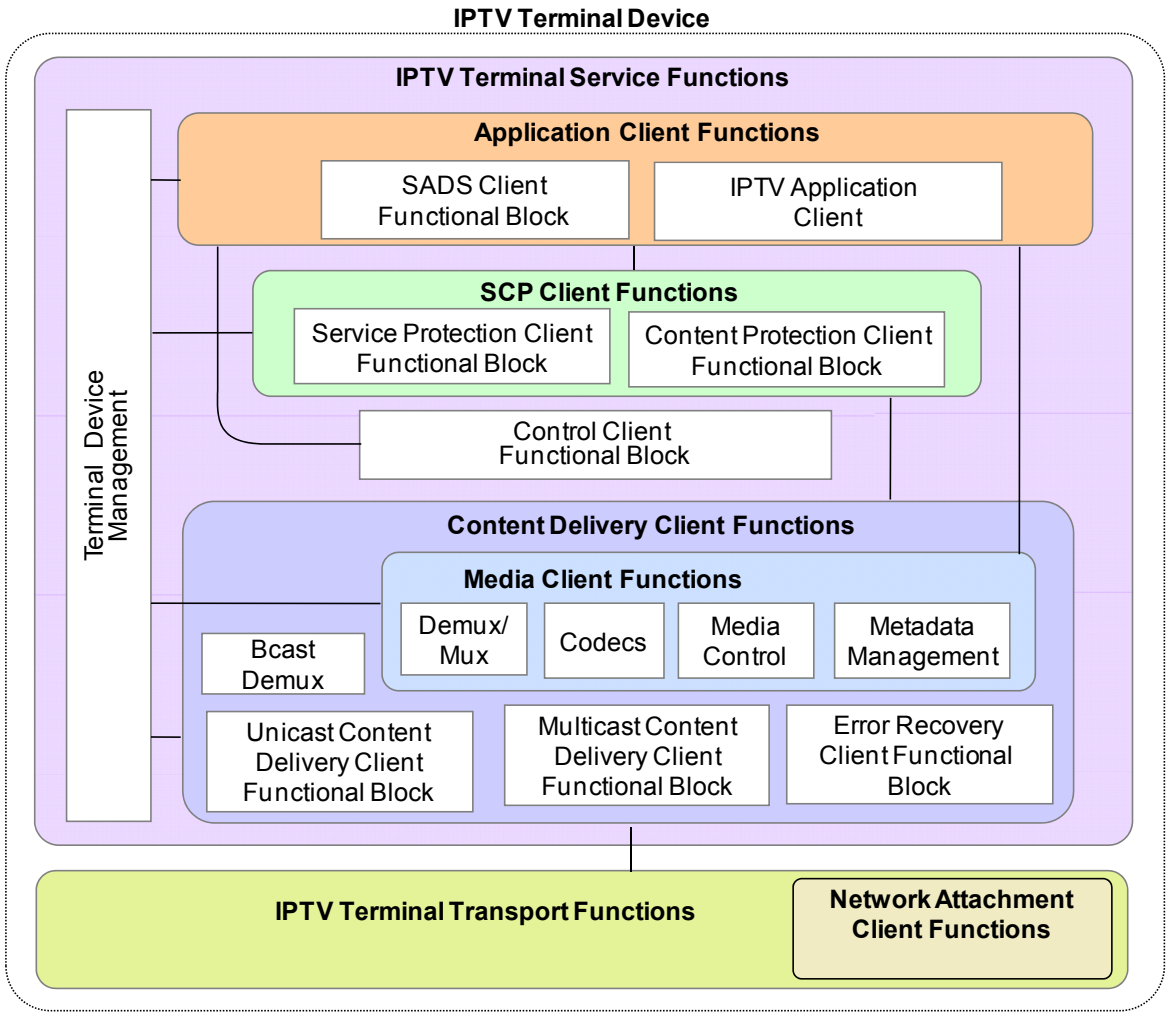

Figure 9-1 – Functional architecture block diagram for IPTV terminal devices

NOTE 1 – Functions and functional blocks in the above figure are intended to correspond to those in [ITU-T Y.1910] and [ITU-T J.700] to maintain peer to peer relationships. However, the media client functions included here are not shown in [ITU-T Y.1910] or [ITU-T J.700], but are related to the content delivery functions described in those Recommendations.

NOTE 2 – In the IMS case, the "Control Client Function" is referred to as "Session Client Function" in [ITU-T Y.1910].

9.1.1 Applications

- Applications include the software components capable of enabling functional and observable behaviour, such as the GUI, SNF, VoD controls, and other service related applications.
- Some applications are recommended for basic management of the IPTV TD, such as power management and event management.
- Some applications are also recommended for supporting services, including but not limited to SCP applications, plug-in applications, browser applications, media player applications, and GUI applications.

9.1.2 SADS client functional block

The SADS client functional block provides for the end user's discovery and selection of IPTV services and applications [ITU-T Y.1910].

9.1.3 SCP

The SCP consists of the service protection (SP) functionality and the content protection (CP) functionality. The functional entity includes the following functions:

- Handling of authentication mechanisms including key exchange and processing (SP).
- Creation of content tracing information to be bound to the content, if a content tracing mechanism is deployed (CP).

  This function is left for further study.
- Embedding of content tracing information, or enforcing subsequent embedding of content tracing information, if this mechanism is deployed (CP).

  This function is left for further study.
- Processing of SCP issues (SP).
- Descrambling of input stream (SP).
- SCP can optionally be a software implementation (e.g., downloadable).

[ITU-T X.1191] should be consulted for details about IPTV security aspects.

9.1.3.1 Content protection

The TD is responsible for enforcing content usage rules ascribed to rights information (also known as content protection metadata). This functional entity interprets content rights and keys obtained from the server-side Right&Key management function and then acts on the interpretation to control how the content is processed and exposed to the end-user, either through integrated presentation devices (such as a display or audio rendering system) or through physical interconnects to external devices.

In those cases where the TD transmits protected content to an external device (such as a display output), the content rights may be translated in form.

9.1.3.2 Service protection

For managed services involving protected content, it is typically the case that the end-user (subscriber) and TD must be authenticated and, subsequent to successful authentication, authorized to access service(s) and the content therein.

Depending upon circumstances, authentication and authorization functions may be performed separately on the TD and the end-user(s). In other cases, additional devices in end-user premises, such as a delivery network gateway and other end-user devices may require authentication before service access is authorized.

The combination of authentication and authorization can be used for access control to both IPTV service and to the TD, for purposes of service and content acquisition prior to use.

- Subscriber and TD authentication.

  This function is responsible for authenticating subscribers and TDs.

  – Subscriber authentication: a process to verify the user.

  – TD authentication: a process to verify the TD.

  In situations where X.509 base certificates are used for authentication, a revocation function is required.

- Server authentication.

  – A function in TD to authenticate the server for mutual authentication.

- Service access control.

  – A function to constrain acquisition and access of services to authorized users by using security mechanisms such as scrambling and encryption, i.e, a conditional access system.

9.1.3.3 Renewable security

This clause is left for further study.

The following are the minimum requirements for renewable security:

- renewable security functionality may be used;
- renewable security encompasses removable (e.g., Smart Card, Cable Card) and/or downloadable (e.g., DCAS) security;
- removable security is an optional component;
- the removable security functionality is described in more detail in clause 10.1.8.

9.1.4 Demux/Mux

The Demux/Mux functional entity is required in order to support the following functions:

- de-multiplexing of video, audio, and data streams;
- re-multiplexing functionality to combine video, audio, and/or data streams, for potential distribution over the home network, optionally;
- embedding of content tracing information if required by the content provider and not done previously (see clause 9.1.3).

9.1.5 Codecs

The Codecs functional entity is required for:

- decoding the compressed video and audio streams;
- decoding textual data, i.e., closed caption;
- embedding of content tracing information if required by the content provider and not done previously (see clause 9.1.3).

9.1.6 Media control

This functionality is responsible for the control of various media processing such as de-multiplexing, decoding, metadata handling, content storing, and play back of content, including content streaming. DVR controllers can be also considered as being part of this functionality.

9.1.7 Metadata management

This functional entity is responsible for metadata management such as the metadata-related services described in clause 7.3. Details of metadata management can be consulted in [ITU-T H.750].

9.1.8 Broadcast demux

The IPTV TD can optionally support non-IP content reception such as terrestrial, satellite or cable broadcasting services. This functionality is responsible for MPEG-TS handling for such broadcast signals. The broadcast demux functionality is outside the scope of this Recommendation.

9.1.9 Connection and session management

- The connection/session management functional entity is required for authentication, communication, and management of the connection to the IPTV server through the IPTV network (i.e., NGN).
- The connection/session management functional entity is also required for managing the protocols necessary to stream and control the flow of media and other contents arriving at the IPTV terminal device, using protocols such as IGMP and RTSP.

9.1.9.1 Unicast content delivery client

The unicast client functional block receives content from the unicast delivery functional block within the content delivery and storage functions.

The unicast content delivery client functional block is responsible for receiving content streams (e.g., via RTP over UDP) via IPTV terminal transport functions based on the use of the unicast protocols and mechanisms [ITU-T Y.1910].

RTSP for unicast content:

The IPTV TD is required to support RTSP for the delivery of unicast on-demand content or for the support of linear TV with trick mode, and the remote control of a streaming media server. A session ID is used to keep track of sessions, this way no permanent TCP connection is required. RTSP messages such as "describe", "setup", "play", "pause", "record", and "teardown" are sent from the IPTV TD to the streaming media server for controlling the delivery of the selected media stream.

9.1.9.2 Multicast content delivery client

The multicast client functional block receives content from the multicast delivery functional block within the content delivery and storage functions.

The multicast content delivery client functional block is responsible for receiving content streams (e.g., via RTP over UDP) via IPTV terminal transport functions based on the use of the multicast protocols and mechanisms [ITU-T Y.1910].

IGMP/MLD for multicast content:

Assuming that the CPE (DNG, IPTV TD) supports IGMP for IPv4 or MLD for IPv6, and that SI info supports IP transmission, the CPE uses the multicast destination address and/or the source IP address (if using source specific multicast – SSM) in SI to join the appropriate multicast flow transporting the content requested from the end user.

In order to support linear TV with trick mode service using local buffer/storage, the IPTV TD should have a buffer capability for caching content for subsequent end user control of playback.

Clauses 6.3.4.2 of [b-ITU-T J.290] and 6.2.1 and 7 of [b-ITU-T J.292] describe how a J.290-series compliant client (NG-STB-A/NG-STB-MI-A) supports MPEG-2 transport over QAM and video over IP (MPEG encapsulated in IP), as well as IP signalling protocols such as IGMP, MLD, and RTSP. This support is necessary for any IPTV TD wishing to enable IP-based command and control.

9.1.10 Error recovery

The Error recovery functional entity is recommended for improving the QoS/QoE provided by the network. Retransmission, forward error correction (FEC), and hybrid combinations of both are known mechanisms for error recovery.

[b-ITU-T H.701] contains a detailed description of error recovery.

9.1.10.1 FEC

An FEC-based error recovery protocol uses redundant information to allow the receiver to correct packet losses. With this redundant information, the receivers can recover from packet losses locally at the receiver. FEC may be used in unicast and multicast delivery.

9.1.10.2 Retransmission

Retransmission-based error recovery protocols use feedback messages to recover from packet losses, thereby requiring a return feedback path and one or more retransmission servers. On detecting a packet loss, e.g., by noting the gap of packet sequence number, a receiver requests a sender or designated repair servers to retransmit the lost packets. Retransmission may be either unicast or multicast, depending on the distribution of clients reporting the errors.

9.1.11 Terminal management

The terminal device management functional entity provides the functions "provisioning and management", described in clause 7.4, and "diagnostics" described in clause 7.10.

To satisfy the above-described functional requirements, the terminal device management functional entity basically includes the following functions:

- Configuration management of IPTV TDs.

  NOTE 1 – The device configuration may be also performed at manufacturing time or manually entered by the user.

- Monitor and control the data reception functions such as network interface, unicast/multicast content delivery clients, etc.

In the near future, the QoE function may be charged with the important role of:

- Monitoring the status of "TD-OD" interface for QoE metrics as an option.

  NOTE 2 – Detailed description of IPTV QoE can be found in [ITU-T G.1080].

The following information of IPTV TD could be collected and handled by the terminal device management function:

- IPTV TD information: manufacturer, model, and software/firmware version;
- information related to IPTV TD capabilities: the maximum number of streams that can be decoded, the audio and video formats and profile/levels supported, SCP capabilities, the inclusion of a personal video recorder (PVR), etc.;
- the ability to enable or disable IPTV TD capabilities;
- parameters related to networking (IP address and port number) and packet markings;
- information related to the media streams (e.g., RTP, MPEG-2 transport streams) for both, streams and mid/end-points (e.g., buffer related metrics);
- transmission related metrics: IP packets received, packets lost, jitter, etc.;

- service transaction related information: channels watched and duration;
- optionally, information related to the estimated quality of the content: that of video and audio streams.

NOTE 3 – Remote management is closely related to this functional block. However, remote management is studied in another Recommendation.

9.1.12 HN capability

- The HN interface is optional.
- The HN interface entity is responsible for managing the HN-TD1 and HN-TD2 interfaces described in clauses 10.1.4 and 10.1.5, respectively.
- Encryption and decryption of content streams for storage, display, and propagation to home network is recommended.
- Transferring applicable SCP rights/privileges throughout the home network is recommended.

9.1.13 Peripheral device

- A peripheral device, such as a video camera, wireless headset, Bluetooth USB adapter, or other components may be used by the end-user to interact with applications.
- The peripheral device is an optional component.
- The peripheral device interface is described in clauses 10.1.6 and 10.1.7 for "TD-PD" and "TD-OD" interfaces, respectively.

9.2 Interfaces

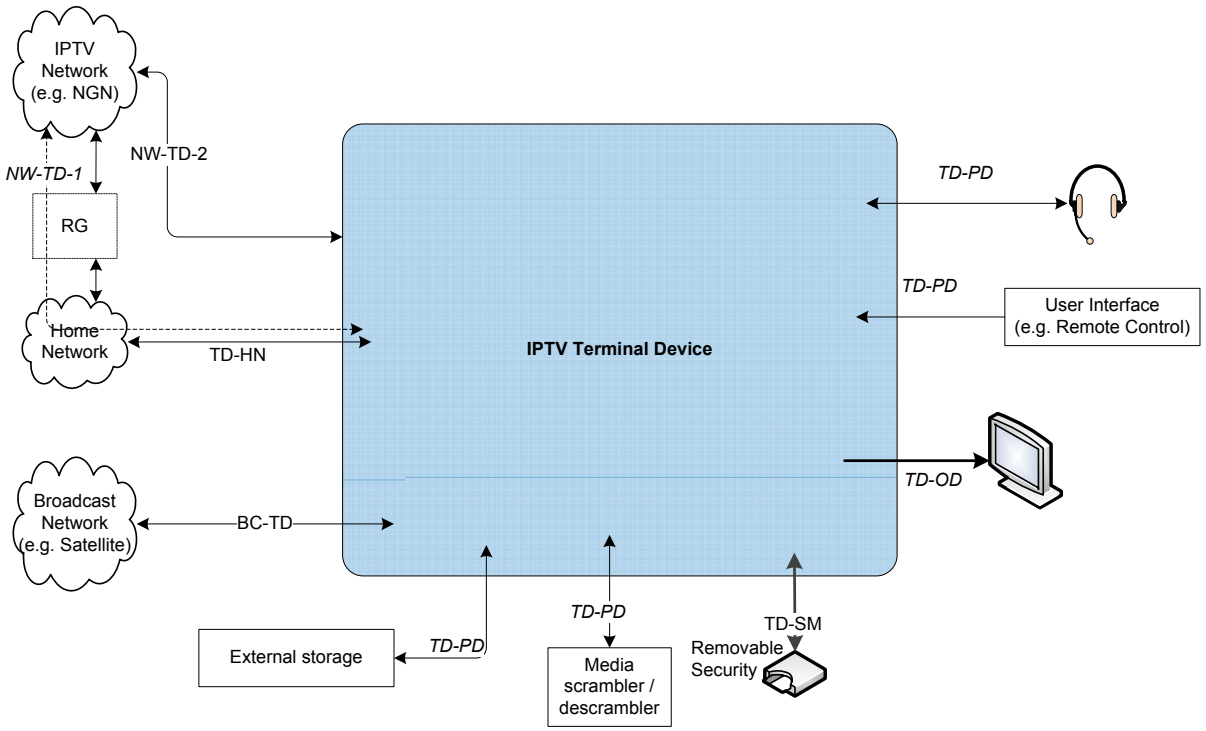

Figure 9-2 – IPTV terminal device physical interfaces

NOTE – The IPTV terminal device physical interfaces diagram is not meant to indicate required interfaces, rather, it is meant to show possible external TD interfaces.

9.2.1 Network interface

The network interface functional entity includes the following functions:

- send and receive signals;
- processing of layer 2 functions;
- processing of IP packets;
- processing of TCP/UDP packets;
- handling of the control flows;
- IPTV terminal device attachment and initialization process;
- management and reception of content over the BC-TD interface described in clause 10.1.1, for the connection to a broadcast network (e.g., satellite, terrestrial, cable);
- management and reception of content over the NW-TD1 and NW-TD2 interfaces described in clauses 10.1.2 and 10.1.3, respectively, for the connection to the IPTV network (e.g., NGN).

9.2.2 Peripheral device interface

- The peripheral device interface is required for interaction between the user devices and the appropriate applications.
- The peripheral device interface receives input from any number of desired peripheral devices (e.g., remote control, wireless headset) in order to provide bidirectional interaction between the end-user and the IPTV TD.
- The peripheral device interface functional entity is required for the TD-PD interface which is described in clause 10.1.6.

9.2.3 Output interface

The output interface functional entity is required for:

- TD-OD interface which is described in clause 10.1.7;
- handling graphics overlay and OSD for applications;
- the interface of an external display device. It is optional for the IPTV TD to include this functionality.

9.2.4 User interface

A suitable user interface is recommended to be equipped with IPTV TD.

- A user interface is a combination of software and hardware components through which a user can interact with the user input functional entity [ITU-T F.902]. It can manifest itself in such forms as:
  - a remote control,
  - a keyboard.
- The user interface supports input events, as described in the "Multimedia Application Platforms and End-Systems for IPTV".

9.3 IPTV terminal software architecture

Figure 9-3 shows the IPTV terminal software architecture (note that this architecture is compatible with the architecture shown in [ITU-T J.701]).

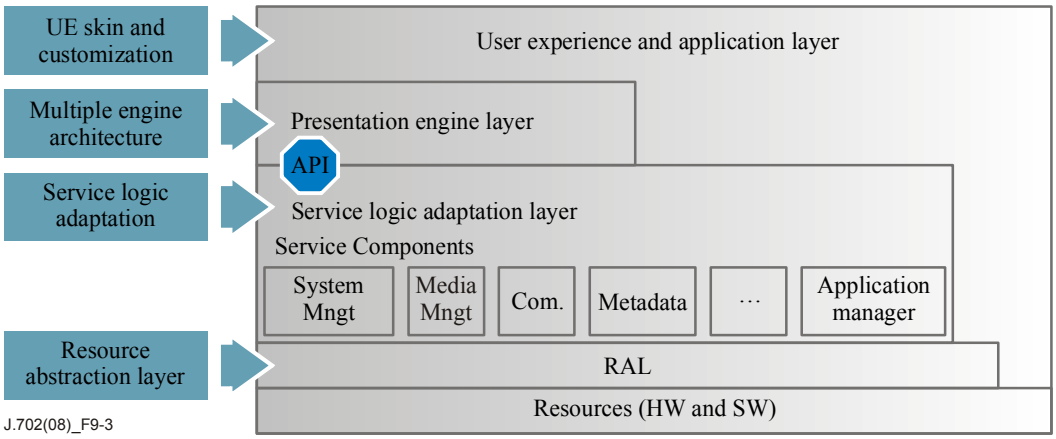

Figure 9-3 – IPTV terminal software architecture – overview

9.3.1 Resource abstraction layer (RAL)

The IPTV terminal middleware is hardware-agnostic. A specific resource abstraction layer (RAL) exists for each specific hardware and operating system. This provides the necessary interface to the lower layers (e.g., RAM, network access, hard drive, USB port, etc.). The RAL interface is designed so that device drivers can be written irrespective of the service logic adaptation layer.

9.3.2 Service logic adaptation layer

The service logic adaptation layer is made of service components. The service components are pure native components that offer functionalities common to all middleware implementations (e.g., service selection and presentation, service information management, PVR, security system). They are used and enriched by the application services in order to simplify the development of service components and applications above it.

The definition and the scope of services depend on the concrete functionalities deployed in the IPTV system.

Nevertheless, some service components can be defined that are generic in nature:

- system and resource management component,
- media management component,
- communication component,
- security component,
- metadata access component,
- user interaction component.

All these components can optionally use the functions available on the network.

9.3.3 Presentation engine layer

The presentation engine layer may include various engines along with a set of high-level services. This layer is built on top of the service logic adaptation layer.

In some implementations this layer may not exist.

9.3.4 User experience and application layer

The applications are either downloaded or resident. In particular, an application is powered by a presentation engine (e.g., HTML browser). An application can either have full or restricted access to the presentation engine layer features. Moreover, some applications may directly access the service logic adaptation layer without using a presentation engine.

10 IPTV terminal device interfaces

In this Recommendation, IPTV terminal device interfaces are defined from physical and logical points of view in accordance with [ITU-T J.293]. It also describes how the logical interfaces and the physical interfaces are associated with each other. Based on the definitions of [ITU-T J.293], the following clauses define the terminal device interfaces.

10.1 Logical interfaces

10.1.1 BC-TD interface

Refer to clause 6.1.1 of [ITU-T J.293].

10.1.2 NW-TD1 interface

Refer to clause 6.1.2 of [ITU-T J.293].

10.1.3 NW-TD2 interface

Refer to clause 6.1.3 of [ITU-T J.293].

10.1.4 HN-TD1 interface

Refer to clause 6.1.4 of [ITU-T J.293].

10.1.5 HN-TD2 interface

Refer to clause 6.1.5 of [ITU-T J.293].

10.1.6 TD-PD interface

Refer to clause 6.1.6 of [ITU-T J.293].

10.1.7 TD-OD interface

Refer to clause 6.1.7 of [ITU-T J.293].

10.1.8 TD-SM interface

TD-SM is the interface between the IPTV TD and an optional removable security function, such as an IC card. The following are the specifications for the TD-SM interface.

If removable security is to be implemented, the IPTV TD is required to be equipped with at least one interface for TD-SM. The possible interfaces for TD-SM are included in Appendix II, the interfaces to support TD-SM are not limited to those described in Appendix II, but are meant as exemplary interfaces to be used by the IPTV TD for security-related issues.

[ITU-T X.1191] should be consulted for details on the security issues of the IPTV system.

10.2 Physical interfaces

Refer to clause 6.2 of [ITU-T J.293].

11 RG (residential gateway)

This clause is left for further study.

12 Solution toolbox and profiles

The profiles for the Fast model IPTV TD are indicated in Annex A. A possible codec selection is described in Appendix I.

Generally two basic configurations may be applicable for the profile of terminal device. One is "basic IPTV-centric terminal device configuration" and the other is "basic IPTV-centric terminal device with PVR".

The "Basic IPTV-centric terminal device configuration" is characterized by:

– no broadcast reception,

– no PVR.

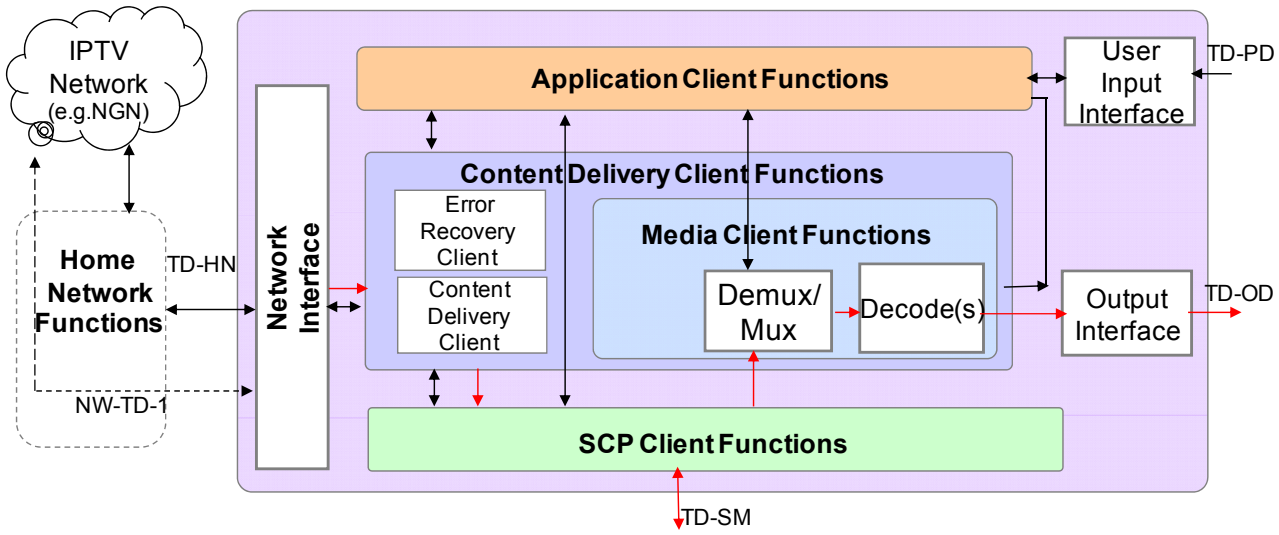

Figure 12-1 – Functional architecture for the basic IPTV-centric terminal device

Storage is available as an option in the demux for pause and other trick mode features.

Annex A

Baseline and extended functionality

(This annex forms an integral part of this Recommendation)

Table A.1 defines the baseline functionality for support of basic IPTV services, and optional step-up functions.

Table A.1 – Baseline and extended functionality

Baseline functionality	Extended functions (optional)
IPv4. Multicast control (e.g., IGMPv2). Unicast control (e.g., RTSP). Network attachment (e.g., DHCP client). High definition output. Multicast flow/TS linkage. Zapping control. Service and content protection. Error recovery (e.g., Packet FEC). Clock synchronization. Distribution area awareness.	IPv4/IPv6 dual stack, IPv6. Advanced multicast control (e.g., MLDv2, IGMPv3). Advanced error recovery (e.g., packet FEC and/or local packet ARQ/FEC).

Annex B

Codec selections

(This annex forms an integral part of this Recommendation)

The IPTV terminal device is required to support at least one of the following audio codecs, which are used in existing content delivery systems.

Table B.1 – List of audio codecs

Audio	MPEG-1 Layer II
	AC-3
	MPEG-2 AAC

The IPTV terminal device is required to support at least one of the following video codecs, which are used in existing content delivery systems.

Table B.2 – List of video codecs

Video	MPEG-2
	H.264/AVC

Appendix I provides examples of other codecs that can optionally be used by the IPTV terminal device.

Appendix I

Examples of codecs

(This appendix does not form an integral part of this Recommendation)

The following table provides examples of codecs that might be supported by the IPTV terminal device. These can be divided into two categories: codecs for IPTV content coding for content delivery services (see clause 6.1); and codecs for IPTV applications on interactive services (see clause 6.2), e.g., learning service with real-time communication capability.

For IPTV applications, encoding as well as decoding might be necessary for the supplemental communication API of IPTV terminal middleware, as described in [ITU-T J.701].

Table I.1 – Examples of codecs

	Codec	Purpose
Audio	MPEG-4 HE AAC	Content coding.
	MPEG-4 HE AAC v2	Content coding.
	Enhanced AC-3	Content coding.
	AMR-WB+	Content coding.
	G.722	Applications.
	G.722.1	Applications.
	G.722.1.C	Applications.
	G.722.2	Applications.
	G.729.1	Applications.
Video	VC-1	Content coding.
	AVS	Content coding.

Note that this appendix does not constitute a normative part of this Recommendation. The above table is intended to provide guidelines for the implementation of optional codecs.

Appendix II

VBI data processing

(This appendix does not form an integral part of this Recommendation)

The IPTV TD should be capable of passing through, extracting, decoding and rendering vertical blanking interval (VBI) lines carried in an encoded content stream and should make the VBI data available to the operating system and applications for processing.

The IPTV TD may support the following closed captioning standards and VBI capabilities: [b-ANSI/SCTE-20], [b-ANSI/SCTE-21] and [b-ETSI EN 301 775] (modified by [b-ANSI/SCTE-127]), [b-CEA-608-E], and [b-CEA-708-D].

In the event both [b-ANSI/SCTE-20] and [b-ANSI/SCTE-21] closed captions are present simultaneously, the preference is to select [b-ANSI/SCTE-21] closed captioning data.

In support of legacy standards, an IPTV terminal device should be capable of decoding closed caption, teletext, or subtitles traditionally present in VBI data, which are instead carried in the IP multimedia stream and re-created as VBI signals. Correct timing and formatting of such information should be maintained.

NOTE – This is one possible means of delivering closed captions to the IPTV terminal device, although other methods are available (e.g., [b-ETSI EN 300 743]).

Appendix III

Service flow charts of interactions between applications, service platforms and terminal middleware

(This appendix does not form an integral part of this Recommendation)

III.1 Flow of upgrade

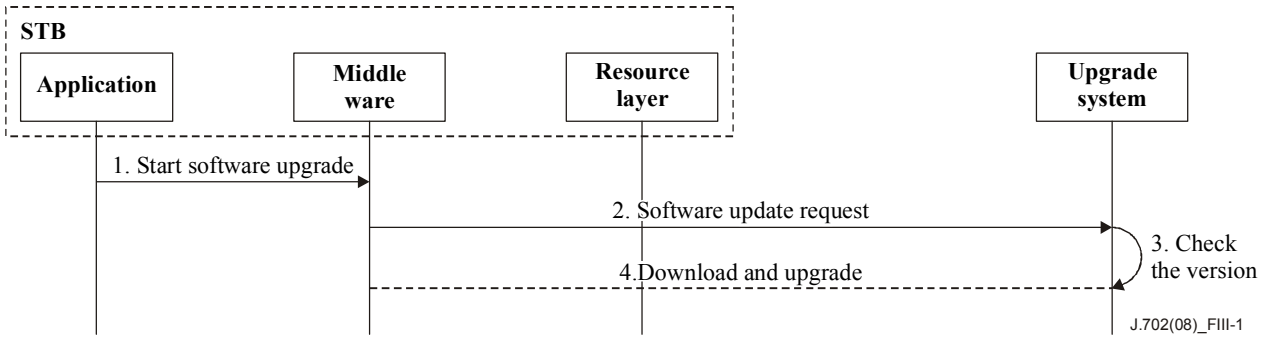

Figure III.1 – Flow of upgrade

1.&2. The STB starts the process of software upgrade, sending the upgrade request to the upgrade system.

3. The upgrade system checks the available version for upgrade.

4. The STB downloads the software.

III.2 Flow of boot-strap and initialization

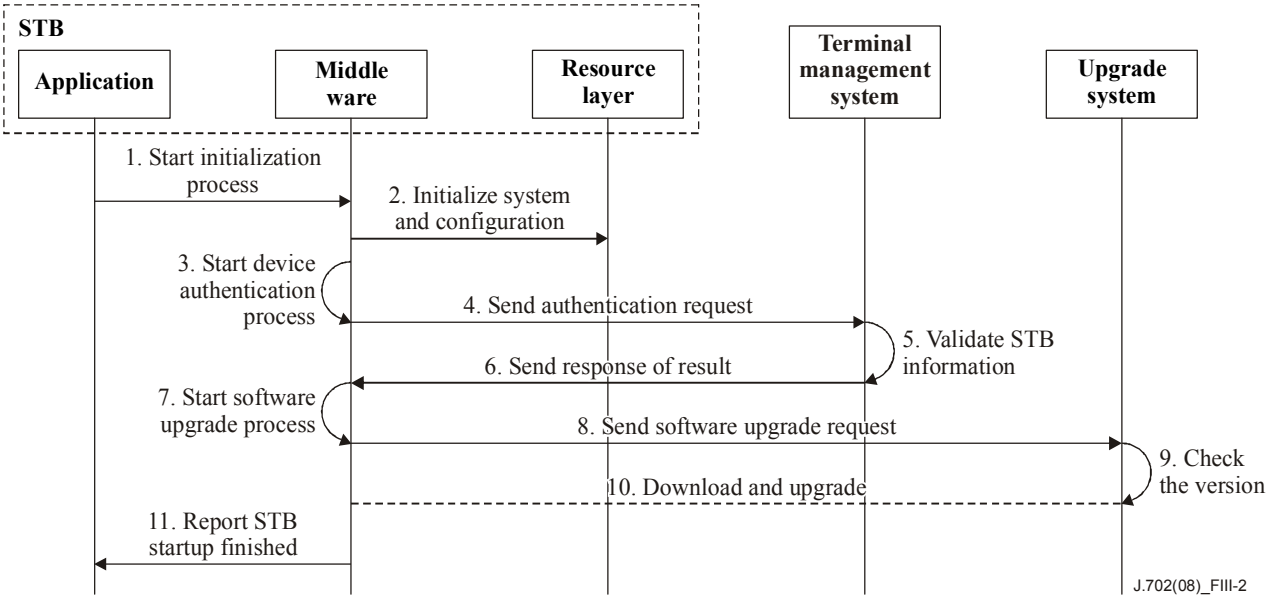

Figure III.2 – Flow of boot-strap and initialization

1. The application component starts the initialization process of the STB.

2. The middleware starts components of network, DRM, etc.

3. The middleware starts the process of device authentication.

4. The authentication request is sent to the terminal management system.

5. The terminal management system validates the information of the STB, including hardware version, software version, etc.
6. Response of the authentication result is sent to the STB. If it is necessary to upgrade the software, an upgrade response is sent back.
7.-10. Steps 7 to 10 are optional. If necessary, the software upgrade process is carried out.
11. End of start-up is reported to the application.

III.3 Flow of service authentication

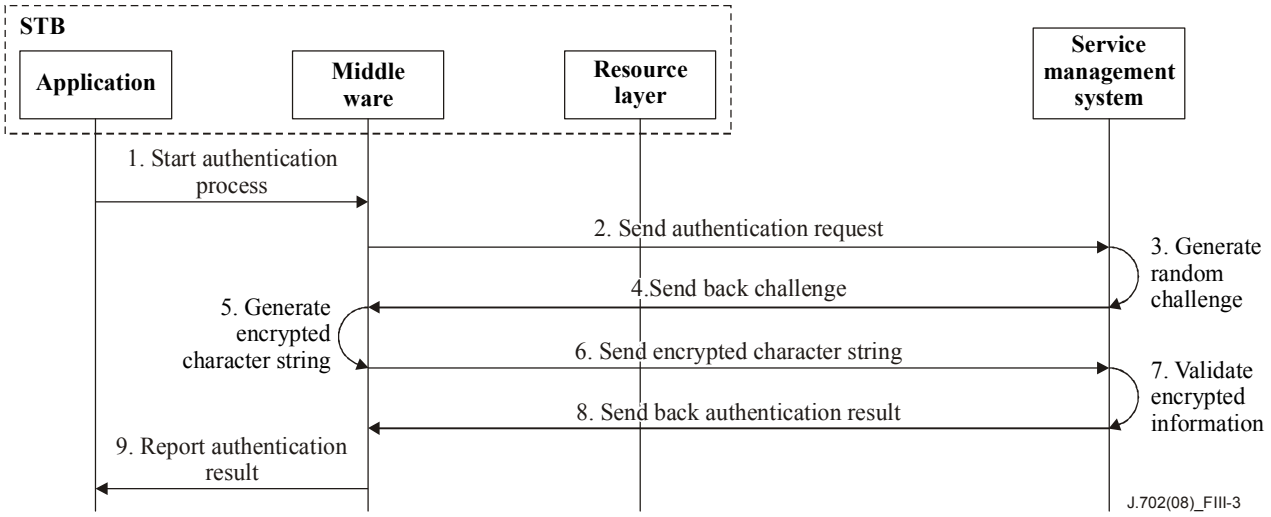

Figure III.3 – Flow of service authentication

1. The application component starts the service authentication process.
2. The interior component of middleware sends an authentication request to the service management system.
3.&4. The service management system generates a random challenge and sends it to the STB.
5.&6. The interior component of middleware generates an encrypted-character string and sends it to the service management system.
7. The service management system decrypts the character string and validates the information of the STB.
8. The service management system sends back the result of the authentication.
9. The middleware notifies the application the authentication result.

III.4 Flow of living broadcast service

1. The application starts the living broadcast.
2. The middleware establishes a media stream channel with the CDN and sends it the orders.
3. The media stream is transmitted from the CDN to the STB.
4. The application closes media and sends orders to the middleware.
5. The middleware sends orders to the CDN to stop the media stream and close the connection.
6. The application closes the service control instance and releases the resource.

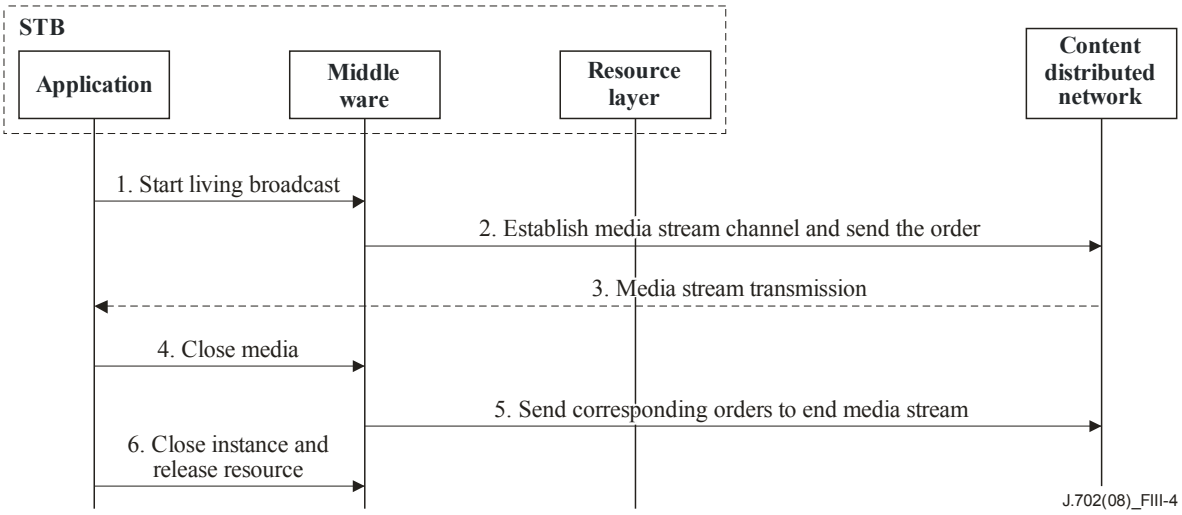

Figure III.4 – Flow of living broadcast service

III.5 Flow of time-shift service

1. The application starts the living broadcast.
2. The middleware establishes a multicast channel with the CDN and sends it the orders.
3. The broadcast media stream is transmitted from the CDN to the STB.
4. The user presses the button for pause or fast backward; the middleware reports the key-press event to the application.
5. The application sends a media control order to the middleware.

6.&7. The middleware sends the corresponding order (pause or fast backward) to the CDN, stops the multicast media stream and destroys the multicast channel.

8. The middleware establishes a unicast channel with the CDN.
9. A unicast media stream is transmitted from CDN to STB.
10. The user presses the button for fast forward; the middleware reports the key-press event to the application.
11. The application sends the order of fast forward to the middleware.

12 to 14. The middleware sends the corresponding order to the CDN. When the stream is played to the end of the record, the middleware sends an order to stop the play of the unicast media stream and establishes a multicast channel.

15. The broadcast media stream is transmitted from the CDN to the STB.
16. The application closes the media and sends an order to the middleware.
17. The middleware sends an order to the CDN to stop the media play and destroys the channel.
18. The application closes the service control instance and releases the resource.

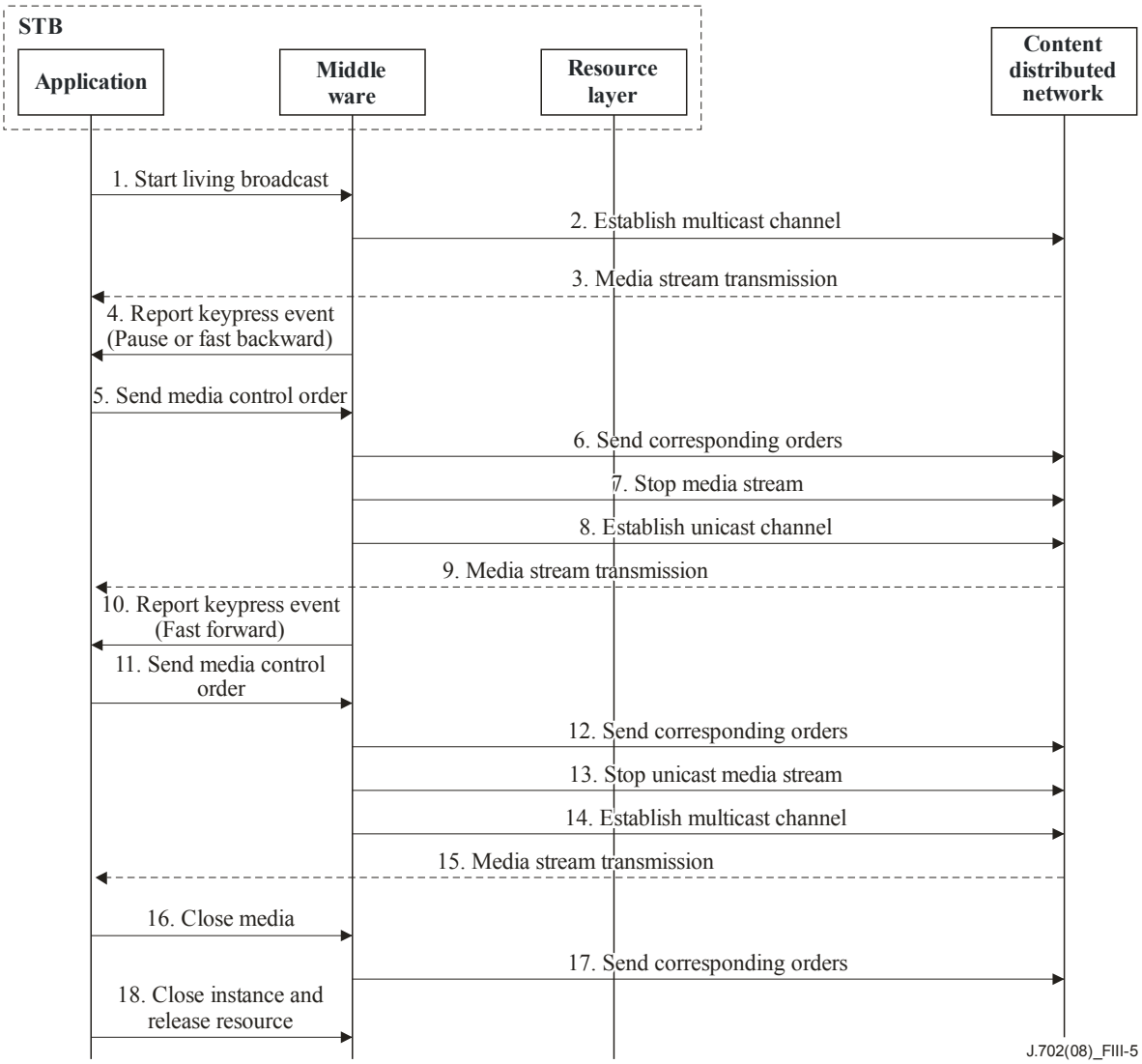

Figure III.5 – Flow of time-shift service

III.6 Flow of VoD service

1. The application starts the VoD service.
2. The middleware establishes a unicast channel with the CDN and sends it the orders.
3. The media stream is transmitted from the CDN to the STB.
4. The user presses the button for pause, fast backward or fast forward; the middleware reports key-press event to the application.
5. The application sends a media control order to the middleware.
6. The middleware sends the corresponding order (pause, fast backward or fast forward) to the CDN.
7. The application closes the media and sends an order to the middleware.
8. The middleware sends an order to the CDN to stop the media stream and disconnects the channel.
9. The application closes the service control instance and releases the resource.

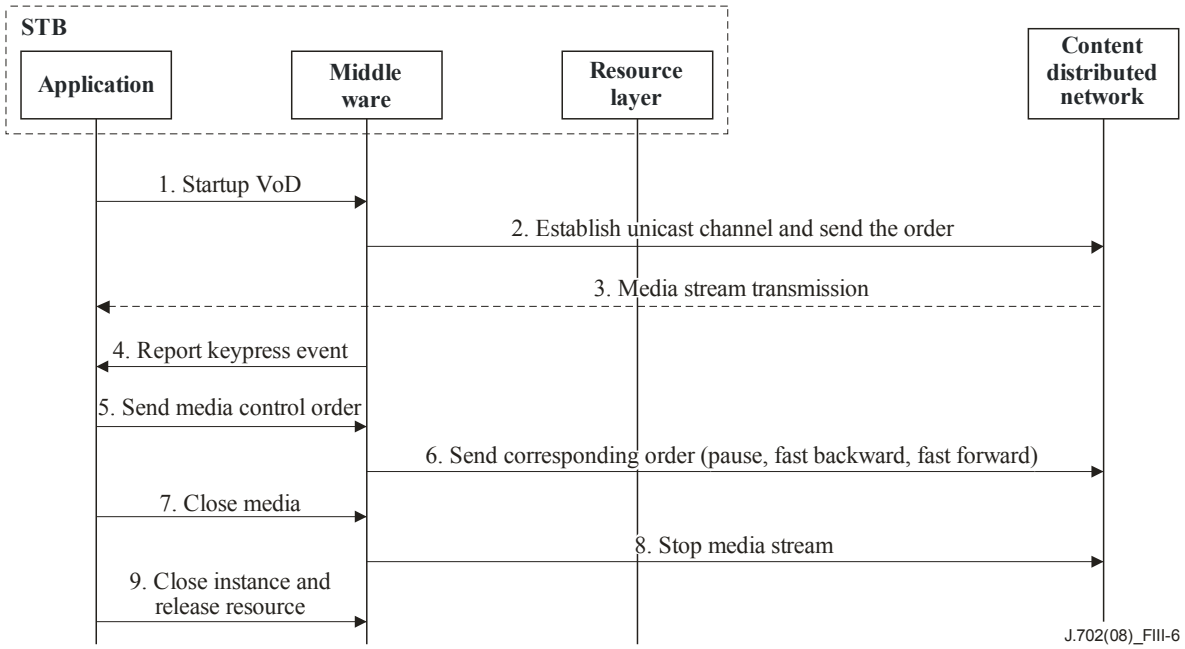

Figure III.6 – Flow of VoD service

III.7 Flow of log upload

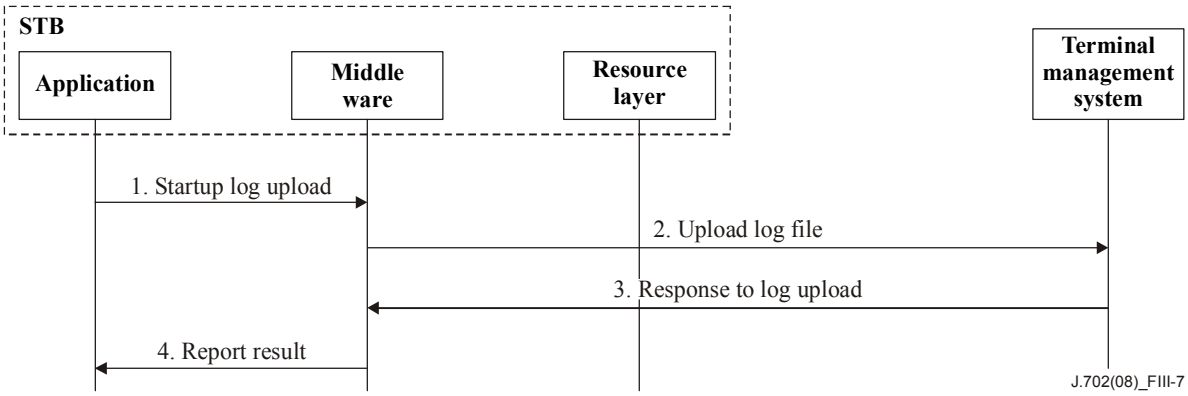

Figure III.7 – Flow of log upload

1. The application calls the middleware to start the request of log upload.
2. The STB uploads log files to the terminal management system.
3. The terminal management system sends the response to the STB.
4. The middleware reports the upload result to the application.

III.8 Flow of status report

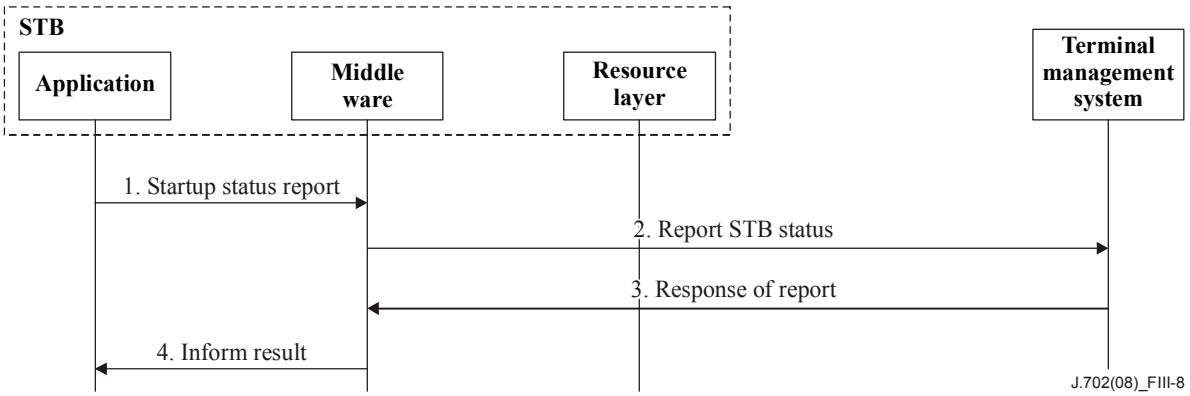

Figure III.8 – Flow of status report

1. The application calls the middleware to start the status report, including service information or configuration information.
2. The middleware informs the terminal management system of the status of the STB.
3. The terminal management system sends the response of the report to the STB.
4. The middleware informs the application result of the report.

III.9 Flow of configuration

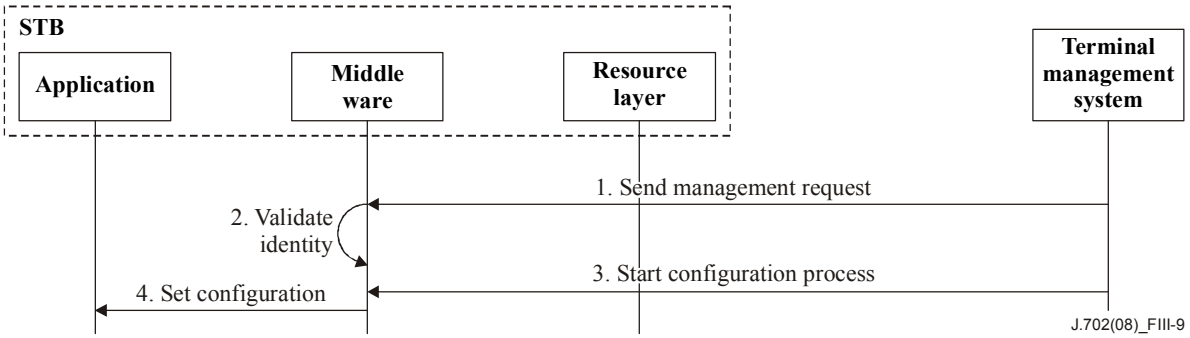

Figure III.9 – Flow of configuration

1. The terminal management system sends a management request to the STB.
2. The middleware validates the identity of the terminal management system.
3. The terminal management system starts the configuration process.
4. The middleware sets the corresponding configuration to the application.

Appendix IV

Service information

(This appendix does not form an integral part of this Recommendation)

The IPTV TD can use the service/system information to find out where on the network to access any content that the user selects. In order to support an IPTV TD, existing service/system information data needs to be updated and modified to provide the data necessary for an IPTV TD to discover and access the digital/analogue services that are available on the network. In addition to the existing RF/frequency-related information, the updated SI data must support at least the following, (this is not an exhaustive list), in order to allow for IP transmission:

- source IP address (to allow for SSM),
- multicast Destination IP address and UDP Port,
- different IP encapsulation methods (e.g., UDP/RTP/MPEG2-TS),
- stream bandwidth information, etc.

The IPTV TD software should accept the program specific information and service information (PSI/SI), including the program association table (PAT), the program map table (PMT), the network information table (NIT), the virtual channel table (VCT), the event information table (EIT), and the system time table (STT).

The IPTV TD should use the system time message to synchronize its local clock and should provide a clock signal to the middleware and the applications. The IPTV TD should be capable of maintaining a channel map and make it available to middleware and applications.

SI standards are region-specific. The following are some of the regional standards that apply:

- In North America: [b-ANSI/SCTE-65].
- In Europe: [b-ETSI EN 300 468].
- In Japan: [b-ARIB STD-B10].

Appendix V

Service discovery schemes

(This appendix does not form an integral part of this Recommendation)

Item 1: Explanatory text of service discovery

Clause 7.1 of [ITU-T J.293] defines a generic three layered record structure. The IPTV TD defined in this Recommendation is recommended to support a service provider discovery mechanism with this general record structure. The following figure is a conceptual diagram of the record structure.

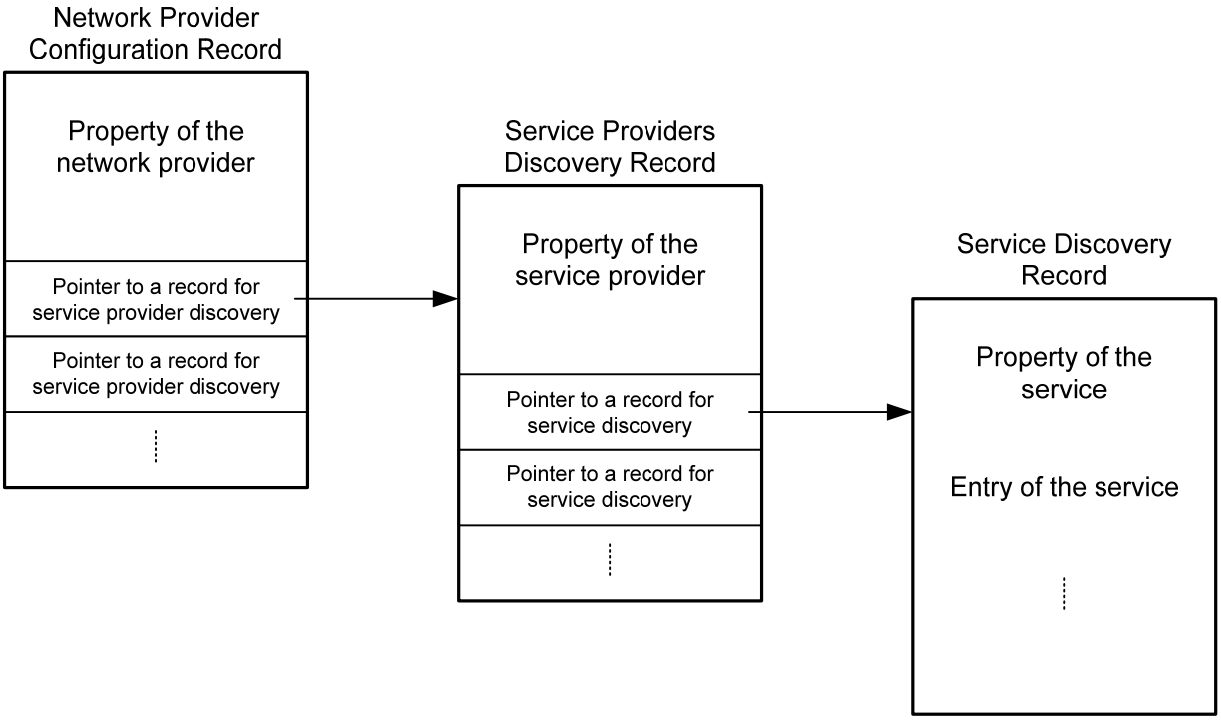

Figure V.1 – Conceptual diagram of the three layered record structure

The network provider configuration record consists of the property of the network provider (e.g., time service information of the network) and pointers to a record for service provider discovery.

The service providers discovery record contains the property of the service provider (e.g., the name of the provider, logo, URL, etc.) and pointers to a record for service discovery.

The service discovery record is an actual entry point of the service. This might be an IP multicast address for a linear TV reception, URL to a VoD service, service information (SI) tables, XML-based service entry, and so on.

Item 2: Profiles of service discovery

The following informative table shows a comparison of the service discovery schemes used in the currently available IPTV systems.

Table V.1 – Comparison of the service discovery schemes (informative)

	Network provider configuration record	**Service providers discovery record**	**Service discovery record**
ETSI TS 102 034 (DVB-IP)	Contains time server's address and pointers to platform providers.	Contains a list of the name, logo URI of the service providers and pointers to service offering records.	Pointers to services (list of IP multicast addresses for linear TV and unicast address for other services).
Japan	Contains time server's address and pointers to platform providers.	Contains a name and logo URI of the platform provider and pointers to services (address for SI acquisition and URLs for acquisition of entry resource information of VoD content).	SI for linear TV service, which contains multicast addresses for signal reception. Entry resource information for VoD service.

Bibliography

[b-ITU-T H.701] Recommendation ITU-T H.701 (2009), *Content delivery error recovery for IPTV services*.

[b-ITU-T H-Sup.1] ITU-T H-series Recommendations – Supplement 1 (1999), *Application profile – Sign language and lip-reading real-time conversation using low bit rate video communication.*

[b-ITU-T J.290] Recommendation ITU-T J.290 (2006), *Next generation set-top-box core architecture*.

[b-ITU-T J.292] Recommendation ITU-T J.292 (2006), *Next generation set-top-box media-independent architecture*.

[b-ITU-T M.60] Recommendation ITU-T M.60 (1993), *Maintenance terminology and definitions*.

[b-ITU-T M.1400] Recommendation ITU-T M.1400 (2006), *Designations for interconnections among operators' networks*.

[b-ITU-T M.2301] Recommendation ITU-T M.2301 (2002), *Performance objectives and procedures for provisioning and maintenance of IP-based networks*.

[b-ITU-T M.3050.1] Recommendation ITU-T M.3050.1 (2007), *Enhanced Telecom Operations Map (eTOM) – The business process framework*.

[b-ITU-T X.800] Recommendation ITU-T X.800 (1991), *Security architecture for Open Systems Interconnection for CCITT applications*.

[b-ITU-T Y.101] Recommendation ITU-T Y.101 (2000), *Global Information Infrastructure terminology: Terms and definitions*.

[b-ITU-T Y.2012] Recommendation ITU-T Y.2012 (2006), *Functional requirements and architecture of the NGN release 1*.

[b-ITU-T Y-Sup.5] ITU-T Y-series Recommendations – Supplement 5 (2008), *ITU-T Y.1900-series – Supplement on IPTV service use cases.*

[b-ITU-T TP.TACL] ITU-T Technical paper: FSTP-TACL *Telecommunications Accessibility Checklist (2006).*
(available at http://www.itu.int/publ/T-TUT-FSTP-2006-TACL/en).

[b-ANSI/SCTE-20] ANSI/SCTE 20 (2004), *Method for Carriage of Closed Captions and Non-Real Time Sampled Video*.

[b-ANSI/SCTE-21] ANSI/SCTE 21 (2006), *Standard for Carriage of NTSC VBI data in cable Digital transport streams*.

[b-ANSI/SCTE-65] ANSI/SCTE 65 (2008), *Service Information Delivered Out-of-Band for Digital Cable Television*.

[b-ANSI/SCTE-127] ANSI/SCTE 127 (2007), *Carriage of Vertical Blanking Interval (VBI) Data in North American Digital Television Bitstreams*.

[b-ARIB STD-B10] ARIB STD-B10 (2008), *Service Information for Digital Broadcasting System*.

[b-ATIS-0800002] ATIS-0800002 (2006), *IPTV Architecture Requirements*.

[b-CEA-608-E] CEA 608-E (2008), *Line 21 Data Services*.

[b-CEA-708-D] CEA 708-D (2008), *Digital Television (DTV) Closed Captioning*.

[b-IETF RFC 868] IETF RFC 868 (1983), *Time Protocol*.

[b-IETF RFC 1305] IETF RFC 1305 (1992), *Network Time Protocol (Version 3) Specification, Implementation and Analysis*.

[b-IETF RFC 1350] IETF RFC 1350 (1992), *The TFTP protocol (Revision 2)*.

[b-IETF RFC 1769] IETF RFC 1769 (1995), *Simple Network Time Protocol (SNTP)*.

[b-IETF RFC 2131] IETF RFC 2131 (1997), *Dynamic Host Configuration Protocol*.

[b-IETF RFC 2132] IETF RFC 2132 (1997), *DHCP Options and BOOTP Vendor Extensions.*

[b-IETF RFC 2578] IETF RFC 2578 (1999), *Structure of Management Information Version 2 (SMIv2)*.

[b-IETF RFC 2616] IETF RFC 2616 (1999), *Hypertext Transfer Protocol – HTTP/1.1*.

[b-IETF RFC 3315] IETF RFC 3315 (2003), *Dynamic Host Configuration Protocol for IPv6 (DHCPv6)*.

[b-IETF RFC 3411] IETF RFC 3411 (2002), *An Architecture for Describing Simple Network Management Protocol (SNMP) Management Frameworks*.

[b-IETF RFC 3412] IETF RFC 3412 (2002), *Message Processing and Dispatching for the Simple Network Management Protocol (SNMP)*.

[b-IETF RFC 3413] IETF RFC 3413 (2002), *Simple Network Management Protocol (SNMP) Applications*.

[b-IETF RFC 3414] IETF RFC 3414 (2002), *User-based Security Model (USM) for version 3 of the Simple Network Management Protocol (SNMPv3)*.

[b-IETF RFC 3415] IETF RFC 3415 (2002), *View-based Access Control Model (VACM) for the Simple Network Management Protocol (SNMP)*.

[b-IETF RFC 3416] IETF RFC 3416 (2002), *Version 2 of the Protocol Operations for the Simple Network Management Protocol (SNMP)*.

[b-IETF RFC 3417] IETF RFC 3417 (2002), *Transport Mappings for the Simple Network Management Protocol (SNMP)*.

[b-IETF RFC 3418] IETF RFC 3418 (2002), *Management Information Base (MIB) for the Simple Network Management Protocol (SNMP)*.

[b-ETSI EN 300 468] ETSI EN 300 468 V1.10.1 (2009), *Digital Video Broadcasting (DVB); Specification for Service Information (SI) in DVB systems*.

[b-ETSI EN 300 743] ETSI EN 300 743 V1.3.1 (2006), *Digital Video Broadcasting (DVB); Subtitling systems*.

[b-ETSI EN 301 775] ETSI EN 301 775 V1.2.1 (2003), *Digital Video Broadcasting (DVB); Specification for the carriage of Vertical Blanking Information (VBI) data in DVB bitstreams*.

[b-ISO/IEC 29341-x] ISO/IEC 29341-x series, *Information technology – UPnP Device Architecture***.**

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