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TELECOMMUNICATION STANDARDIZATION SECTOR OF ITU



# SERIES H: AUDIOVISUAL AND MULTIMEDIA SYSTEMS IPTV multimedia services and applications for IPTV – IPTV terminal devices

IPTV terminal devices: Basic model

Amendment 1: New Appendix II on terminal device implementation example

Recommendation ITU-T H.721 (2009) - Amendment 1



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#### **Recommendation ITU-T H.721**

#### **IPTV terminal devices: Basic model**

#### Amendment 1

#### New Appendix II on terminal device implementation example

#### Summary

Recommendation ITU-T H.721 describes and specifies the functionalities of the 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 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 QoS. The expected types of IPTV terminal devices are set-top boxes and digital TV sets with embedded IPTV capabilities.

Amendment 1 introduces new Appendix II, which describes implementation examples that support ITU-T H.721 terminal device specifications.

#### History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T H.721	2009-03-16	16
1.1	ITU-T H.721 (2009) Amend.1	2010-07-30	16

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#### FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications, information and communication technologies (ICTs). The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

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In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementers are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database at <u>http://www.itu.int/ITU-T/ipr/</u>.

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#### **Recommendation ITU-T H.721**

#### **IPTV terminal devices: Basic model**

#### Amendment 1

#### New Appendix II on terminal device implementation example

Modifications introduced by this amendment are shown in revision marks. Unchanged text is replaced by ellipsis (...). Some parts of unchanged text (clause numbers, etc.) may be kept to indicate the correct insertion points.

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#### 4 Abbreviations

This Recommendation uses the following abbreviations:

• • •

CDN	Content Delivery Network
CRID	Content Reference Identifier
CRL	Certificate Revocation List
DEMUX	Demultiplexer
DHCP	Dynamic Host Configuration Protocol
DNS	Domain Name System
DRM	Digital Rights Management
DTS	Decoding Time Stamp
DVI	Digital Visual Interface
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

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ICMP	Internet Control Message Protocol
IGMP	Internet Group Management Protocol
IPTV	Internet Protocol Television
IPTV TD	Internet Protocol Television Terminal Device
LED	Light Emitting Diode
LLI	Licence Link Information
MAFR	Multimedia Application Framework
MLD	Multicast Listener Discovery protocol
MUX	Multiplexer
NCI	Network Content Control Information
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
PTS	Presentation Time Stamp
RAM	Random Access Memory
RTSP	-Real Time Streaming Protocol
RTP	Real-time Transport Protocol
QoE	Quality of Experience
QoS	Quality of Service
SADS	Service and Application Discovery and Selection
SCP	Service and Content Protection
SDP	Session Description Protocol
SNA	Service Navigation Application
SSL	Secure Socket Layer
SI	Service Information
SNTP	Simple Network Time Protocol
STB	Set-Top Box
TD	Terminal Device
TLS	Transport Layer Security
TS	Transport Stream
TTS	Time-stamped Transport Stream
UI	User Interface
URI	Universal Resource Indicator
) P	ITH TH 721 (2000) (A J. 1 (07/2010)

URL Universal Resource LocatorVGA Video Graphics ArrayVoD Video-on-DemandXML eXtensible Markup Language

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## **Appendix II**

## **Terminal device implementation example**

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

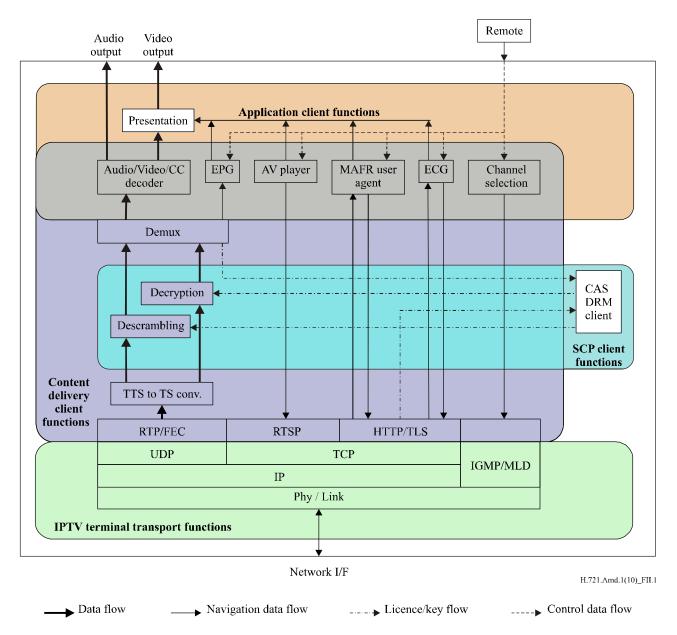
[NOTE – To improve the legibility of the text, revision marks are not shown.]

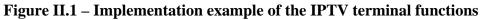
This appendix provides implementation examples of ITU-T H.721 terminal device (TD) specifications supporting linear TV, video on-demand, and interactive services.

#### II.1 **IPTV** terminal device functional overview

#### II.1.1 TD reference model

Figure 8-1 depicts the functional architecture of the IPTV TD-Basic model according to this Recommendation. Figure II.1 illustrates details of an example implementation of an IPTV TD-Basic model using the functional elements in Table II.1.





#### Table II.1 – Functional elements

Functional element	Description
Communication interface	A communication interface is an interface used to transmit/receive signals from/to communication networks.
Communication processing	The communication processing block processes communication protocols such as RTP, UDP, HTTP/TLS, RTSP, TCP, IP and IGMP/MLD. Network jitter absorption and FEC processing are performed for the streaming data that is sent using UDP. Refer to clause 7.2.4.
TTS/TS conversion	Clock synchronization and jitter removal based on TTS/TS conversion is an optional function. In the TTS/TS conversion process, TTS that is output from the communication process is buffered (FIFO), and the MPEG-2 TS stream that is synchronized with a 27-MHz clock on the transmitter side is output using the TTS time stamp and 27-MHz terminal automated clock. Refer to Appendix I.

#### **Table II.1 – Functional elements**

Functional element	Description	
Descrambler	A descrambler decodes scrambled MPEG-2-TS streams using a scramble key that is obtained from a SCP client.	
Decrypter	A decrypter decodes encrypted MPEG-2-TS streams using a content key that is obtained from a SCP client.	
Demultiplexer	A demultiplexer splits multiplexed MPEG-2 TS streams into video streams, audio streams, subtitle, PSI/SI, ECM packets, etc.	
Video decoder	The video decoder decodes video data.	
Audio decoder	The audio decoder decodes audio data.	
Subtitle decoder	The subtitle decoder decodes subtitle data.	
Channel selection process	An application used to select linear TV services.	
AV player	An AV player is an application that provides transport control for VoD content.	
Presentation process	In the presentation process, data such as stream data from video decoders, browsers, EPG and ECG are merged to create data that are presented to users.	
Video output	A video output is an interface used to output video signals to displays.	
Audio output	An audio output is an interface used to output audio signals to speakers.	
MAFR user agent for IPTV	A MAFR user agent for IPTV is an application that provides the playback function for MAFR documents obtained from portal servers. For more information on MAFR user agent for IPTV, see [b-ITU-T H.761] and [b-ITU-T H.762]	
EPG	An EPG extracts service information (SI) provided in linear TV services and provides navigation functions including functions to display IP broadcast program lists, program details, etc.	
ECG (option)	An ECG provides navigation functions using metadata that is obtained from an ECG metadata server, including functions to display lists of contents provided in VoD services, purchased content lists and content detail information.	
Remote controller	A remote controller is used to operate a terminal.	
SCP client	A SCP client obtains a licence from a SCP server. When using linear TV services, a SCP client extracts a scramble key from ECM that is obtained by demultiplexing IP broadcast streams using the licence and provides the scramble key to a descrambler. When using VoD services, a SCP client provides the content key that is extracted from the licence to a decrypter.	

#### **II.1.2** Other TD functions

Other terminal functions not included in clause II.1.1 are described in Table II.2.

Function	Description		
Service discovery	A process to obtain configuration information which enables end users to connect to a particular service. The TD is able to initially obtain configuration information of CDN operators, platform operators and service providers as initial connection information. It is also possible that a service provider plays multiple roles such as CDN operator, and/or platform operator. Refer to [ITU-T H.770].		
Portal selection	A function to enable users to select a portal of a service provider to display portal documents of the service provider in a MAFR user agent for IPTV.		
Registration verification entry	A function to enable users to specify a service provider to obtain the registration verification MAFR document of the specified service provider and display it in a MAFR user agent for IPTV.		

#### **Table II.2 – Other terminal functions**

#### **II.1.3 Data handled by the TD**

Data items handled by a typical IPTV TD-Basic model are described in Table II.3.

Data	Outline			
Content	Video data, audio data, subtitle data, etc. for viewing. Provided by VoD services and linear TV services.			
MAFR document	A document produced using a MAFR language (e.g., LIME, NCL, etc.) that contains information required to implement portal services such as a navigation tool to use contents, basic registration and licence acquisition.			
ECG metadata	Contains information of VoD content used for implementing the electronic content guide.			
SI data	Service information data contain linear TV programming information that is used for implementing EPG.			
Licence	Data containing the rights management and protection information for target contents and a decryption key used to decrypt encrypted contents.			
URI of CDN configuration information	URI that is used to obtain the CDN configuration information. In this implementation this URI represents the service discovery entry point defined in [ITU-T H.770]. The use of a pre-configured URI is a common method to assign the entry point required for service discovery.			
CDN configuration information	Information necessary to obtain the platform configuration information corresponding to platform operators which are available on the particular network being used.			
Platform configuration information	Information related to platform operators and their respective services. Information such as portal server addresses (for VoD service) and SI stream addresses (for IPTV broadcasting) of service provided by the platform operator are some examples.			
Logo ID management information	Information that is used to manage the correspondence of logo ID with service ID, service provider ID and network ID.			
Logo data	Contains information for a logo mark that is defined for each channel and service provider and is used to display channel selection banners, EPG, etc.			
Licence renewal notification information	Provides information on whether there is a licence renewal or not to facilitate prompt licence renewal.			
Purchased package information	Provides information on purchased packages to display content contract information in ECG.			

#### Table II.3 – Data handled by TDs

Data	Outline		
Content playback control information	Information that is required for VoD content playback control.		
User residence information	Information in regard to location of residence and postcode of users.		
Parental control information	Information including the parental level (minimum age for viewing) and parental password (code number) that are set by users to implement parental control.		
Network setting information	Setting information such as IP address that terminals need to connect to communication networks and receive various services.		
Basic registration information	Information from service providers with whom basic registration has been completed, including service provider ID, information on authentication key, and SCP server URI.		

#### II.1.4 Data flows for IPTV TD-Basic model

This clause presents typical data flow examples for terminal devices supporting linear TV, video on-demand, and interactive services.

#### II.1.4.1 Linear TV data flow

This clause illustrates an example of the sequential data flow inside the IPTV TD for linear TV service. See accompanying Figure II.2.

- (1) When a user performs the selection operation for a linear TV channel using the remote controller, a request to join the multicast group which provides linear TV using the IGMP/MLD protocol is transmitted, reception of the linear TV stream starts.
- (2) The linear TV stream is subjected to communication processing and TTS/TS conversion processing.
- (3) The demultiplexer extracts the ECM, which is transmitted to the SCP client.
- (4) The SCP client uses the multicast licence obtained from the SCP server to take out the scramble key from the ECM and inputs the key to the descrambler.
- (5) The descrambler uses the scramble key input from the SCP client to descramble the linear TV stream.
- (6) The demultiplexer separates the stream into video, audio and subtitle data.
- (7) The video, audio and subtitle decoders decode the above data and output video and audio signals.

For navigation of the linear TV service, an EPG (9) that implements the SI data separated by the demultiplexer or the portal (8) reproduced by the MAFR user agent is used.

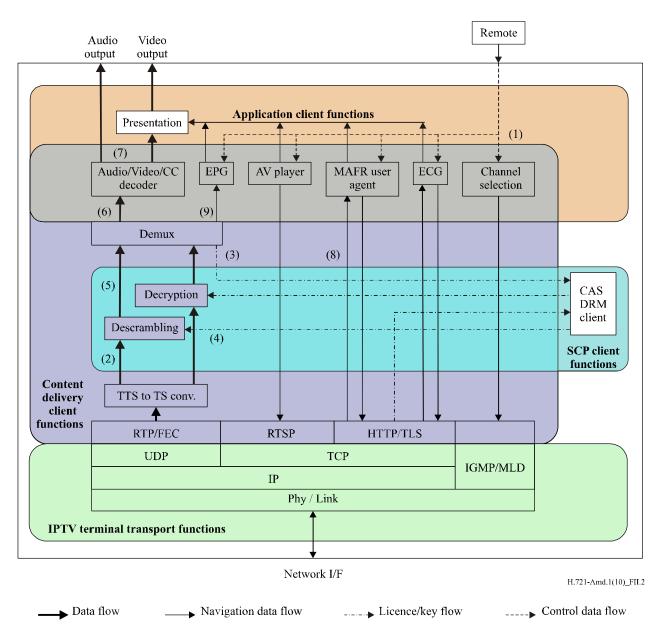


Figure II.2 – Linear TV service

#### II.1.4.2 Video on-demand data flow

The following illustrates an example of data flow inside the receiver for video on-demand service. See accompanying Figure II.3.

- 1) Content is selected by the browser or ECG.
- 2) The browser or ECG notifies the information related to the content playback control metafile of the selected content to the VoD playback control component.
- 3) The VoD playback control component obtains and analyses the content playback control metafile from the playback control information server.
- 4) When the VoD playback control component detects that the selected content has been encrypted, it notifies the SCP client to obtain a VoD licence.
- 5) The SCP client obtains the VoD licence from the SCP server.
- 6) The SCP client sets the content key contained in the VoD licence in the decrypter.
- 7) The VoD playback control component uses the communications protocol (HTTP or RTSP) to issue a request for playback to the video content server.

8) The video content that is received is subjected to communication processing, TTS/TS conversion processing and processing by the decrypter, demultiplexer, video decoder, audio decoder, and subtitle decoder so that the video and audio signals can be output.

In the sequence described above, if the response from any of the servers results in an error or timeout, an appropriate message shall be displayed.

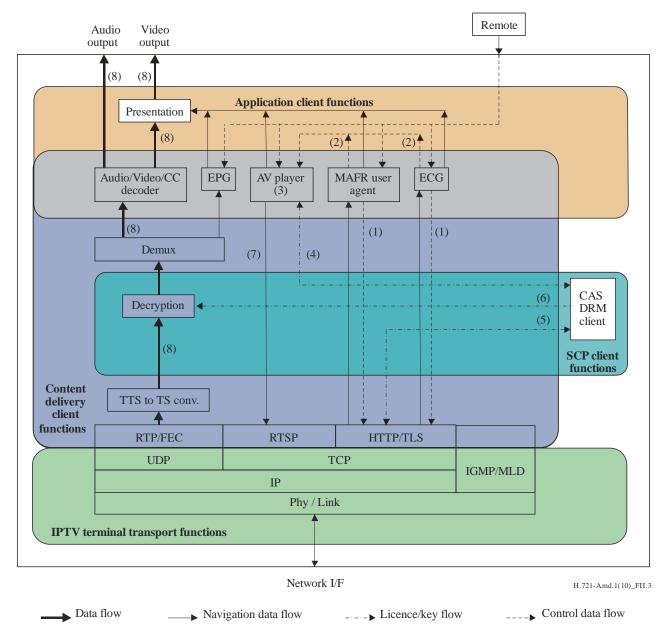
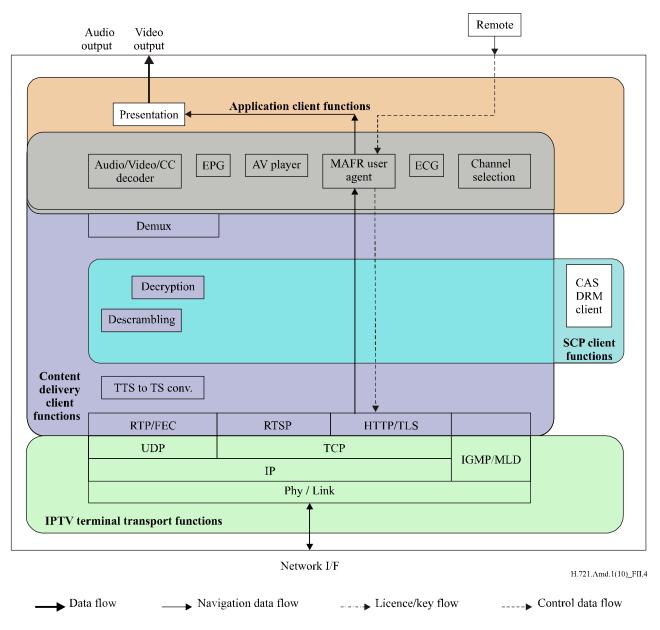


Figure II.3 – VoD service

#### **II.1.4.3** Portal interactive service data flow

The following illustrates an example of data flow inside the receiver for portal services. See accompanying Figure II.4.

When a portal is started using a remote controller, a browser accesses a portal server using the HTTP/TLS protocol to obtain a MAFR document. The obtained MAFR document is reproduced in the browser, and video/audio signals are output.



#### **Figure II.4 – Portal service**

#### II.2 Summary of IPTV TD-Basic model functions

This Recommendation provides a high-level description of functionalities of IPTV TD-Basic model. The Recommendation also specifies required, recommended and optional requirements. Table II.4 summarizes IPTV TD features and functions providing the appendix clause number to find the corresponding examples.

IPTV TD functions described in Appendix II		Requirement level	Related ITU-T H.721 clause	
Netv	vork attachment and service discovery			
II.3	Network settings	Required	7.2.1.1 Terminal device attachment and initialization	
II.4	Initial setting overview	Required	7.2.1.2 Service Provider description entry points	
II.5	Initial settings	Required	7.2.1.3 Service Provider discovery and service attachment	
II.6	Portal selection	Required	7.2.1.3 Service Provider discovery and service attachment	
	Privacy			
II.7	Function to clear user configuration information	Required	7.2.3 Privacy	
	Media client functions			
II.8	Playback of VoD content	Required	9.3.1.1 Playback and trick mode functionalities for VoD	
II.9	Electronic Content Guide	Recommended	9.3.1.1 Playback and trick mode functionalities for VoD	
II.10	Parental control settings	Recommended	9.3.5.4 Parental control	
II.11	Residence location configuration	Required	9.3.4.2 Permanent data stored in the storage functional block	
II.12	Terminal preset information	Required	9.3.4.2 Permanent data stored in the storage functional block	
II.13	Basic registration information management	Required	9.3.4.2 Permanent data stored in the storage functional block	
	SCP client functions			
II.14	SCP client identification	Required	<ul><li>9.3.4.2 Permanent data stored in the storage functional block</li><li>9.4 SCP client functions</li></ul>	
	Application client functions			
II.15	MAFR user agent requirements for IPTV	Required	9.5.1 <i>IPTV application client functions</i>	
	Input interface			
II.16	Remote controller	Recommended	10.1.2 Remote controller	
	– Detailed implementation information of the VFJ-0002], [b-IPTVFJ-0004] and [b-IPTVFJ-0004]		ibed in clause II.3-16 can be found in	

## **Table II.4 – IPTV TD functions**

#### **II.3** Network settings

Table II.5 lists the items that require settings in a screen among the settings that a terminal needs in order to communication networks and receive various services.

Classification	Category	Sub-category	Requirement level	Remarks
IPv4/IPv6 operation switching	Dual/operatie (IPv4/IPv6)	Dual/operation specification (IPv4/IPv6)		
IPv6	Network add	lress setting	Required	Default: Automatic acquisition
		atic acquisition (Router sement (RA))		
	IP addr Subnet			
	Defaul	t gateway		
		l setting		
	IP add			
	Subnet	mask t gateway		
	DNS	t gateway	Required	Default: Automatic setting
	Autom	atic setting		
	Manua	l setting		
IPv4	Network add	lress setting	Required	Default: Automatic acquisition
	Autom	atic setting (DHCP)		
	IP add	tess		
	Subnet			
		t gateway		
		l setting		
	IP add			
	Subnet			
		t gateway		
	DNS		Required	Default: Automatic setting
	Autom	atic setting		
	Manua	l setting		

#### **Table II.5 – Required network settings**

#### **II.3.1** Supplementary information

It is desirable that information that can be obtained through DHCP and DHCPv6 not be stored on terminals.

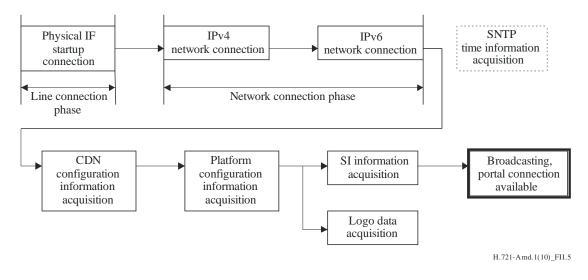
The assumed default IPv4/v6 switching mode is dual operation. Considering cases in which user operability is reduced (e.g., in terminal operations, etc.) depending on the network environment, it is desirable to enable independent operation settings.

#### II.4 Initial setting overview

A terminal that acquired an IP address obtains the CDN configuration information via HTTP, based on a uniquely determined URI. Additionally, the terminal obtains the platform configuration information (e.g., the pf\_url) included in the CDN configuration information, and determines whether linear TV services are provided by the platform based on the presence of relevant elements (e.g., ip\_broadcast\_service) in the platform configuration information. When linear TV services are provided, information such as multicast addresses for receiving SI information is available for reference in the platform configuration information. To actually receive it, a terminal transmits the participation notification (JOIN) for the SI information multicast stream multicast group and obtains NIT for the platform and other SI information. At this point, features such as channel selection, EPG display, portal connection and ECG metadata acquisition become possible.

#### II.5 Initial settings

In order to receive linear TV/VoD services, etc., various types of information should be obtained by a terminal.



**Figure II.5 – Setting process** 

Figure II.5 illustrates a process flow from the moment the power is turned on for the first time to the initial acquisition of various types of information (this flow does not necessarily define the processing order):

1) Line connection phase

After the power is turned on, the terminal detects a linkup when it is connected to a physical line. It is desirable to provide an indication of the link status (e.g., using an LED).

2) Network connection phase

After the physical line is connected and the link layer connectivity is detected, if the terminal is set to address automatic configuration of an IP (recommended default setting), the terminal attempts both IPv4 and IPv6 address acquisition since it may be connected to either or both networks. The above process is not required if the terminal is set to fixed IP address mode.

3) CDN configuration information acquisition

After the network connection phase is completed, the terminal obtains the CDN configuration information that enables the terminal to access information for obtaining time information and other information in regard to connection to a platform configuration

information server that is operated by a platform operator providing services in the CDN. The terminal is connected to a server by referencing the connection destination information in the preset CDN configuration information. It is assumed that the terminal is connected to one CDN, which is associated with one CDN configuration information server. After the initial acquisition, the update process should be performed once per day.

The CDN configuration information mainly contains the following information:

- A server address to connect via simple network time protocol (SNTP) to implement time management, and various parameters that are used for summer time operation, etc.
- Information for individual platforms:
  - Identification information to distinguish amongst platforms.
  - Connection destination information to obtain a platform configuration information file.
  - Serial information to distinguish CDN configuration information updates, etc.
- 4) Platform configuration information acquisition

The terminal refers to the connection destination of the platform configuration information written in the CDN configuration information and obtains information such as portal server connection destination and multicast address for SI reception. This information is in a server that is built for each platform operator who provides services in the CDN. If the platform provides linear TV service, the configuration information includes relevant information (e.g., the element ip\_broadcast\_service) required to receive broadcasts. After the initial acquisition, the platform's serial information is confirmed when CDN configuration information is referenced, and platform configuration information can be obtained and updated when there is a change. The platform configuration information mainly contains the following information:

- i) Platform identification information to distinguish amongst platforms.
- ii) Connection destination information to obtain logo data.
- iii) Various elements that are required to receive SI-dedicated streams:
  - multicast address for SI transmission;
  - transmission port information;
  - SI transmission server address, etc.
- iv) Various elements for each service provider:
  - identification to distinguish service providers;
  - connection destination information to connect to portals;
  - connection information to connect to a meta server that is used by the ECG, etc.
- 5) SI information acquisition

When ipbroadcast\_service is included in the platform configuration information, the terminal acknowledges that broadcasting services are provided in the platform and receives SI information by referencing information such as the multicast address required for receiving SI dedicated streams in the platform configuration information. This data is transmitted using multicast communication. Therefore, JOIN should be transmitted to an edge router to receive data streams, LEAVE should be transmitted after receiving the required data, and the stopping process should be performed.

6) Logo data acquisition

Terminals can display logo data on the EPG display and selection screens of multiple operators. Logo data can be obtained for each platform operator, service provider, and channel.

Platform operators maintain logo data servers and create logo data that is used in linear TV services.

The URI of a logo data server is indicated by the logo\_url of a platform configuration information file, and the file that associates logo id and channels or operators (logo id management file) and other logo files are allocated in a logo server. It is desirable to perform update processing when platform configuration information is referenced after initial acquisition. Also, since the information element of the logo id management file name described in the logo server connection destination contains serial information, the information can be updated if there is a change.

7) Time information acquisition

Terminals can obtain time information using SNTP or other methods.

When terminals obtain time information, they can adjust the time e.g., by referring to server connection destinations and offset values in the CDN configuration information.

#### **II.6** Portal selection

The terminal must provide a function to display and select links to all service provider portals who provide services in the network environment to which the terminal is connected.

Also, when basic registration is completed with one or more service providers, it is desirable that the service providers with whom basic registration has been completed are given priority when service providers are displayed/selected.

#### **II.7** Function to clear user configuration information

In order to support handover and disposal of terminals, terminals should provide an initialization function to clear personal information that is stored in the NVRAM of terminals. In addition, terminals should provide a function to clear personal information that users have set (such as user setting information and company-specific area information) and a function to restore factory settings. In order to prevent operation mistakes by users, it is desirable to take measures to prevent erroneous operation, for example by placing this function in a deeper layer of the operation menu.

#### II.8 Playback of VoD content

VoD content items may be selected either from a resident function such as ECG, or from a portal. This clause describes the operational specifications that are specific to CDN scope services.

#### **II.8.1** Starting VoD content

Terminals should start streaming according to the following procedures:

- 1) Terminals access a video content server on a communication network using the sequence that is described in clause II.8.1.1 according to the ProgramURL description of OnDemandProgram in the instance description metadata (ProgramLocationTable) that corresponds to the content reference identifier (CRID). When streaming is started from a portal, the information is listed in content\_uri of launchIPTVContent() function that is described in [b-ITU-T H.IPTV-MAFR.6]. When the streaming is started from ECG, the CRID of the content is selected from the ECG.
- 2) When streaming is started from ECG, authentication is performed between terminals and a video content server so that the terminals can access the server on the communication network and obtain content playback control metafiles of the contents.
- 3) Terminals obtain content playback control metafiles of the content to be streamed from a video content server on a communication network:
  - Entry resource information (ERI): Information for identifying the entry resources of per-use content.

#### 16 Rec. ITU-T H.721 (2009)/Amd.1 (07/2010)

- Licence link information (LLI): Information used to refer to a licence of per-use content.
- Network content control information (NCI): Information related to use of streaming services.
- 4) Terminals analyse NCI and obtain information in regard to content streaming control.
- 5) Terminals analyse LLI and obtain a licence from a SCP server by specifying a licence ID to identify the licence that is required to playback the contents. When there are multiple licences that can playback the contents, the licence that was selected in advance from ECG is used.
- 6) Terminals input the licence into a SCP client and obtain the rights management and protection information and a content key.
- 7) Based on the content URL obtained by analysing ERI, terminals access a video content server and receive and playback streaming data via RTP using RTSP streaming control.
- 8) When playback is resumed using a resident function, terminals search the playback start point in the stream resources based on the information related to resume that was stored in the terminals when the content playback was previously stopped. To start from a portal, terminals obtain a playback start position that is specified in a MAFR document.

#### **II.8.1.1** Protocol for reproduction control metafile acquisition

- 1) Terminals request acquisition using the HTTP or HTTPS Get method. HTTPS is used when LLI is included.
- 2) Transmission/reception of reproduction control metafile.

A video content server returns an HTTP response including the module format data. Figure II.6 shows an example of the reproduction control metafile acquisition sequence.

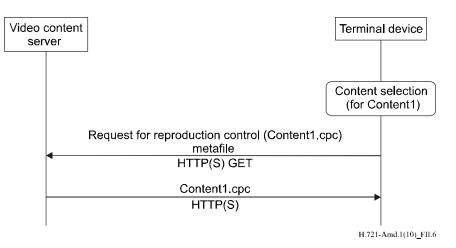


Figure II.6 – Sequence to acquire control metafile

#### **II.8.2** Content reproduction control

Terminals should implement the following processes in regard to playback control for stream resources:

- Terminals should operate according to clause II.8.2.1 in regard to trick playback during playback of stream resources.
- For clock synchronization, terminals should perform processes in accordance with Appendix I.
- Terminals that implement FEC should perform processes in accordance with [ITU-T H.701].

#### **II.8.2.1** Trick playback

In order to implement a trick playback function using a user interface function such as a remote controller, terminals must perform the following processes:

- Two types of fast-forward playback/fast-rewind playback methods are assumed: a method to use stream resources that are dedicated to fast-forwarding and fast-rewinding and a method to use stream resources composed only of the TS packets related to I-frames that are extracted from 1x-speed stream resources. The former method is called the "normal TS method", and the latter method is called the "I-frame TS method".
  - Terminals distinguish between the normal TS method and the I-frame TS method based on the speed value listed in the NCI of the contents.
  - The speed value listed in the NCI should be used to specify the fast-forwarding/fast-rewinding speed.
  - For the normal TS method, terminals should perform playback processes that correspond to the time stamp value of TTS, PCR, PTS and DTS as with 1x-speed playback. Packets other than video packets (audio packets and subtitle packets) should be discarded without being played.
  - For the I-frame TS method, terminals should ignore the time stamp value of TTS, PCR, PTS and DTS, and perform playback processes. In the I-frame TS method, it is assumed that correct clock synchronization information and presentation synchronization information are lost. Therefore, free-run sequential playback, which does not use the clock synchronization feature of terminals, is acceptable. Also, packets other than video packets (audio packets and subtitle packets) should be discarded without being played.
  - When terminals reach the end position of contents during fast-forwarding or the start position of contents during fast-rewinding, the terminals should distinguish the status based on an instruction notified from a video content server (ANNOUNCE method) and perform appropriate processes such as stopping or resuming playback.
- In regard to jump playback, it is desirable to implement a jump playback function that enables jumping to a playback point (or an interval) in the contents. Implementation methods vary depending on terminals, including methods to specify jumping intervals and positions to jump to.
- It is desired that terminals implement a chapter playback function. Implementation methods vary depending on terminals:
  - Terminals analyse ERI of the contents to be reproduced and obtain chapter start points and chapter titles that are described.
  - Using a user interface function such as a remote controller, terminals jump to a chapter start point. The procedures for jumping are the same as the procedures for jump playback.
  - Chapter information display methods to display chapter information are implementation-defined. When chapter jump is performed using remote controller buttons, it is desirable that the corresponding chapter title be displayed immediately after the chapter jump.

#### II.8.2.2 Pause/Stop

In order to pause or stop playback of contents using a user interface function such as a remote controller, terminals should implement the following processes:

- Terminals should avoid disconnection by transmitting a method or heartbeat in an interval that is smaller than the timeout value in the Session header of the SETUP response. However, terminals should perform stop processing to continue the PAUSE status for more than a defined period of time to reduce the server load.
- In order to perform stop processing, terminals should use the NPT value listed in the Range header of the RTSP PAUSE response as a playback stop position of the contents, associate it with the content, and record/store the information.

#### II.8.2.3 Resume

When terminals support resume operation using a resident function, terminals should implement the following processes. The resume function provided by a resident function is different from the resume function provided by a portal service in that it is provided differently depending on terminals based on the following processing:

- As described in clause II.8.2.2, Pause/Stop, when content playback is interrupted by a resident function such as stop, terminals should associate and store the playback stop position of the interrupted content and the identification information of the target streaming content. For the playback stop position, the NPT value described in the Range header of the RTSP PAUSE response should be used.

#### **II.8.2.4** Playback termination

The following two cases are assumed as transition destinations when content playback ends:

- When playback of contents that are started from a resident function such as ECG ends, it is desirable that the display of the terminal returns to a resident graphical UI such as ECG, by which contents playback were started.
- When playback of contents that are started from a portal ends, the streamstatus attribute is automatically changed to "stop".

Completion of content playback is detected using an instruction that indicates completion of content playback from a video content server (ANNOUNCE method). When the notice header indicates reception of the Event\_Code for playback termination, terminals should display appropriate messages describing the reason for termination.

There are two independent processes in playback termination:

- 1) termination processing using a user interface function through remote controller operations such as stop, and
- 2) termination processing for communication servers such as transmission of RTSP TEARDOWN and disconnection of sessions due to timeout.

#### II.8.2.5 Information display during viewing

AV players are capable of displaying the following information during stream resource playback (note that information display methods are implementation-defined):

- Banners related to contents that are being reproduced: content titles and content outlines can be displayed according to the information described in ERI of the contents.
- A user interface function to switch elementary stream (ES) for contents that are being reproduced: audio ES and subtitle ES should be switched using the information described in PMT that is multiplexed to the stream resource of the contents. For audio ES switching labelling, "Audio 1, Audio 2" suffices. For subtitle ES switching labelling, a format in

which no subtitle or one of the languages in the subtitle ES is selectable, can be used. The default subtitle setting is no subtitle.

- A progress bar indicating the streaming playback position: the current playback position on the length of the content that is described per the session description protocol (SDP) can roughly be determined by combining the value of the Range header indicated in the Response message of the RTSP PAUSE method, clock value in a terminal, or PTS value of the stream, etc. For example, when the mode changes from trick playback to normal playback, the PAUSE method is always used for transmission/reception. By this, the playback start time position is located, and time elapsed that is measured by the terminal's clock is added during the following normal playback. During high-speed playback, the product of the measured playback time and the speed value can be added.
- Graphical UI that is used to specify a time code for jump playback: for example, terminals can provide a graphical UI that provides a sub-menu enabling entry or selection of a playback time position for the content being reproduced using a user interface function such as a remote controller.

#### **II.9** Electronic content guide

This clause describes an example of the electronic content guide (ECG) function that is implemented by terminals using ECG metadata provided by service providers. The ECG function is an optional function, and whether it is implemented or not, depends on the terminal.

The ECG uses the metadata that is provided by content delivery service providers in advance and provides users with the means to search contents, display information, reproduce, purchase contents, and work with portals using a terminal resident function. Especially, the ECG enables searching across service providers since it is implemented as a resident function.

#### **II.9.1** Functions provided by ECG

An ECG provides the following functions:

- A function to specify the entire ECG metadata, or a search condition for each service provider and obtain metadata.
- A function to obtain ECG metadata from multiple service providers.
- A function to display lists and details of obtained ECG metadata to users.
- A function to move from displayed ECG metadata to contents and procedures to purchase packages.
- A function to display contents and packages that are purchased by users.
- A function to reproduce purchased contents.

#### **II.9.2** Information comprising ECG and management

#### **II.9.2.1** ECG metadata management using terminals

It is assumed that obtained metadata is temporarily stored in cache for ECG. Implementation of cache depends on individual terminals. It is assumed that cache capacity ranges from the minimum of a content search result screen to the maximum of all ECG metadata from all service providers. Also, the assumed storage methods range from saving temporarily in RAM as storage media to saving on a hard-disk drive.

ECG compatible terminals build and manage a metadata database based on obtained ECG metadata to reduce stress on users to use functions such as search. However, the methods to manage ECG metadata in terminals are implementation-defined.

The following points in regard to ECG metadata cache management should be noted:

- Metadata should be obtained from an ECG metadata server of a service provider and managed so that it is available for use as lists, etc.
- Metadata for individual content and package metadata comprising a content group should be correctly associated.
- Effort should be made so that the difference between ECG metadata in a service provider server and cache in the terminal becomes less than one day.
- Terminals should always keep the metadata database up-to-date based on the latest ECG metadata that is obtained.
- When an expiration date is specified, expired ECG metadata should not be presented to users. Expiration dates may be shortened, so metadata should be updated in an appropriate manner.

#### **II.9.2.2** Management of viewing availability information for individual packages

Terminals should save PurchaseID, usage start date, and usage end date of packages, or the licence ID and the expiration date of licence usage and the date on which the select option is reset for select packages, in NVRAM, at least until the usage end date or the date on which the select option is reset.

#### **II.9.2.3** Other information managed by terminals

It is desirable that terminals can manage viewing status of contents that are available for viewing, such as information on whether they are viewed or not, and content playback stop positions for the resume function, etc.

#### **II.9.3** ECG metadata acquisition

The following points in regard to metadata acquisition by ECG should be noted:

- 1) Cache capacity of ECG varies depending on the terminals. Exceeding the cache capacity may result in lost data when obtaining ECG metadata.
- 2) Terminals connect to an ECG metadata server, as described in <meta\_url> in the platform configuration information of a service provider with whom basic registration has been completed and obtain metadata.
- 3) When obtaining ECG metadata, terminals should obtain metadata partially, for example by specifying the size (taking into consideration their cache capacity).
- 4) When the obtained ECG metadata has the same ProgramInformation/@programID as the cached metadata, and @fragmentVersion of the obtained ECG metadata is new, the cached metadata should be replaced by the obtained metadata.
- 5) Scheduling to obtain ECG metadata is implementation-defined, but effort should be made so that the difference between the cached metadata and the server metadata is less than one day.
- 6) Implementation in which terminals of a manufacturer obtain ECG metadata concurrently should be avoided. When the error code 503 (Service Unavailable) is returned from a server, terminals should connect to the server after an appropriate interval.
- 7) When there are multiple service providers with whom basic registration has been completed, terminals should obtain metadata evenly from the multiple service providers, associate the obtained metadata with respective service providers and manage the metadata in their metadata database.

#### **II.9.4** Content information and package information display

ECG should provide at least a function to display content and package lists and detail screens. The following points in regard to each display function should be noted:

- 1) ECG should be able to display content and package lists using obtained metadata. There are two assumed types of lists to be displayed: content lists and package lists. Also, group lists can be displayed using group information elements such as series.
- 2) Other list display methods are implementation-defined, but as the number of contents may become large, consideration should be given to paging, scrolling, hierarchical displays, etc.
- 3) It is assumed that package name, package type, price, new arrival, recommended package, and status (such as viewing period) are displayed when packages are displayed in a list. It is assumed that content name, new arrival, recommended contents, and status (such as viewing availability and viewing period) are displayed when contents are displayed in a list. Also, it is assumed that group name, new arrival, recommended group, and status (such as viewing period) are displayed when groups (e.g., series) are displayed.
- 4) The display order in lists is implementation-defined, but consideration should be given to avoid unfair display opportunity among service providers, for example, by ordering items using search keys.
- 5) A purchase button can be displayed for the contents and packages in the content list screen and package list screen.
- 6) Users should be able to move to a detail screen that displays information such as details of contents and packages and purchase conditions by selecting individual contents and packages displayed in lists.
- 7) Detailed information of obtained contents and packages should be viewable. A purchase button should be displayed for each content and package in the detail information screen so that users can proceed to purchase procedures.
- 8) When multiple data is defined with the same tag in ECG metadata, the data should be displayed in the order that follows the described order.
- 9) In regard to licence information related to contents and packages such as viewing period, licence reference information should be obtained and displayed.
- 10) It is desirable that contents and packages that have already been purchased be differentiated in the contents list screen and package list screen as well as in the detail screen.
- 11) If there is a provider logo, it is desirable that the logo be displayed.
- 12) The items that should be displayed in list screens and detail screens are implementation-dependent.

#### **II.9.5** Search using ECG metadata

The ECG function should provide users with a metadata search function in cooperation with an ECG metadata server. The following points should be noted in regard to searching:

- 1) Terminals should accept metadata search conditions from users, send the search condition to ECG metadata servers and obtain ECG metadata. When ECG metadata is obtained, terminals can cache the metadata according to their cache capacity.
- 2) ECG metadata display for search results should conform to the display method described in clause II.9.4 above.
- 3) Obtained ECG metadata should be compared to cached metadata, and cached metadata should always be up-to-date.

- 4) When a user presents the same search condition as cached ECG metadata, and it has been more than one day since the ECG metadata was cached, the search should include the ECG metadata server of the service provider.
- 5) Search by genre may be performed according to implementation-dependent classification schemes.
- 6) Consideration should be given to avoid unfair metadata searches among service providers.

#### **II.9.6** Purchase of packages

Using the ECG function, users should be able to move from list and detail screens to the package purchase screen to purchase packages.

- 1) By selecting a button to start the purchase procedure in the content list, package list, and detail screens, users should be able to start a MAFR user agent for IPTV using the URI indicated in PurchaseInformation/Purchase/PricingServerURL of the purchase information element corresponding to the contents and packages, move to a portal server of a service provider and proceed with the purchase procedure.
- 2) When multiple packages contain the selected content, users should be able to select a package.
- 3) When a package is purchased in a portal server, viewing availability information should be saved in the terminal at least until the viewing period ends. The storage period after expiration of the viewing period is implementation-defined.
- 4) When users return to the ECG function after purchasing packages, it is recommended that the transition to the purchased package detail screen be carried out using the ECG button or startResidentApp() in the MAFR document after the purchase.
- 5) When contents and packages are displayed, they should be displayed in a way that users can find out what items have been purchased and what are for purchase.
- 6) In regard to contents included in the subscriber's plan, the CRID of the contents should be added to the above URI as an argument, and users should be able to move to a portal server and proceed with the selection procedure.

#### **II.9.7** Purchased content and package lists

Using the ECG function, users should be able to display contents and packages that are available for viewing and reproduce them by selecting a content.

- 1) Users should be able to display a list of contents and packages that are available for viewing using viewing availability information that is saved on terminals. A dedicated screen can be prepared, or it can be included in the list screen. When the purchased content and package list is included in the list screen or detail screen, the available for viewing status should be displayed.
- 2) When users display the list of contents and packages that are available for viewing, it is desirable that a play button, viewing status (previous viewing position), viewing period of the contents and links to portal servers be displayed.
- 3) When multiple contents become available for viewing by purchasing one package such as pack and all-you-can-view packages, only package information should be displayed. Displaying all contents is not needed.
- 4) Since it is assumed that package purchase and cancellation of package purchase take place off-line, it is desirable that terminals provide a button that starts a function to synchronize viewing availability information with a service provider server, or other means to execute an equivalent function such as a menu item.

The following methods can be used for synchronization:

- a) Terminals access a portal server of a service provider and specify the user using a method such as user authentication with DRM\_ID by executing the obtained MAFR document. Then terminals perform update processing for the MAFR document that is customized for a specified user using setContentPackageInfo() (when the information on packages for which purchase application has been made is added individually) or updatePackageLicenceInfo() (when the information is updated collectively).
- b) Using ECG, users connect to the contract package information URI of the platform configuration information using HTTPS and obtain a contract package information file. If the error code 503 (Service Unavailable) is returned from the server, terminals should connect to the server after an appropriate interval. In regard to acquisition timing, it is assumed that terminals can perform automatic updates using the above protocol at any time, e.g., when the power is turned on. Allowing terminals to access a server concurrently should be avoided.

#### **II.9.8** Linkage with portal

It is desirable that links to the corresponding service provider portals be displayed in content lists and package lists.

A MAFR user agent for IPTV is started using <portal\_url> in the platform configuration information when a user moves to a portal of a service provider.

#### **II.10** Parental control settings

Parental control settings vary depending on local regulations. This clause describes an example of parental controls.

The following three functions should be configurable in the menu screen of terminals.

- Parental level (minimum age for viewing): The minimum age is set according to local policies (e.g., between 4 and 20). Programs, contents, etc., with a parental rating exceeding the set value are not displayed.
- Parental password (code number).
- Parental control ON/OFF.

It is desirable that the initial setting does not display R-20 programs (equivalent to parental control = ON, parental level = 19).

#### **II.10.1 Function overview**

This function is used to compare the parental rate that is described in PSI/SI and ECG metadata with the parental level (minimum age for viewing) that is set on a terminal by a user. When the parental rate exceeds the parental level (minimum age for viewing), users are asked to enter a password (code number) for the parental control target program/contents, which can be viewed only when the entered password matches the password that is preset in the terminal by the user.

This function is used for programs provided by conditional access services and contents provided by conditional playback services.

Terminals should be equipped with a function to set the parental level to ON/OFF, and when the parental level is OFF, terminals should not display the parental level/password entry screen until the parental level is set to ON.

When a password and/or parental level are not set, terminals should not present any services including restricted programs and should display a screen to ask users to set a password and/or parental level. It is desirable to allow users to set the above-mentioned "parental function ON/OFF" function in the password and parental level setting screens.

#### **II.10.2** Initial setting

In the factory setting of terminals, it is desirable that the parental function is set to ON and the parental level is set to 19 or an equivalent value. However, actual parental level setting and password setting are implementation-defined.

When the parental level is set to 19, users are not asked to enter a password to view programs and contents that are under R-19. If a password is not set in the factory setting, users should set a password when they change the parental level setting.

#### **II.10.3** Parental level (minimum age for viewing)

Examples of parental levels: The parental rate of a program should be (rating + 3). The rating takes a value between 0x01 and 0x11. The parental rate for content takes a value between R-4 and R-20.

An exceptional process is applied when a value between 0x12 and 0xFF is specified for rating (age restriction rate), where all become restricted regardless of the parental level setting, except when the parental level (minimum age for viewing) of the terminal is set to "no restriction (unconditional)" or when the setting is made not to use the above-mentioned parental control.

Adult-themed video services with 0x11 rating and R-20 adult themed contents should not be displayed even when the restriction is temporarily removed. However, the above-mentioned restriction does not apply to digital TV services that have 0x11 rating.

This restriction does not apply to programs that do not have a rating (age restriction rate).

Values that are set in terminals should fall between 4 and 20, and should be specifiable in years.

#### **II.10.4** Password (code number)

- 1) Password digit number: the password should be a decimal four-digit number.
- 2) Deletion of password: Deletion of password is optional, depending on the terminal.

#### **II.10.5** Restriction removal status

After a password and the parental level are set and when the restriction is removed temporarily (after password authentication), it is desirable that the restriction be removed at least until the power is turned off (including when the power is turned off using a remote controller).

#### **II.11** Residence location configuration

Examples of location settings include:

- Administrative region (e.g., prefecture) code: In order to provide services that correspond to a user's residence location, administrative region codes should be configurable.
- Postal code (seven-digit): In order to provide services that correspond to a user's residence area, postal codes should be configurable.

#### **II.12** Terminal preset information

The terminal preset information includes items that are preset in terminals and that terminals require to receive various services. For example, the information on the URL from which the CDN configuration information is obtained.

#### **II.13** Basic registration information management

During basic registration with a service provider, a terminal saves the information to identify the contracted service provider (ip\_service\_provider\_id) in NVRAM using the basic registration completion process document in a portal. Terminals use this information to give priority to the providers with whom basic registration has been completed when, for example, displaying the EPG.

Authentication key information and the SCP server URI are also saved and managed in NVRAM. Upon expiry, the relevant basic registration information is nullified.

#### II.14 SCP client identification

It is assumed that SCP client identifiers (e.g., DRM\_ID) are registered with subscriber management servers of the operators as a means to identify devices and users of these devices. SCP client identifiers are used as needed when the terminal browser, etc. processes authentication, and users do not usually need to know the values. However, users may need to report the values by phone or by other means when, for example, a service is cancelled due to device failure. Therefore, terminal manufacturers need to consider the way by which DRM\_IDs can be notified to users.

#### Examples of DRM\_ID

The DRM\_ID is called the "DRM number" and can be displayed as a hexadecimal (0 to F) 16-digit string divided into groups of four characters connected with "-" (hyphens) in the following display format:

where "X" is an hexadecimal number or a character between 0-9, A-F (letters in upper case).

#### **II.15** MAFR user agent requirements for IPTV

In order to implement a MAFR user agent for IPTV (e.g., [b-ITU-T H.761] or [b-ITU-T H.762]), terminals need to satisfy corresponding functions and specifications, implementation of additional functions for linear TV/VoD services, as well as SCP related features.

Also, a resident application should start and terminate the MAFR user agent for IPTV under the following conditions:

- Starting a MAFR user agent for IPTV:
  - When access to a portal is instructed by a portal selection method.
  - When displaying simulated data broadcasts using the data broadcasting button of a remote controller (e.g., *d button in some regions*) during linear TV reception.
  - When displaying a portal page specified at start-up to return to upon termination of VoD that is started from the portal.
  - When displaying a registration verification document for a portal of the corresponding service provider.
  - When displaying a purchase processing document in PurchaseInformation/Purchase/ PricingServerURL through the purchase operation by a user in the package purchase screen of ECG.
- Terminating a MAFR user agent for IPTV:
  - When linear TV channel selection is performed, or when the network is switched.
  - When selecting an IP broadcast specified by executing epgTune() function in a portal document.
  - When an AV player is started by executing launchIPTVContent() function in a portal document.
  - When a resident application such as the initial setting, EPC, ECG and the portal selection screen is started by user operation.
  - When restarting ECG by executing startResidentApp() function in the portal document for purchase processing that is started from ECG with pricingServerURL.

#### II.16 Remote controller

It is desirable that the main functions of terminals can be controlled by remote controller operations. For convenience of users, it is desirable to standardize buttons to match regional specifications.

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