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Secondary distribution of IPTV services

IPTV service requirements and framework for secondary distribution

Recommendation ITU-T J.700

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Recommendation ITU-T J.700

IPTV service requirements and framework for secondary distribution

Summary

The telecommunications industry today is pursuing development of a new generation of television services, typically called IPTV, built upon IP networking technology to deliver integrated triple-play voice, data and video services across a converged network infrastructure. The cable industry has a long history of successfully delivering video services over hybrid fibre/coax (HFC) networks while adding support for data and voice through the DOCSIS and IPCablecom architectures. Recommendation ITU-T J.700 describes the use of the IPTV mechanism, and is intended to support IPTV services over existing cable-based secondary distribution networks and/or other networks to enhance the existing television distribution services.

This revised Recommendation provides a clearer relationship of the IPTV architecture between this Recommendation and Recommendation ITU-T Y.1910, and the relationship to the service provider interface is newly described. In addition, the latest access network technologies for secondary distribution such as radio frequency over glass (RFoG), wavelength-multiplexed video transport over optical fibre, and hybrid use of HFC and optical fibre, are mentioned. This revision is also intended to provide a number of editorial corrections.

History

Edition	Recommendation	Approval	Study Group
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Recommendation ITU-T J.700

IPTV service requirements and framework for secondary distribution

1 Scope

This Recommendation describes the service requirements and functional framework architecture for support of IPTV services to provide enhanced broadcasting, where broadcast programmes are delivered over existing cable-based secondary distribution networks composed of HFC or FTTx with some enhancements by applications and/or services provided over IP-enabled networks. It addresses the service requirements, use cases and functional components required to support these requirements. Where possible, this Recommendation utilizes the material already developed, or under development, in ITU-T Recommendations related to video service delivery over secondary networks.

This Recommendation describes the use of an IPTV mechanism based on the general ITU-T IPTV functional architecture [ITU-T Y.1910]. The IPTV applications and services addressed in this Recommendation are intended to be transferred over existing cable-based secondary distribution networks and/or other networks to enhance the existing television distribution 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.

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3 Definitions

3.1 Terms defined elsewhere

None.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 client DVR (cDVR): An instance of a DVR where the end-user terminal device contains the recording capability that can be solicited and operated by end users to record and store video, audio and other associated content locally for subsequent playback.

3.2.2 digital video recorder (DVR): A recording capability that can be solicited and operated by end users to record and store video, audio and other associated content for subsequent playback.

3.2.3 distributed DVR (dDVR): Multiple instances of a DVR where a combination of cDVRs and nDVRs can be used to record and store video, audio and other associated content for subsequent playback. For example, this usually occurs within a home network containing multiple cDVRs in order to distribute storage of video, audio and other content.

3.2.4 DOCSIS-based CPE: A terminal device that contains an embedded DOCSIS cable modem. Hybrid CPEs and IP-only CPEs may be DOCSIS based.

3.2.5 enhanced broadcasting: A system that is capable of delivering broadcast programmes over existing secondary distribution networks composed of HFC or FTTx with enhancements by applications and/or services transferred over IP-enabled networks.

3.2.6 hybrid CPE: A terminal device that is capable of receiving content services over MPEG transport streams and IP.

3.2.7 IP-only CPE: A terminal device that is capable of receiving content services over IP only.

3.2.8 mobile DVR (mDVR): A mobile instance of a DVR where a mobile terminal device can be a cDVR (having the capability to store video, audio and other associated content locally) or contain a means of accessing an nDVR or other cDVR.

3.2.9 MPEG transport CPE: A terminal device that is capable of receiving content services over MPEG-2 transport streams only.

3.2.10 network DVR (nDVR): An instance of a DVR where a network element contains the recording capability that can be solicited and operated by end users to record and store video, audio and other associated content in the network for subsequent playback.

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4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AAC	Advanced Audio Coding
AAC-LC	Advanced Audio Coding – Low Complexity
AC-3	Arc Consistency algorithm #3 (Dolby)
AIT	Application Information Table
API	Application Programming Interface
ASD	Authorized Service Domain
A/V	Audio/Video
AVC	Advanced Video Codec
AVT	Audio/Video Transport
BLT	Bit-block Transfer
BPL	Broadcast over Power Line
BSS	Business Support System
CA	Conditional Access
CAS	Conditional Access System
CDN	Content Delivery Network
cDVR	client Digital Video Recorder
CID	Caller Identity Display
CM	Cable Modem
CMTS	Cable Modem Termination System
CODEC	Coder-Decoder
CPE	Customer Premises Equipment
CSCF	Call Session Control Function
dDVR	distributed Digital Video Recorder
DEPI	DOCSIS External PHY Interface
DHCP	Dynamic Host Configuration Protocol
DLNA	Digital Living Network Alliance
DM	Device Management
DMP	Digital Media Player
DMR	Digital Media Renderer
DNS	Domain Name System
DOCSIS	Data-Over-Cable Service Interface Specification
DPI	Digital Programme Insertion
DRM	Digital Rights Management
DRRP	Dynamic Resource Registration Protocol
DSG	DOCSIS Set-top box Gateway

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DSL	Digital Subscriber Line
DSM-CC	Digital Storage Media Command and Control
DTCP	Digital Transmission Content Protection
DVB	Digital Video Broadcasting
DVD	Digital Versatile Disc
DVR	Digital Video Recorder
DVS	Digital Video Service
EAS	Emergency Alert System
eCM	embedded cable modem entity (e.g., STB, router, MTA, etc.)
ECM	Entitlement Control Message
EMM	Entitlement Management Message
eMTA	embedded Multimedia Terminal Adapter
EPG	Electronic Programme Guide
ERM	Edge Resource Manager
ES	Elementary Stream
FCAPS	Fault, Configuration, Accounting, Performance and Security
FG IPTV	ITU-T IPTV Focus Group
FTTx	Fibre-To-The (node, curb, premise or home)
FW	Firewall
GEM	Globally Executable Multimedia home platform
GE-PON	Gigabit Ethernet – Passive Optical Network
GIF	Graphics Interchange Format
GPON	Gigabit-capable Passive Optical Network
GUI	Graphical User Interface
GW	Gateway
HD	High Definition
HDCP	High-bandwidth Digital Content Protection
HDD	Hard Disk Drive
HDMI	High-Definition Multimedia Interface
HDNI	Home Digital Network Interface
HDTV	High-Definition Television
HFC	Hybrid Fibre/Coax
HRC	Harmonically-Related Carriers
HSD	High Speed Data
HSS	Home Subscriber Server
HTTP	HyperText Transfer Protocol
HTTPS	Secure HyperText Transfer Protocol

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ICE	Interactive Connectivity Establishment
I-CSCF	Interrogating Call Session Control Function
IGMP	Internet Group Management Protocol
IM	Instant Messaging
IMS	Internet Protocol Multimedia Subsystem
IP	Internet Protocol
IPPV	Impulse Pay Per View
IPTV	Internet Protocol Television
IPv6	Internet Protocol version 6
IRC	Incrementally-Related Carriers
IRT	Integrated Receiver Transcoder
ISDN	Integrated Services Digital Network
ISMS	Information Security Management System
ITV	Interactive Television
JAR	Java Archive
JCE	Java Cryptography Extension
JPEG	Joint Photographic Experts Group
LAN	Local Area Network
LLC	Logical Link Control
LPCM	Linear Pulse Code Modulation
MAC	Media Access Control
M-CMTS	Modular Cable Modem Termination System
MDU	Multi-Dwelling Unit
mDVR	mobile Digital Video Recorder
MHP	Multimedia Home Platform
MLD	Multi-Listener Discovery
MP3	MPEG-1 audio layer 3
MPEG	Moving Picture Experts Group
MPEG-ES	Moving Picture Experts Group Elementary Stream
MPEG-TS	MPEG Transport Stream
MPTS	Multiple Programme Transport Stream
MSO	Multiple System Operator
MTA	Multimedia Terminal Adapter
NACF	Network Attachment Control Function
NAT	Network Address Translation
nDVR	network Digital Video Recorder
NGN	Next Generation Network

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NIT	Network Information Table
NPT	Normal Play Time
NTSC	National Television System Committee
NVOD	Near Video on Demand
OCAP	OpenCable Applications Platform
OMA	Open Mobile Alliance
ONU	Optical Network Unit
OOB	Out-Of-Band
OSD	On-Screen Display
OSS	Operational Support System
PAT	Programme Association Table
PBP	Personal Basic Profile
PCM	Pulse Code Modulation
PCMM	PacketCable Multimedia
P-CSCF	Proxy Call Session Control Function
PDU	Packet Data Unit
PEG	Public, Education and Government access
PES	Packetized Elementary Stream
PiP	Picture-in-Picture
PMT	Programme Map Table
PNG	Portable Network Graphics
PON	Passive Optical Network
PPV	Pay Per View
PSI	Programme Specific Information
PSTN	Public Switched Telephone Network
PVR	Personal Video Recorder
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
QPSK	Quadrature Phase-Shift Keying
RACF	Resource and Admission Control Function
RAM	Random Access Memory
RF	Radio Frequency
RFoG	Radio Frequency over Glass
RG	Residential Gateway
RGB	Red Green Blue
RSVP	Resource ReServation Protocol
RTCP	Real-time Transport Control Protocol

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RTE	Real-time Encoder
RTP	Real-time Transport Protocol
RTSP	Real-time Streaming Protocol
S-CSCF	Serving Call Session Control Function
SCF	Service Control Function
SD	Standard Definition
SDP	Session Description Protocol
SD&S	Service Discovery and Selection
SDU	Single-Dwelling Unit
SDV	Switched Digital Video
SI	Service Information
SIP	Session Initiation Protocol
SNMP	Simple Network Management Protocol
SOAP	Simple Object Access Protocol
SP	Service Provider
SPI	Service Provider Interface
SPTS	Single Programme Transport Stream
SRM	Session and Resource Manager
SSL	Secure Sockets Layer
SSM	Source-Specific Multicast
STB	Set-Top Box
STT	System Time Table
STUN	Simple Transversal of User datagram protocol through Network address translation
TCP	Transmission Control Protocol
TFTP	Trivial File Transfer Protocol
TMN	Telecommunications Management Network
TURN	Transversal Using Relay Network address translation
UDP	User Datagram Protocol
UPnP	Universal Plug and Play
VBI	Vertical Blanking Interval
VC-1	Video Codec 1
VCR	Video Cassette Recorder
VCT	Virtual Channel Table
VOD	Video On Demand
VoIP	Voice over Internet Protocol
V-ONU	Video Optical Network Unit
VPN	Virtual Private Network

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VRN	Video Rich Navigation
WAN	Wide Area Network
WDM	Wavelength Division Multiplexing
WMA	Windows Media Audio
WSDL	Web Services Description Language
XCAP	eXtensible markup language Configuration Access Protocol
xDSL	(symmetric, asymmetric, high bit-rate, very high speed) Digital Subscriber Line
XML	eXtensible Markup Language

5 IPTV reference model, scenarios and requirements

It is helpful to start with a high-level reference model for IPTV over secondary distribution. In this clause, we introduce that model and discuss some scenarios for service delivery. Once this high-level view is set, the service and functional requirements are introduced and discussed.

5.1 Scenarios for IPTV services

Figure 1 shows the basic IPTV reference model derived from the model defined by [ITU-T Y.1910]. Taking the typical cable operators' environments, it has been modified slightly to allow for the network provider and service provider to be the same entity. It has been also modified to show some basic functional relationships.

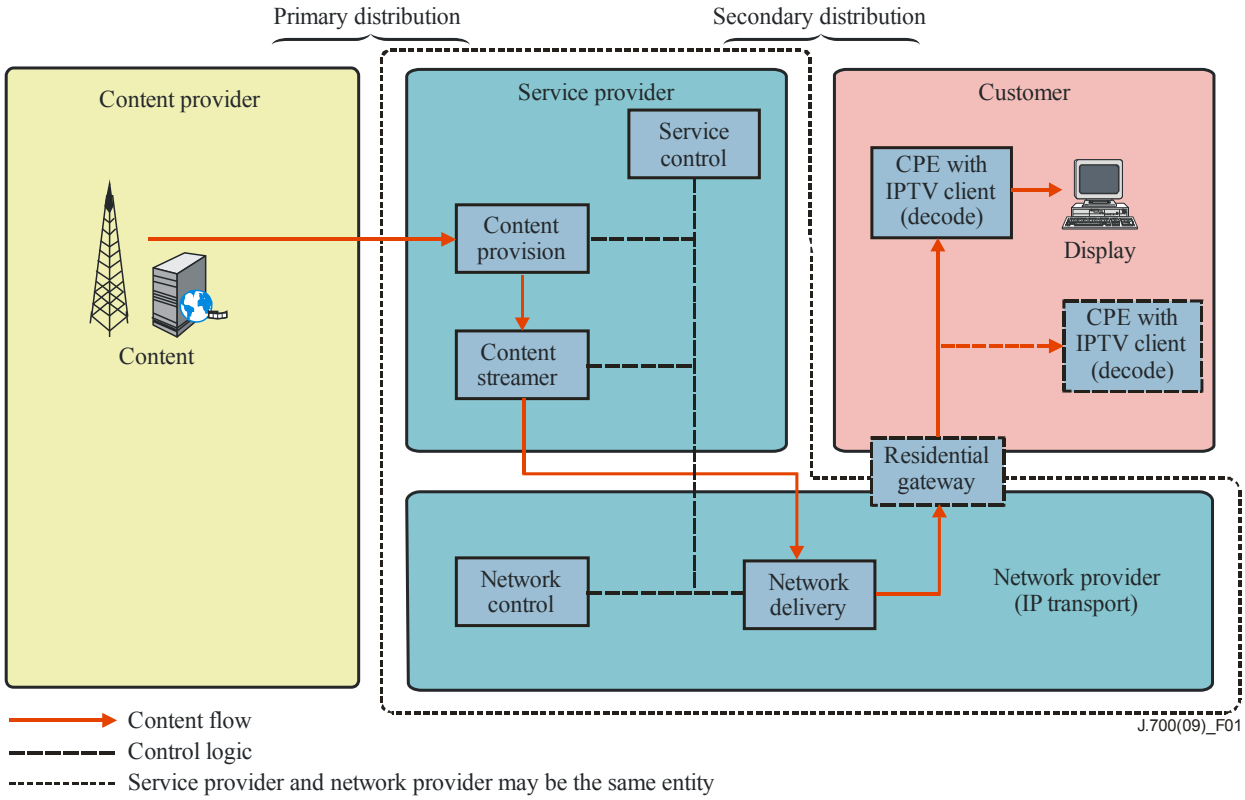


Figure 1 – IPTV reference model

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The content provider, service provider and network provider in Figure 1 may be distinct entities; however, there are numerous scenarios where multiple functions may be provided by a single entity. The implementation of the reference model may vary based on whether there are single or multiple entities. The dotted line in Figure 1 above indicates the scenario where the service provider and network provider may be the same entity.

In Figure 1, the interaction between the content provider and the service provider is considered to be "primary distribution". The interaction from service provider to customer is "secondary distribution". The scope of this Recommendation is to provide a framework for secondary distribution only.

In Figure 1 above, the content is received from the content provider at the service provider in the content provision function (primary distribution). The content provision function acquires, manages and provisions content according to service provider requirements (e.g., ad-insertion, logo superimposing, encryption, compression, etc.). Content is then sent to the content streamer function to be streamed and delivered to the customer via the network provider through the network delivery function (secondary distribution). The service control function is used to control interaction with the customer and distribute content via the network provider. The network control and the network delivery functions operate within the network provider entity in order to disseminate and deliver content and data to and from the customer. Each customer entity may contain a residential gateway (owned and/or operated as a CPE by the network provider, service provider or customer), which functions to receive and send content and data to and from the other CPEs within the customer premises network. The CPE may send content to an optional display, which may be used to view and interact with content that is decoded for viewing at the CPE.

The customer premises network may consist of multiple CPEs with IPTV clients, which may or may not have connected or integrated displays. Each CPE, including the residential gateway, communicates upstream, through the network provider, to the network control and service control functions to control the delivery of content and for supporting exchange of data for interactive applications.

For this Recommendation, we derive an IP-enabled secondary distribution system based on the basic reference model and considering existing deployed technology. This secondary distribution system for enhanced broadcast is illustrated in Figure 2.

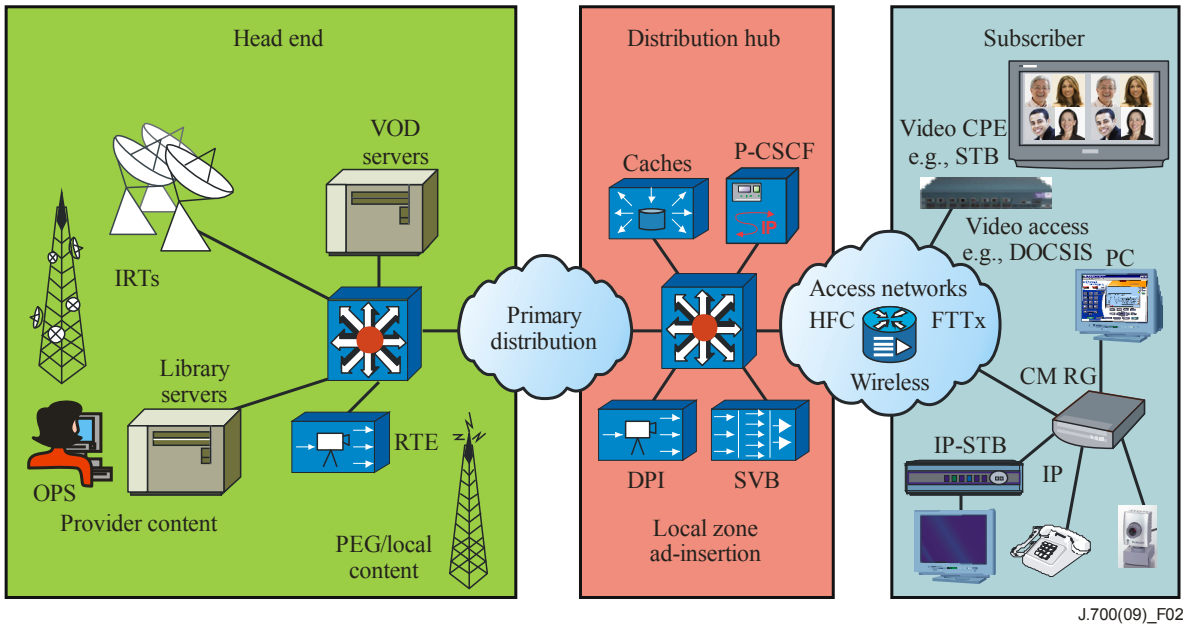


Figure 2 – Example of high level end-to-end physical network for enhanced broadcast

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The physical network typically consists of:

- A head end for content acquisition, operations support and subscriber management. The head end allows for content to be made available based on the needs of a particular region served by the cable operator. Often VOD servers reside at the head end, and programming is tailored and branded to the profile of the regional market.
- The distribution hub is the operator's closest location to the subscriber. This is one place where local content can be added (e.g., local programming and ad insertion). Resource management on the access network occurs at the distribution hub, as well as initial termination of signalling for services.
- The subscriber or customer premises is often the demarcation point beyond which the operator may have less control. Leased equipment (owned by the cable operators) is considered trusted, and often other equipment within the customer premises is not considered within the trust boundary. The expanding need to support in-premises networking of content provides a number of challenges in areas such as conditional access (CA), digital rights management (DRM) and network address translation (NAT)/firewall traversal.

The primary focus of this IPTV framework Recommendation is to enable delivery of IP-based video services to end-users in the following ways:

1) Delivering enhanced video and other multimedia capabilities to the TV using IP – This scenario is generally considered to enhance the existing digital television delivery service. The existing video service delivery mechanisms remain intact, but are enhanced to allow for additional service overlays. All of these may also provide an integrated experience with the existing broadcast-based television services.

   a) IP video features – For example, mosaics of video content (e.g., for interactive programme guide or picture-in-picture) require multiple-tuner capabilities using traditional delivery mechanisms. IP gives the ability to deliver multiple video streams for various display purposes efficiently.

   b) Web-based services – Video delivery through standard web-based mechanisms can be used in conjunction with existing digital TV offerings to provide interactivity. For example, enhanced information services related to programming can be displayed through access to web servers over the IP network.

   c) IP-based enhancements – Combining existing broadcast video applications with new interactive IP-based multimedia services. For example, IPCablecom [b-ITU-T J.160] defines a standard architecture for voice over IP (VoIP) and IPCablecom2 [b-ITU-T J.360] defines multimedia services for cable networks. Other IMS-based multimedia services are being defined as well. These new services will be integrated with existing digital television offerings.

2) Delivering video over IP to devices in the home – As IPTV technology matures, operators may realize gains in bandwidth efficiency, lower CPE costs and flexibility in presentation by delivering video in IP to the end devices.

   a) Content may be delivered through traditional RF-modulated MPEG streams to a set-top box-based CPE, and then made available within the home to IP devices through the IP home gateway.

   b) Content may be delivered end-to-end with IP-based streaming. An IP-video home gateway would enable delivering the streams to (potentially multiple) IP devices within the home.

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3) Delivering video over IP to devices outside the home – As operators move to provide service to devices beyond the traditional secondary delivery network, many mobile opportunities are presented.

   a) IPCablecom2 provides an IMS-based mechanism for multimedia delivery to mobile devices. Interworking with the IMS delivery subsystem to allow IPTV services to be delivered to the mobile devices is a key component of this architecture.

   b) Innovative mechanisms may allow for content delivery to remote devices outside the home. This capability is often referred to as "place-shifting".

5.2 Service requirements

There are a number of types of services anticipated to be supported by the broadcast enhanced by IPTV defined in this Recommendation. The supported services, described from the CPE perspective, might include the following items.

5.2.1 Digital video and audio content

The CPE should be capable of decoding and processing digital video channels from the network. Examples of digital video include MPEG-2, MPEG-4 AVC and VC-1 based encoding formats. Digital video may include associated digital audio services. Stand-alone audio services may also be offered.

Content may be service-provider or subscriber generated.

See also requirement R 6.5.2-01 of [ITU-T Y.1901].

5.2.2 Navigation and electronic programme guide support

The CPE should support an interactive electronic programme guide (EPG) application selected by the network operator. The interactive EPG runs on top of the middleware and supports all available video and audio services including broadcast, on-demand, time-shifted multimedia services (i.e., DVR) and IP video, and provides utilities that include, but are not limited to:

- Available subscriber and service provider content lists.
- Search and navigation tools of available content.
- Channel and content selection, including last channel recall and favourite channel lists.
- DVR client and on-demand controls, including play, rewind, fast forward and pause.
- DVR client recording control, including reminders.
- Parental control, including block by time, channel, ratings, title and content type.
- Services control, including enabling and disabling access to pay-per-view content.

See also requirements R 6.1-04, R 6.3.6-03, RR 6.3.6-01 and clause 6.6.5 of [ITU-T Y.1901].

5.2.3 Content on demand

The CPE should be able to provide on-demand services and should interoperate with the network and service providers' on-demand infrastructure. On-demand enables television viewers to select from an extensive library of content stored on a video server, and have it delivered over a channel via the cable network. All on-demand services should allow the viewer to pause, fast forward and rewind programming, similar to a VCR or DVD. Other on-demand content such as audio and games should be supported.

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On-demand services available using multiple authorization modes that should be supported include, but are not limited to:

- Complimentary on-demand.
- Subscription on-demand.
- Pay-per-view.
- Network-based digital video recorder (DVR) where subscriber specified content is stored at head end-based servers.
- Push on-demand (download-based content distribution services).

From the standpoint of the end user's experience, authorization modes can operate differently depending on the subscriber's relationship with the network and service providers. Each offers play, pause, stop, fast-forward and rewind capabilities. Authorization flexibility allows multiple viewing conditions which include the ability to watch any movie, as often as the customer wishes, for a service provider-defined period of time.

See also requirements R 6.1-03, OR 6.1.1-02 and clause 6.5.1.5 of [ITU-T Y.1901].

5.2.4 Support for digital programme insertion (DPI)

The IPTV framework for the secondary distribution architecture should support the following content insertion services in accordance with [ITU-T J.280], [ITU-T J.181] and Recommendation ITU-T J.189:

- Digital-into-digital advertising includes the capabilities to insert, or splice, one digital programme (the ad) into a second digital programme (the content being viewed). Insertion should include both video and audio content. The insertion may occur in the head end, the hub, the CPE or a combination of any to deliver a particular ad to the viewer. Advertising content can be streamed in real time as part of the transport multiplex for a video service, stored in an on-demand ad insertion system, or available in the hard drive of a DVR-capable CPE and streamed to the CPE across the home network. The CPE should support seamless splicing of ads in all supported formats from any supported source into a video stream as it is being displayed.
- Targeted (geographic grouping) and addressable (demographic grouping) advertising delivers a particular ad to a more targeted audience of viewers. This is normally accomplished by putting multiple ads into the same digital stream multiplex and the CPE selects which ad to present to the viewer based on tagging data on the ads and information present in the CPE.
- Interactive advertising provides the ability for the subscriber to interact with the advertisement using the remote control to, for example, request a coupon or additional information.
- Data collection mechanisms gather information on channel viewing, advertising viewing or other subscriber utilization habits. The CPE should support applications that collect and store data for bulk reporting to a server at scheduled intervals.

See also requirements OR 6.1-03 and OR 6.1.1-09 of [ITU-T Y.1901].

5.2.5 Video game support

Video games may be supported by the CPE at the application layer. CPE models that support video games should provide resource capacity, including processing and memory, to support various gaming applications.

See also requirement R 6.1.1-02 of [ITU-T Y.1901].

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5.2.6 Interactive television

The CPE should support interactive television (ITV) applications such as, but not limited to:

- Weather.
- News.
- Sports.
- Investment.
- Local programming.

See also requirements R 6.1.1-02 and OR 6.5.2.9-01 of [ITU-T Y.1901].

5.2.7 Other IP-based applications

The CPE may have the capabilities to utilize the IP access to provide new applications provided by the service provider such as (but not limited to):

- E-commerce including managed content purchases and enhanced shopping channel.
- Textual and video IM.
- E-mail.
- Web-based services/Internet portal access.
- Telephony integration (voicemail, caller ID, etc.).
- Third party call control.
- Video and audio conferencing.
- Real-time text applications.
- Content sharing (video, still images, etc.).
- Audio books.
- Subscriber preferences and parental controls.
- Navigation through a unified messaging application.
- Presence which recognizes the presence of an active user and provides this information to a CPE application.
- Distance learning, telemedicine and other information services.
- Home security monitoring.
- Multi-user online gaming.
- Remote content management.

These services are supported by the CPE at the application layer. The CPE should provide resource capacity, including processing and memory, to provide an interactive user experience.

5.2.8 Managed content and server-based services

Managed content is web-like content, but contained on internal network or service provider servers. This allows the CPE to access this data without the security concerns that comes with full Internet access.

Server-based services are those where processing and rendering of the service or content occurs at the head end and an MPEG stream is sent to the CPE for display.

The CPE should provide the necessary support for managed content and server-based services.

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5.2.9 Multi-camera angle programming

Multi-camera angle programming is broadcast programming that has several video streams associated with it. Each video stream can, for example, show a different angle of a sporting event. The user navigates through the different camera angles by using their remote control, which communicates with a CPE application that provides this service, and selecting the desired video stream.

Multi-camera angle programming is supported by the CPE at the application layer. The CPE should provide resource capacity, including processing and memory, to support multi-camera angle programming.

See also requirement RR 6.1-06 of [ITU-T Y.1901].

5.2.10 E-commerce support

The CPE should provide application layer support for e-commerce services including shopping channels. These applications enable direct ordering of featured products and services at the time of display using the remote control. This material will most likely be stored remotely and the CPE should have the ability to communicate with the data repository via secure channels that are analogous to HTTPS protocols.

5.2.11 Digital video recorder (DVR) services

A DVR service is defined as a recording capability that can be solicited and operated by end users to record and store video, audio and other associated content for subsequent playback.

It is recommended that the IPTV CPE be capable of supporting DVR services. The CPE should be capable of supporting four envisioned DVR services:

1) Client DVR (cDVR).
2) Network DVR (nDVR).
3) Distributed DVR (dDVR).
4) Mobile DVR (mDVR).

While each of the envisioned DVR technologies may be unique, the service that is required to be supported by the CPE remains constant to the end user.

In all cases, the end user can interact with a GUI (such as the EPG or DVR on-screen display (OSD)) in order to schedule, modify, playback, erase, etc., recordings.

It is recommended that the DVR service support the ability to:

- Schedule recordings (manually or through the use of an EPG).
- Schedule repeating recordings (manually or through the use of an EPG, e.g., record the whole season of a programme).
- Display a list of already recorded programmes/content and a list of upcoming recordings.
- Modify pre-existing scheduled recordings.
- Rank recordings according to priority (high priority recordings take precedence, when recording, over lower priority recordings).
- Play back recorded programmes/content.
- Erase recorded programmes/content (whether viewed or not).
- Copy recorded programmes/content to removable or external local storage devices, according to copyright privileges.
- Automatically (end user unaware) record content.

See also OR 6.1.1-02 and clause 6.5.1.6 of [ITU-T Y.1901].

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5.2.12 Other services

The IPTV system should support needed community and accessibility services, which are additional content components intended to assist people hindered in their ability to perceive an aspect of the main content, as required by the local customer base, for example:

- Emergency alert system (EAS).
- Closed caption, subtitles, audio description and sign language interpretation.
- Real-time text communication between users of the system.

For further information, refer to the accessibility and standardization website [b-ITU-T Accessibility], which includes pointers to the telecommunication accessibility guidelines and telecommunication accessibility checklist.

See also requirements R 6.5.2.10-11, R 6.5.2.10-12 and Appendix I (public interest cross-reference) of [ITU-T Y.1901].

5.3 Functional requirements

This Recommendation specifies how television services may be enhanced by IP-based technology over secondary distribution networks as shown in Figure 2. The enhanced broadcast services will likely support some or all of the following important functional requirements.

5.3.1 Control functions

Most configuration and control parameters are transmitted via IP to the control function of the CPE from a controller in the service provider head end.

The CPE control function should support remote configuration, monitoring, logging, reporting and troubleshooting.

The control interface of the CPE may include many classes of functions. These functions may include service information, emergency alert system, conditional access, configuration and management, software download, and polling and report-back. These classes of functions are further described in the following clauses.

5.3.1.1 Service selection mechanisms

5.3.1.1.1 Service information (SI)

The MPEG transport and hybrid CPE should support the service information (SI) system that describes the programme delivery over MPEG transport including (but not limited to) frequencies, system time, channel maps and services in use on the cable system on which the CPE resides.

- The frequency definition defines the centre frequencies of the carriers used on the network and the indices used to refer to the frequencies, including defining HRC, IRC or standard set-top channel maps.
- System time includes the current time and is used to set the CPE time.
- Channel maps define the relationship between the display channel and the frequency, MPEG service number, source ID (for a linear broadcast channel) and where the service can be found.

The hybrid and IP-only CPE use either the service/system information or other solutions (e.g., solution defined in [ETSI TS 102 034], direct access to a web portal with a browser) in order to find out where on the network to access any content that the user selects. In order to support IP-based CPE (hybrid or IP-only), existing service/system information data need to be updated and modified to provide the data necessary for an IP-based CPE to discover and access digital/analogue services provided 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

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