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Cable modems

Residential gateway requirements for the support of broadcast and IP-based interactive services over cable television networks

Recommendation ITU-T J.294



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Recommendation ITU-T J.294

Residential gateway requirements for the support of broadcast and IP-based interactive services over cable television networks

Summary

Recommendation ITU-T J.294 describes objectives, requirements and functional architecture for a residential gateway (RG) supporting broadcast and IP-based interactive services over cable television networks. This Recommendation describes the requirements for the functional components which form logical entities of RG.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T J.294	2010-09-13	9

FOREWORD

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Recommendation ITU-T J.294

Residential gateway requirements for the support of broadcast and IP-based interactive services over cable television networks

1 Scope

This Recommendation describes objectives, requirements and functional architecture for a residential gateway (RG) supporting broadcast and IP-based interactive services over cable television networks. The RG is supposed to be used with a hybrid set-top box (H-STB) composed of RF TV reception capability and IPTV terminal device (IPTV-TD) functions as well as other devices within a home network environment [ITU-T J.190]. The RG device provides a bridging and/or terminating capability between a cable access network (i.e., WAN) and a home network (i.e., LAN) in every layer. The RG has functionalities for network interface, network control, content delivery, service control and applications to exchange control signal and media flow between WAN and LAN. Each functionality has several functional components. This Recommendation describes the requirements for the functional components which form logical entities of RG.

The RG is assumed to be a home gateway for the reception of enhanced broadcast services over cable television networks defined by [ITU-T J.700], consisting of quality of service (QoS), priority mechanisms, management and provisioning functions.

2 References

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

- [ITU-T J.190] Recommendation ITU-T J.190 (2007), *Architecture of MediaHomeNet*.
- [ITU-T J.218] Recommendation ITU-T J.218 (2007), *Cable modem IPv4 and IPv6 eRouter specification*.
- [ITU-T J.293] Recommendation ITU-T J.293 (2008), *Component definition and interface specification for the next generation set-top box*.
- [ITU-T J.700] Recommendation ITU-T J.700 (2009), *IPTV service requirements and framework for secondary distribution*.
- [ITU-T J.701] Recommendation ITU-T J.701 (2008), *Broadcast-centric IPTV terminal middleware*.
- [ITU-T J.702] Recommendation ITU-T J.702 (2008), *Enablement of current terminal devices for the support of IPTV services*.
- [ITU-T X.1191] Recommendation ITU-T X.1191 (2009), *Functional requirements and architecture for IPTV security aspects*.
- [ITU-T Y.1901] Recommendation ITU-T Y.1901 (2009), *Requirements for the support of IPTV services*.
- [ITU-T Y.1910] Recommendation ITU-T Y.1910 (2008), *IPTV functional architecture*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 cable modem [b-ITU-T J.112]: A modulator-demodulator at subscriber locations intended for use in conveying data communications on a cable television system.

3.1.2 cable modem termination system [b-ITU-T J.112]: Located at the cable television system headend or distribution hub, which provides complementary functionality to the cable modems to enable data connectivity to a wide-area network.

3.1.3 closed captioning [b-ITU-T J.193]: Text scrolling on a television display that represents the audio portion of the program, typically provided for the hearing impaired.

3.1.4 conditional access [b-ITU-T J.193]: The conditional granting of access to cable services and content based upon what service suite has been purchased by the customer.

3.1.5 IP-based services [b-ITU-T J.193]: A generic term that includes QoS-controllable both-way and one-way IP-type services rendered over a CATV network on which a high-speed packet-based IP communication system is available. Examples include IP telephony or VoIP, videoconferencing, streaming video feeds, competitive games, and other similar services.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

3.2.1 access network interface: The logical interface between the wide area network (WAN) (i.e., access network) and the residential gateway (RG).

3.2.2 digital rights management: The definition, management, and enforcement of a set of content usage rules. These usage rules will indicate things such as the right to copy, view, or distribute a particular piece of content.

3.2.3 domain: The extent of home-network-compliant direct influence.

3.2.4 emergency alert system (EAS): A system, within which the H-STB participates, that allows a service provider to distribute public emergency alarms and information about the public emergency to all of the customers attached to the cable network.

3.2.5 home network interface: The logical interface between the RG and the local area network (LAN) (i.e., home network).

3.2.6 hybrid set-top-box (H-STB): A compilation of hardware and software functional entities contained within one or more physical devices, that, at a baseline level, provides the receiving functions for cable broadcast services. In addition, the hybrid set-top-box should support the interactive functions of IP-based services, additional time critical services between the access and the home network as well as extension and supplemental services.

3.2.7 local application service delivery platform (LASDP): An application and service execution environment that resides within the home network for the purpose of delivering advanced applications and services developed by either a service provider or by a third party to the cable service subscribers.

3.2.8 MediaHomeNet: A network that connects multiple elements in a home environment to allow delivery of multi-purpose, multimedia services.

3.2.9 middleware: Software within the H-STB which provides a set of APIs that against which applications can be developed, and that provide access to the resources and services of the H-STB.

3.2.10 residential gateway: A grouping of logical elements used to achieve access for home network(s).

3.2.11 services: The set of services that are required and to be supported by the RG.

3.2.12 service provider interface (SPI): A service provider interface residing in the network side for the purpose of delivering advanced applications and services to the user. Applications and services can be developed either by the service provider or by a third party developer.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AOD	Approved Output Domain
API	Application Program Interface
ASD	Authorized Service Domain
BED	Best Effort Domain
CA	Conditional Access
CAS	Conditional Access System
CM	Cable Modem
CMTS	Cable Modem Termination System
CPE	Customer Premises Equipment
DLNA	Digital Living Network Alliance
DOCSIS	Data over Cable System Interface Specification
DPI	Digital Program Insertion
DRM	Digital Rights Management
DSG	DOCSIS Set Top Gateway
DTCP	Digital Transmission Content Protection
EAS	Emergency Alert System
ECG	Electronic Content Guide
EPG	Electronic Program Guide
ESG	Electronic Service Guide
FW	FireWall
GEM	Globally Executable Multimedia home Platform
GSD	Guaranteed Service Domain
HFC	Hybrid-Fibre/Coax
HN	Home Network
HPNA	Home Phoneline Networking Alliance
HSP	Home Security Portal
H-STB	Hybrid Set-Top-Box
HTML	HyperText Mark-up Language
IGMP	Internet Group Management Protocol

IP	Internet Protocol
IPDV	IP Packet Delay Variation
IPER	IP Packet Error Ratio
IPG	Interactive Program Guide
IPLR	IP Packet Loss Ratio
IPTD	IP Packet Transfer Delay
LAN	Local Area Network
LASDP	Local Application Service Delivery Platform
MLD	Multicast Listener Discovery
MOCA	Multimedia Over Coax Alliance
MPEG	Moving Picture Experts Group
MW	Middleware
NAPT	Network Address Port Translation
NAT	Network Address Translation
OCAP	Open Cable Application Platform
ONU	Optical Network Unit
OSGi	Open Services Gateway Initiative
OSS	Operation Support System
PLC	Power Line Communication
QoS	Quality of Service
RF	Radio Frequency
RFC	Request For Comments
RFoG	RF over Glass
RG	Residential Gateway
RTP	Real-time Transport Protocol
RTSP	Real-time Streaming Protocol
SPI	Service Provider Interface
STB	Set-Top-Box
SVG	Scalable Vector Graphics
TS	Transport Stream
UI	User Interface
UPnP	Universal Plug and Play
V-ONU	Video distribution Optical Network Unit
VM	Virtual Machine
VOD	Video On Demand
VoIP	Voice over IP
WAN	Wide Area Network

5 Conventions

In this Recommendation:

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

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

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

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

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

6 General

The rapid development of IP technologies enables the RG, with an integrated DOCSIS CM, to provide gateway functions for IP-based services, provide connectivity with the managed IP network, diverse VoIP, real-time services for IP broadcast, VOD and competitive games over IP transport. While DOCSIS CM offers a variety of IP-based services, DOCSIS 3.0 system has a capability of very high-speed data transmission by its bonding facility which enables high quality video transmission over RF without IP technology.

With regard to the transportation of TS over IP networks as a kind of IP-based services, [b-IETF RFC 2250] describes IP encapsulation of MPEG Transport Streams for transport of video and audio streams using the real-time transport protocol (RTP). The document recommends that consideration be given for encapsulations of the MPEG TS and Program Stream (PS) with RTP supporting full semantics of an MPEG system. The RG has to transfer these TS and PS to terminal devices without any signal impairment.

As a physical layer transport, this document assumes the primary usage of coaxial cable networks composed of CM and CMTS which enable efficient transmission of the RF signal and IP packets. However, this transport can also be replaced with FTTH networks owned by cable operators, as a bearer of IP datagrams and RF signals.

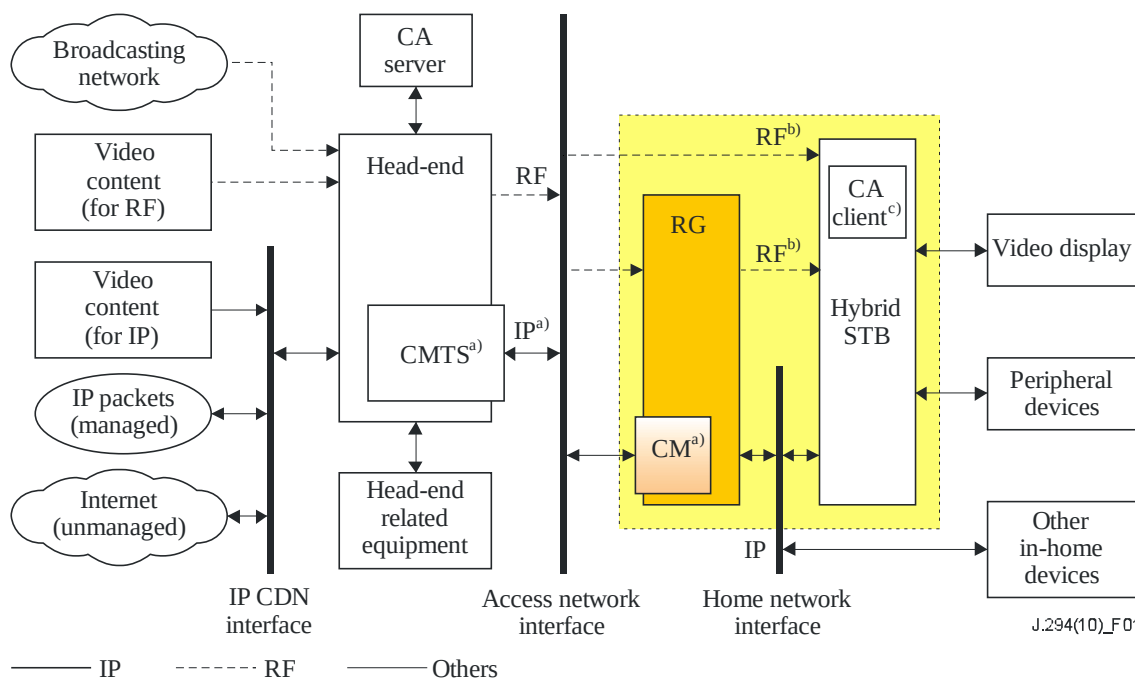
Full support for IP multicasting allows a host to create, join and leave host groups, as well as send IP datagrams to host groups. It requires implementation of the Internet Group Management Protocol (IGMP) and extension of the IP and local network service interfaces within the host. When initiating an application and joining a multicast group, the IGMP sends an IGMP membership report message to routers in the subnet to notify them of those joining the multicast group. A router in RG sends an IGMP query message to confirm the presence of H-STBs in the multicast group. Each H-STB returns the IGMP membership report to this query message. By doing this, the router function which resides in the RG detects which STB is present on the interface and sends the multicast packet to the required interface only. Multicast listener discovery (MLD) protocol works in the same way for IPv6 network environment. The RG is required to support the IGMPv2 (IPv4) or MLDv2 (IPv6) protocol.

Furthermore, the H-STB needs to provide the functions of transferring/processing or modifying the content through the use of APIs. [b-ITU-T J.200] and [ITU-T J.701] are available as the baseline API documents for the H-STB. In the similar way, some application platforms are required for providing different services which cable operators will create. Such platforms can be realized using the bundle applications on the application platform.

It is recommended to implement a Java-based application management platform, e.g., open services gateway initiative (OSGi) framework, in the RG to facilitate management of application programs such as network control, CPE device control over UPnP transaction, log services, permission administration functions and customer services as shown in Appendix I. These softwares are so called "bundle software", which can be easily installed to and removed from the RG by operators' intentions. Each bundled software is able to work independently over the OSGi framework by communicating with OSGi servers located in the IP network.

The RG is also required to connect the access network and the home network seamlessly. The home network spans a number of networking technologies (Layer-1/2 – PHY/MAC and upper layers), delivery protocols, application devices, and services from the access and broadcast networks. The RG addresses the bridging and controlling of the home network environment by focusing on IP elements with defined interfaces and proprietary elements that can communicate using proprietary protocols. The main functions required for RG are management and provisioning of home network, addressing, packet handling, quality of service (QoS), security, content protection and delivery of services over the home network.

The cable access network is required to deliver both of RF-based broadcasting services and IP-based interactive services with appropriate quality and permissible latency. The focus of this Recommendation is to clarify the requirements for a residential gateway (RG) that provides functions to receive broadcast and IP-based interactive services over cable television networks. Figure 1 depicts the location of RG within CATV network configuration.



- a) "IP" should be interpreted as "IP over DOCSIS or other cable access technology on HFC or RFoG". However, other types of IP networks such as G-PON, GE-PON or other optical transport network should be also allowed. In this case, CMTS and CM will be replaced by OLT and ONU respectively, and "IP" should be interpreted as "IP over PON".
- b) Hybrid STB can select either of the two RF signal paths.
- c) CA client for RF service is mainly located in hybrid STB.

Figure 1 – Location of RG within CATV network configuration