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Broadband, triple-play and advanced multimedia
services – Advanced multimedia services and applications

Architecture and functional requirements for home networks supporting IPTV services

Recommendation ITU-T H.622.1

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Recommendation ITU-T H.622.1

Architecture and functional requirements for home networks supporting IPTV services

Summary

Recommendation ITU-T H.622.1 describes an architecture for home networks supporting IPTV services and its functional requirements.

In this Recommendation, home networks and IPTV-related entities are defined, and interfaces between these entities are identified. Functions needed for the home network to support IPTV services are described. Requirements for these functions are also described in this Recommendation.

Source

Recommendation ITU-T H.622.1 was approved on 14 October 2008 by ITU-T Study Group 16 (2005-2008) under the Recommendation ITU-T A.8 procedure.

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Delivery network gateway, home network, interoperability, IPTV services, IPTV terminal device, QoS, remote management, residential gateway, security.

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Recommendation ITU-T H.622.1

Architecture and functional requirements for home networks supporting IPTV services

1 Scope

This Recommendation describes the relationship between the home network (HN) and IPTV-related entities. It also identifies rules and requirements for functions needed on the home network to support IPTV services. It further sets criteria to verify compliance of home network devices, e.g., IPTV terminal devices, to the identified rules and requirements.

The architecture and requirements described in this Recommendation are based on current delivery network technology and thus advanced IPTV services and features that are possible with emerging NGN (next generation network) architecture, e.g., multicast control, are not covered. Advanced IPTV features and services in NGN-based home networks are for further study.

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

This Recommendation uses the following terms defined elsewhere:

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

NOTE – Many terms such as home access (HA) [ITU-T J.190], home gateway, residential gateway, delivery network gateway and so on are used for the same device.

3.1.2 home network (HN) [ITU-T H.622]: A home network is the collection of elements that process, manage, transport and store information, thus enabling the connection and integration of multiple computing, control, monitoring, communication and entertainment devices in the home.

3.2 Terms defined in this Recommendation

This Recommendation defines the following terms:

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

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

3.2.2 home network (HN) capable IPTV TD: An IPTV TD which has HN capability. This is typically a server and/or a client to HN devices.

3.2.3 HN capable TD: A TD which has HN capability. This is typically a server and/or a client to HN devices.

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

3.2.5 IPTV terminal function (ITF): The end-user function(s) associated with a) receiving and responding to network control channel messages regarding session set-up, maintenance and tear-down, and b) receiving the content of an IP transport from the network and rendering.

3.2.6 terminal device (TD): A device which typically presents and/or processes content, such as a personal computer, a computer peripheral, a network appliance, a mobile device, a television set, a monitor, a voice over IP terminal or an audiovisual media player.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

ACL	Access Control List
ALG	Application Layer Gateway
ALL	Application Layer Logic
AN	Access Network
BC-NW	Broadcast Network
DA	Destination Address
DHCP	Dynamic Host Configuration Protocol
DLNA	Digital Living Network Alliance
DMP	Digital Media Player
DMS	Digital Media Server

DMZ	Demilitarized Zone
DNG	Delivery Network Gateway
DNGF	Delivery Network Gateway Function
DNS	Domain Name System
DoS	Denial of Service
DSCP	Differentiated Services Code Point
DSL	Digital Subscriber Line
DTCP	Digital Transmission Content Protection
ECG	Electronic Content Guide
EPG	Electronic Programme Guide
FEC	Forward Error Correction
GUI	Graphical User Interface
HA	Home Access
HN	Home Network
IGMP	Internet Group Management Protocol
IP	Internet Protocol
IPI	Internet Protocol Interface
IPTV	Internet Protocol Television
L2	Layer 2
LAN	Local Area Network
MAC	Media Access Control
MDI	Medium Dependent Interface
MDI-X	Medium Dependent Interface Crossover
MLD	Multicast Listener Discovery
NAT	Network Address Translation
NT	Network Terminal
NW	Network
OAM	Operations, Administration and Maintenance
OLT	Optical Line Terminal
ONT	Optical Network Termination
OUI	Organizationally Unique Identifier
PLT	Power Line Transmission
PON	Passive Optical Network
PPP	Point-to-Point Protocol
PPPoE	Point-to-Point Protocol over Ethernet
PVC	Permanent Virtual Circuit
PVR	Personal Video Recorder

QoS	Quality of Service
RG	Residential Gateway
RTSP	Real-Time Streaming Protocol
SA	Source Address
SCP	Service and Content Protection
SSID	Service Set Identifier
SSM	Source-Specific Multicast
STUN	Simple Traversal of User Datagram Protocol (UDP) through network address translation (NAT)
TCP	Transmission Control Protocol
TD	Terminal Device
UDP	User Datagram Protocol
USB	Universal Serial Bus
VC	Virtual Channel
VCI	Virtual Channel Identifier
VLAN	Virtual Local Area Network
VPI	Virtual Path Identifier
VoD	Video on Demand
VoIP	Voice over IP
WAN	Wide Area Network
WEP	Wired Equivalent Privacy
WPA	Wi-Fi Protected Access
WRR	Weighted Round Robin
XML	eXtensible Markup Language

5 Conventions

In this Recommendation, the following conventions apply.

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

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

Furthermore, [HGI_Rn] means the n-th requirement as identified in [HGI]. For example, [HGI_R100] means the R100 requirement identified in [HGI].

The items tagged by [HGI_Rn] have been included in this Recommendations with the kind permission of the Home Gateway Initiative. Readers interested in the most current publication of Home Gateway Initiative should consult the website of that body here:

<http://www.homegateway.org/publis/index.html>.

6 Home network architecture

The home network has become a preferred environment for many users to receive multimedia services in the home. Thus, IPTV services are likely to be delivered using home networking technology. In order to provide IPTV users with good user experience and to bring down the costs, IPTV devices need to interact seamlessly with the home network and with each other on the home network. For that purpose, a standardized home network architecture supporting IPTV services is essential.

Figure 6-1 below depicts the home network architecture defined in this Recommendation.

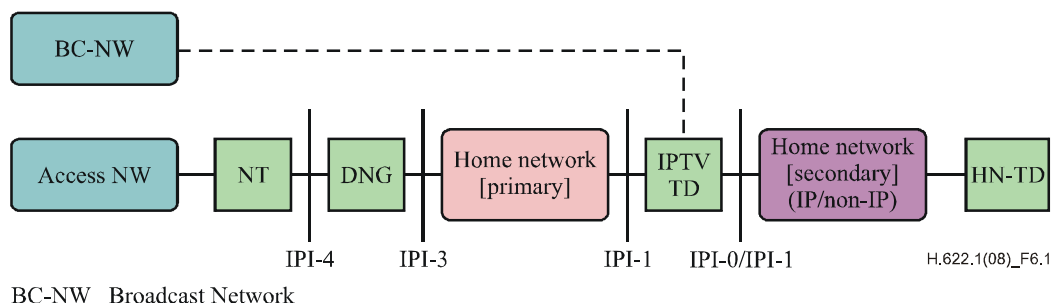


Figure 6-1 – Home network architecture

The components of the home network architecture are described as follows.

Primary domain (IP-HN-P)

The primary domain deals with IPTV-related IP traffic between the access network and the IPTV terminal device (IPTV TD) including audio and video streams. Traffic in the primary domain is associated with traffic to and from the access network. The devices and traffic related to the primary domain are required to be configured to be reachable to and from the access network, directly or indirectly (e.g., via NAT). Since this domain is expected to work as an extension of the access network, technical coordination such as QoS mapping with the access network is required.

Secondary domain

The secondary domain deals with IPTV-related traffic between the IPTV TD and the home network terminal device (HN-TD). The devices and traffic belonging to the secondary domain do not need to be configured to be reachable to and from the access network. For example, there may be cases where locally assigned IP addresses are enough for this domain. The secondary domain can be divided into two parts, IP and non-IP, depending on the network layer protocol used.

IP secondary domain (IP-HN-S)

The IP secondary domain is a part of the secondary domain based on IP.

Non-IP secondary domain (PR-HN-S)

The non-IP secondary domain is a part of the secondary domain based on non-IP protocols, such as [b-IEEE 1394].

Network termination (NT)

The network termination resides between network provider's access network and home network. The NT is the termination point of the access network. For example, in the cable broadband service environment, a cable modem is the NT. Likewise, a digital subscriber line (DSL) modem is the NT in the DSL broadband service environment. Another example for NT is an optical network termination (ONT), which is a termination device of an optical access network.

Delivery network gateway (DNG)

The DNG serves as a gateway between the access network and home network. It provides crucial functions for services on the home network. Functions of the DNG are described in detail later in this Recommendation.

IPTV terminal device (IPTV TD)

An IPTV terminal device is used by end-users to receive IPTV services. An IPTV set-top box is an example of an IPTV terminal device.

Home network terminal device (HN-TD)

Terminal devices that do not directly interact with the service or network provider may be used by the end-user to use IPTV services on the home network. These devices are classified as HN-TD. An example of such terminal devices is a traditional digital TV connected to the home network using the IEEE 1394 interface.

The above architecture contains interfaces between devices and domains. These interfaces are summarized in Table 6-1 below.

Table 6-1 – Interfaces within the home network architecture

Interface		Note
IPI-0		Interface between IPTV TD and HN-TD that has no direct connection with the DNG.
IPI-1		Upstream side interface of IPTV TD or HN-TD. In the HN-TD case, the HN-TD has a direct IP connection with the DNG.
	IPI-1a	IPI-1 interface used for power line
	IPI-1b	IPI-1 interface used for Ethernet (10/100/1000 BASE-T)
	IPI-1c	IPI-1 interface used for home PNA
	IPI-1d	IPI-1 interface used for coaxial
	IPI-1e	IPI-1 interface used for wireless
IPI-3		Downstream side interface of DNG
	IPI-3a	IPI-3 interface used for power line (see clause 10.3.1)
	IPI-3b	IPI-3 interface used for Ethernet (10/100/1000 BASE-T) (see clause 10.3.2)
	IPI-3c	IPI-3 interface used for home PNA (see clause 10.3.3)
	IPI-3d	IPI-3 interface used for coaxial (see clause 10.3.4)
	IPI-3e	IPI-3 interface used for wireless (see clause 10.3.5)

Table 6-1 – Interfaces within the home network architecture

Interface		Note
IPI-4		Upstream side interface of DNG (see clause 10.2)
	IPI-4a	IPI-4 interface used for connection with copper access network (see clause 10.2.1)
	IPI-4b	IPI-4 interface used for connection with NT through Ethernet interface (see clause 10.2.2)
	IPI-4c	IPI-4 interface used for connection with NT through coaxial interface (see clause 10.2.3)
	IPI-4d	IPI-4 interface used for connection with wireless access network (see clause 10.2.4)
	IPI-4e	IPI-4 interface used for connection with optical access network (see clause 10.2.5)
NOTE – The layer 2 technologies listed here, e.g., Ethernet and power line, are those that are currently available. This table may be expanded in the future to include new technologies as they become available.		

7 Quality of service (QoS)

In order to provide a good user experience of IPTV services in the home network environment, the QoS aspect of the home network needs to be considered, and necessary QoS mechanisms to ensure good user experiences need to be provided. This clause discusses QoS aspect of the home network in the context of IPTV services.

There are two main QoS techniques that are being used in an IP network: priority (or class) based QoS and parameterized QoS. With the priority QoS technique, intermediate routing entities between the source and the destination of an IPTV data stream determine how to handle an IP packet from the IPTV data stream according to the priority field in the header of that IP packet. The priority field has been set to a certain value (this is called QoS marking or classification) by the source. With this technique, higher priority IP packets will get better treatment during transit to reach the destination, thus their stream can achieve better QoS than others that have a lower priority.

In the parameterized QoS technique, the QoS requirements of an IPTV data stream (e.g., bandwidth, delay and jitter) are specified and requested to the network before the first IP packet is sent. The home network then uses these QoS parameters to set up the environment so that IP packets in the IPTV stream are processed in such a way to ensure that QoS requirements of the stream are met.

The parameterized QoS technique may provide guaranteed QoS as requested for IPTV services but its technology has not yet been widely agreed upon in the industry. For that reason, the QoS aspects of the home network discussed in this Recommendation concern mainly the priority based QoS technique. The application of the parameterized QoS technique to the home network for IPTV services is for further study.

7.1 Home network QoS architecture

This clause describes a QoS architecture that is based on the home gateway initiative (HGI) and its requirements.

NOTE – The QoS mechanisms in this clause are also described in [HGI] in the context of bidirectional services like VoIP. Refer to [HGI] for more details.