

I n t e r n a t i o n a l T e l e c o m m u n i c a t i o n U n i o n

ITU-T

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

G.9971

(07/2010)

SERIES G: TRANSMISSION SYSTEMS AND MEDIA,
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Access networks – In premises networks

Requirements of transport functions in IP home networks

Recommendation ITU-T G.9971



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Recommendation ITU-T G.9971

Requirements of transport functions in IP home networks

Summary

Recommendation ITU-T G.9971 specifies the functional requirements of transport functions in an IP home network associated with the wired access network based on the generic architecture described by Recommendation ITU-T G.9970: "Generic home network transport architecture". This Recommendation first clarifies the position of the home network in end-to-end transport networks as well as the home network functional architecture, and then provides the functional requirements for the transport capabilities of some key components in the home network, such as the access gateway (AGW), IP terminal, etc. Moreover, it mentions some other functional requirements, such as QoS control, management and security so that the operators can reliably provide their services all the way to the IP terminal.

History

Edition	Recommendation	Approval	Study Group
1.0	ITU-T G.9971	2010-07-29	15

Keywords

Access gateway, control, Ethernet, home network, IP, management, NT, ONT, ONU, security.

FOREWORD

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Recommendation ITU-T G.9971

Requirements of transport functions in IP home networks

1 Scope

This Recommendation specifies the functional requirements of transport functions in an IP home network associated with the wireline access network based on the generic architecture described by [ITU-T G.9970]: "Generic home network transport architecture". As popularity of broadband services such as FTTH, VDSL and DOCSIS 3.0 increases, this Recommendation covers the cases of home networks connecting to wireline access networks such as these. Services on this home network are triple play services, such as voice, video and data transfer services. However, incorporation of fixed mobile convergence (FMC) using in-home base station is for further study. Once a home network is connected to an access network, mechanisms need to exist that allow the network operator to manage fault, performance, transfer capability, addressing and security for the home network. In many cases, these will be the same as those used to manage the access network. Note that although the NT/ONT, which terminates an access network, is also studied in this Recommendation from the view point of the home network management, it is out of scope that devices are directly connected to NT/ONT without an AGW. Moreover, the scope only includes the case where Ethernet MAC service (which may be over a variety of physical layers) is provided at the WAN side of NT/ONT.

While [ITU-T G.9960], [ITU-T G.9961] and [ITU-T G.9972] specify the physical layer, such as transceiver, and the mapping between the physical layer and Layer 2 protocols, this Recommendation studies the subject of IP and Ethernet bridging technologies, which does not overlap with the scope of these Recommendations.

This Recommendation first clarifies the position of the home network in end-to-end transport networks as well as the home network functional architecture, and then provides the functional requirements for the transport capabilities of some key components in the home network, such as the access gateway (AGW), IP terminal, etc. Moreover, it mentions some other functional requirements, such as QoS control, management and security so that the operators can reliably provide their services all the way to the IP terminal.

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 G.9960] Recommendation ITU-T G.9960 (2009), *Unified high-speed wire-line based home networking transceivers – Foundation*.
- [ITU-T G.9961] Recommendation ITU-T G.9961 (2010), *Data link layer (DLL) for unified high-speed wire-line based home networking transceivers*.
- [ITU-T G.9970] Recommendation ITU-T G.9970 (2009), *Generic home network transport architecture*.
- [ITU-T G.9972] Recommendation ITU-T G.9972 (2010), *Coexistence mechanism for wireline home networking transceivers*.

[ITU-T H.622]	Recommendation ITU-T H.622 (2008), <i>A generic home network architecture with support for multimedia services.</i>
[ITU-T I.371]	Recommendation ITU-T I.371 (2004), <i>Traffic control and congestion control in B-ISDN.</i>
[ITU-T Y.1541]	Recommendation ITU-T Y.1541 (2006), <i>Network performance objectives for IP-based services.</i>
[ITU-T Y.1563]	Recommendation ITU-T Y.1563 (2009), <i>Ethernet frame transfer and availability performance.</i>
[ITU-T Y.2001]	Recommendation ITU-T Y.2001 (2004), <i>General overview of NGN.</i>
[BBF TR-069]	Broadband Forum TR-069 (2007), <i>CPE WAN Management Protocol v1.1, including its Amendment 2.</i>
[MEF 10.2]	Technical Specification MEF 10.2 (2009), <i>Ethernet Service Attributes Phase 2.0.</i>

3 Definitions

This Recommendation defines the following terms:

3.1 access gateway (AGW): The AGW associates the access network with the IP home network and handles IP-related protocol packets for these networks. The AGW provides IP and/or Ethernet services to the home network side. Its definition in this Recommendation is equal to the Internet gateway device (IGD)/residential gateway (RG) in the Broadband Forum or the home gateway in the HGI. Note that it is different from the terminologies used in [b-ITU-T Y.2091]: its "access gateway" means edge router, while its "residential gateway" means terminal adaptor.

3.2 network termination/optical network termination (NT/ONT): The NT/ONT terminates the optical access network and then generally provides the Layer 2 services to the home network side.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AGW	Access Gateway
FMC	Fixed Mobile Convergence
FTTH	Fibre to The Home
ICMP	Internet Control Message Protocol
IP	Internet Protocol
IPCP	Internet Protocol Control Protocol
IPV6CP	IPv6 Control Protocol
LA	Local Agent
LLDP	Link Layer Discovery Protocol
LM	Local Manager
L2F	Layer 2 Forwarding
L3F	Layer 3 Forwarding
L1T	Layer 1 Termination

L2T	Layer 2 Termination
L2TP	Layer 2 Tunneling Protocol
L3T	Layer 3 Termination
MAC	Media Access Control
NAPT	Network Address and Port Translation
NAT	Network Address Translation
NAT-PT	NAT-Protocol Translation
NGN	Next Generation Networks
NSP	Network Service Provider
NT	Network Termination
ONT	Optical Network Termination
PD	Prefix Delegation
PPP	Point-to-Point Protocol
QoS	Quality of Service
RA	Remote Agent
RM	Remote Manager
RMS	Remote Management Server
RSVP	Resource Reservation Protocol
SIP	Session Initiation Protocol
SLAAC	StateLess Address AutoConfiguration

5 Conventions

local area network (LAN): It represents the home network side of AGW.

wide area network (WAN): It represents the access network side of AGW.

6 Position of home network in end-to-end networks

This clause describes a managed home network within the context of end-to-end transport networks as shown in Figure 6-1. The end-to-end network consists of the home network, the AGW, access networks, the core network and some application servers.

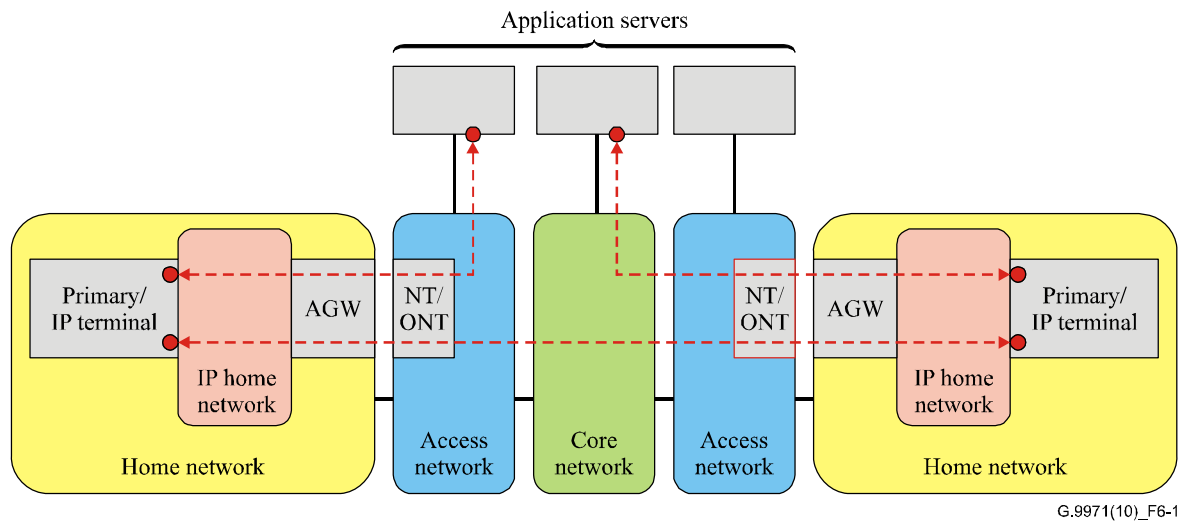
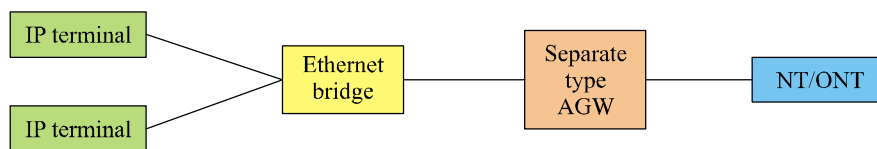


Figure 6-1 – Home network to be managed in end-to-end networks

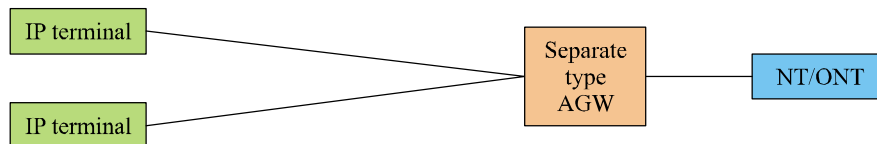
The primary terminal is the end-point where the service from the NSP is terminated, according to [ITU-T H.622]. That is, the end-to-end services are provided between two primary terminals or between each application server and each primary terminal. The AGW connects the IP home network with the access network, which is terminated by NT/ONT. Moreover, the primary terminal defined in the application layer normally attaches to the IP home network, in which case the primary terminal is called IP terminal in transport layer, according to [ITU-T G.9970]. Therefore, the IP terminal, the IP home network, the AGW, the access networks including NT/ONT, the core network and their relevant control networks could be managed by the NSPs. In order to achieve this, this Recommendation specifies the functions needed in each device within the IP home network, such as the IP terminal, the Ethernet bridge, the AGW as well as NT/ONT. The requirements in this Recommendation are more detailed than [ITU-T G.9970]. Note that the case is out of scope where the IP terminal is directly connected to NT/ONT without AGW. Moreover, only the case where Ethernet MAC is used at the WAN side of NT/ONT is included in this Recommendation.

7 Typical IP home network configurations

This clause describes configurations of the IP home network to be studied in this Recommendation. Figure 7-1 shows two kinds of IP home network configuration. Configuration 1 shows that one Ethernet bridge either aggregates the traffic from multiple IP terminals to the AGW or bridges the traffic between two IP terminals. Note that multiple Ethernet bridges can be put in cascade between the IP terminal and the AGW. On the other hand, configuration 2 shows that each IP terminal is directly connected to the AGW. Although this figure shows the separate type AGW, this Recommendation also studies the aggregate type AGW that combines NT/ONT.



Configuration 1: Each IP terminal is connected to AGW via Ethernet bridge.



Configuration 2: Each IP terminal is directly connected to AGW.

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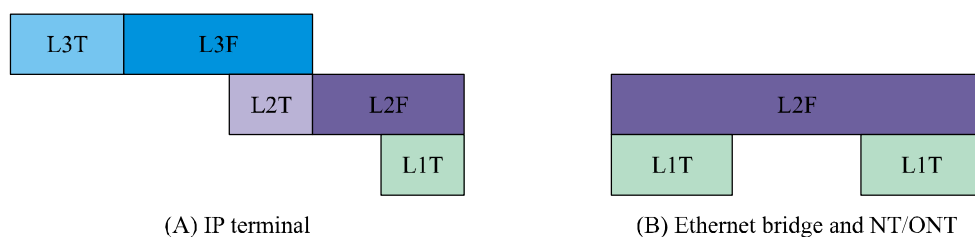
Figure 7-1 – Typical IP home network configurations

8 IP home network functional architecture

Key devices can be defined by using the following functional components:

- Layer 1 termination (L1T): Termination functions of physical layer, such as Ethernet PHY.
- Layer 2 termination (L2T): Termination functions of Ethernet port, such as MAC address assignment.
- Layer 2 forwarding (L2F): Ethernet bridging functions using MAC forwarding table as well as L2 QoS processing, such as L2/L2 QoS mapping, which will be discussed in clause 10. Note that L2F of Ethernet bridge also contains L2/L2 mapping function between Ethernet and wireless within LAN, for example.
- Layer 3 termination (L3T): Termination functions of IP port, such as IP address assignment.
- Layer 3 forwarding (L3F): IP routing functions using IP routing table as well as L3 QoS processing, such as L3/L3 and L3/L2 QoS mappings, which will be discussed in clause 10.

By using these functional components, IP terminal can be composed of L1T, L2F, L2T, L3F and L3T, as shown in Figure 8-1 (A). On the other hand, Ethernet bridge and NT/ONT can be composed of L1T and L2F, as shown in Figure 8-1 (B).



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Figure 8-1 – Functional components of IP terminal, Ethernet bridge and NT/ONT

It is complicated to show transport layer functions of AGW in one figure, because there are various kinds of AGW. As shown in Figure 8-2, there are three fundamental types of separate type AGW, which does not combine NT/ONT.

- a) NAT/NAPT type: Source or destination IP address of an IP packet is changed after being forwarded in AGW in accordance with NAT/NAPT. Note that a MAC address in Layer 2 is terminated in each port.