HGI-RD007-R2

Requirement for the HG interworking with an external NT

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2 Acronyms

3G	Third Generation Mobile Telecommunication (UMTS)
ACS	Auto-Configuration Server
ADSL	Asymmetric Digital Subscriber Line
AN	Access Network
ANP	Access Network Provider
ATF	Architecture Task Force of HGI
ATM	Asynchronous Transfer Mode
BG	Business Group of HGI
BSP	Broadband Service Provider
CAC	Call Admission Control/Connection Admission Control
CoS	Class of Service
CPE	Customer Premises Equipment
CRC	Cyclic Redundancy Check
DBA	Dynamic Bandwidth Allocation
DHCP	Dynamic Host Configuration Protocol
DSCP	Differentiated Services Code Point
DSL	Digital Subscriber Line
DSLAM	Digital Subscriber Line Access Multiplexer
ED	End Device
E-LMI	Ethernet Local Management Interface
EPON	Ethernet Passive Optical Network
ETH	Ethernet
FTTB	Fibre To The Building/Business
FTTCab	Fibre To The Cabinet
FTTH	Fibre to the Home
GBE	Gigabit Ethernet
GEM	GPON Encapsulation Method
GPON	Gigabit Passive Optical Network
HG	Home Gateway
HGI	Home Gateway Initiative
HGW	Home Gateway and Home Network Architecture Working Group of HGI
HN	Home Network
HNA	Home Network Architecture Group of HGI
IEEE	Institute of Electrical and Electronics Engineers
ILMI	Interim Local Management Interface
IP	Internet Protocol

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IPv4	Internet Protocol version 4
IPv6	Internet Protocol version 6
ISP	Internet Service Provider
ITU-T	International Telecommunication Union – Telecommunication standardisation sector
LAN	Local Area Network
MAC	Media Access Control
MDU	Multiple Dwelling Unit
NGN	Next Generation Network
NT	Network Termination
OAM	Operations, Administration & Maintenance
OLT	Optical Line Termination
ONT	Optical Network Terminal
PM	Performance Monitoring
PON	Passive Optical Network
PPP	Point-to-Point Protocol
PPPoA	PPP over ATM
PPPoE	PPP over Ethernet
PtP	Point to Point
PtmP	Point to MultiPoint
PVC	Permanent Virtual Connection
QoS	Quality of Service
RMS	Remote management System
RODM	Remote Operations and Device Management Group of HGI
SLA	Service Level Agreement
SNMP	Simple Network Management Protocol
SP	Service Provider
T-CONT	Traffic Container
UPnP	Universal Plug&Play
VCI	Virtual Channel Identifier
VDSL	Very high speed Digital Subscriber Line
VLAN	Virtual Local Area Network
WAN	Wide Area Network

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3 Introduction

This document HGI-RD007-R2 is part of HGI's Release 2 specification family. It is the production of the Home Gateway Group (HGW), Quality of Services Group (QoS) and Remote and Device Management Group (RODM) of the Home Gateway Initiative (HGI). It is the result of collaborative effort of HGI members that include Broadband Service Providers (BSPs), gateway manufacturers, and silicon vendors.

3.1 About HGI

The Home Gateway Initiative (HGI), formed in 2004, is an industry forum of Service Providers and Home Gateway, chip, software and other vendors, driving the architecture for the Home Network. HGI sets the technical requirements for Home Gateways and Home Networks that meet the service and business needs of Service Providers. The intention is to increase the cost effectiveness of Home Gateways and Home Networks by taking a global approach, involving the worldwide vendor and Service Provider community, referring to existing standards wherever possible, and working alongside other standard development organizations wherever gaps and inconsistencies in or between existing standards are identified. More about HGI can be found at www.homegateway.org.

3.2 Scope and purpose of this document

This document includes the following topics.

- It gives an overview of a scenario including the adoption of a Network Termination (NT) as separated from the rest of the typical HG functionalities. The NT is a managed or unmanaged entity that terminates the L1 and L2 connectivities towards the WAN.
- It defines the basic architecture and NT functionalities.
- It gives specific requirements for the HG to correctly interoperate with an external NT.
- Limited to those impacting the HG, it defines recommendation for the NT (specifically, on its LAN side interface facing the HG) and for the RMS.

The scope of the document does not include the specification of detailed requirements for the NT device. NT requirements can be found for example in ETSI TS 102 973 v1.1.1 [6].

3.3 Structure of the document

The HGI process started from the analysis of use cases and business requirements (Section 4) together with a set of high level requirements produced by the Architectural Task Force (Section 4.1.1). The individual Working Groups then produced detailed sets of formal functional requirements for the HG and recommendations for the NT and RMS which are amalgamated in Section 6, 7 and 8. The contents of Section 5 are informative only and describe the problems related to the connectivity, the QoS and the management of both equipments.

3.4 Definitions of terms

The definitions of MUST and SHOULD in this document are therefore as follows:

MUST A functional requirement which is based on a clear consensus among HGI Service Provider members, and is the base level of required functionality for a given class of HG.

MUST NOT This function is prohibited by the specification.

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SHOULD Functionality which goes beyond the base requirements for a given class of HG, and can be used to provide vendor product differentiation (within that class).

Note: These definitions are specific to the HGI and should not be confused with the same or similar terms used by other bodies.

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4 Introduction of the concept of a separate NT and HG

The access technologies considered in HGI-RD001-R2 (HGI Residential Profile V. 1.0) [1] are DSL (over Ethernet or ATM) and Ethernet. The Ethernet WAN interface was also introduced to let the HG be access agnostic, usable for connecting the HG to an external device, called Network Termination (NT), independent of access technology.

While the current deployment of most of the BSPs and ANPs is ADSL based, there are many of them who are moving to VDSL or fibre access. Fibre Accesses considered are a broad range either Passive Optical Network (EPON, GPON) or Point to Point (PtP). This raises the issue of whether these different technologies should be incorporated into the HG, or be in a dedicated NT.

Both approaches were considered by the HGI BG (Business Group): an NT separated from the HG and an NT integrated within the HG. For the devices the definition are as follow:

- **Home Gateway**: device connecting the HN to the Internet and Service Platforms.
- **Network Termination:** managed or unmanaged entity that terminates the L1 and L2 connectivities towards the WAN. It can be internal of the HG or an external device.

While the case of an NT integrated within the HG was analyzed in HGI-RD001-R2 [1], in the case of a separate NT and HG there are a number of significant details to be decided, e.g. what is the nature of the L1 and L2 connection between the NT and HG, how the NT and HG functions interact, does the NT have any L3 awareness, etc. Use cases prompted by the BG helped to define these points.

4.1 Use cases

As a general rule, one box is cheaper than two, both to supply and operate, as power supply, PCB and housing costs are not duplicated and there is only a single entity to manage. However there are other issues with fibre access which means one box may be less appropriate.

The main reasons for the separation between Home Gateway and NT functionalities in two boxes are the location of the NT, the interoperability status of fibre access systems and regulatory constraints.

- **Installation** - Fibre NT can be positioned either on the outer wall (external) or inside the house or apartment (internal) depending on the locale.

  In the case of an external NT, while this does not actually preclude HG functionality being included in such a device, there are various reasons why it is less than desirable, e.g. difficulty of bringing the LAN network interfaces into the house, wireless interfaces being behind an external wall, visibility of status lights etc.

  In the case of an internal NT, the NT is generally integrated within the HG. However, a two boxes solution may apply in some cases, e.g. when the fibre entry termination is not easily accessible to the customer (and in those cases the same concerns resulting from inaccessibility apply as in the external NT case).

- **Interoperability issues** - PON standards and interoperability definition are not yet stable enough to ensure that OLT and ONTs from different vendors can interwork. At the moment, adding HG functionalities into an NT would increase investment risk and costs, therefore there is a case for keeping the NT not integrated.

- **Regulatory constraints -** It is expected that EU and national regulators will force a separation between ANPs and BSPs businesses to allow open access. One way to do so is by defining a separation point between the functions of the NT (assuring physical and link layer connectivity on the WAN) and the Home Gateway (assuring IP and service connectivity on the WAN). As a further step, this scenario could be extended to a multi-port NT allowing connectivity to multiple BSP through their HGs or devices.

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4.1.1 Separate NT and HG: ATF guidelines

On the basis of the Business Group (BG) use cases, the Architectural Task Force (ATF) produced a set of high level guidelines for a HG interworking with an external NT, worked out by the technical groups to produce requirements on the HG and recommendations on the NT and the RMS. They are reduced to the following.

- The NT is a relatively dumb Layer 2 device. Its definition is out of HGI scope, but some NT recommendation must be given to correctly interoperate with a HG.
- The HG and the NT are interconnected through an Ethernet 100BaseT/GBE port.
- The HG must have a processing capability to support a sustained rate of at least 100 Mbps.
- The NT and the HG are operated by two different entities (ANP and BSP, further details in Cap. 4.2) so, if the NT is a managed device, there is a separate management for the NT and the HG. Some RMS recommendation must be given for the proper HG configuration.

4.2 Service Provider Role models

With the introduction of an NT separated from the HG, a clarification is given about the service provider role identification.

4.2.1 Role model definitions

The HGI model is based on the following roles:

The **Access Network Provider (ANP)** takes responsibility for operating the access network active equipment. The ANP can provide layer 2 “bitstream” connections to BSPs. In case of separate NT and HG, the ANP operates the NT.

The **Broadband Service Provider (BSP)** takes responsibility for operating the IP network, including the HG. The BSP provides IP connectivity to ASPs. The BSP often provides Internet access to end customers as part of his broadband IP connectivity service. In case of separate NT and HG, the BSP operates the HG. It has a relationship with the ANP that allows it to benefit from QoS, multicast, or other advanced network-related features.

The **Managed Application Service Provider (Managed ASP)** takes responsibility for operating an application, and has a relationship with the BSP that allows it to benefit from QoS, multicast, or other advanced network-related features.

The **Unmanaged Application Service Provider (Unmanaged ASP)** takes responsibility for operating an application but does not benefit from QoS, multicast, or other advanced network related features.

4.2.2 Role model assumptions

In case of separate NT and HG, the HGI assumes that there is only one ANP per NT, and, conforming to HGI-RD001-R2 [1], there is only one BSP per HG.

Multiple ASPs (both Managed and Unmanaged) may offer their applications on top of the broadband connectivity provided by the BSP.

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5 Basic scenario definition and basic NT functions

The basic HG, as defined in HGI-RD001-R2 (HGI Residential Profile v.1.0) [1], incorporates an NT with a single WAN port and multiple LAN interfaces.

With the separation of the functionalities in a HG and an NT, they are defined as follow.

- The HG is supplied with a WAN-side 100BASE-T/GBE Ethernet port, to be connected to a NT[1].
    - The HG should have an alternative WAN-side interface (for example ADSL)[2], to be directly connected to another WAN access network, not involving the use of an NT. The Ethernet and the alternative WAN interface are mutually exclusive in operation.
- The NT has an access technology dependent WAN interface and one 100BASE-T/GBE Ethernet port to be connected to the HG (case of a single-port NT).
- The connection between the HG and the NT is a direct link. No intermediate equipments (e.g. Ethernet bridges, hubs) are considered. For connecting more devices to the NT, a multi-port NT, that is an NT with more than one 100BASE-T/GBE Ethernet port, is introduced. While the main interest of HGI, considering the HG concerns, is on a single-port NT, an NT with additional ports could extend the application scenarios, for example allowing connectivity to multiple BSP through their HGs or devices.

Regarding the WAN interface, the NT can be used to offer connectivity for VDSL2, PtP fibre and Point to Multipoint (GPON) technologies. For some future applications also a 3G WAN may be considered.

The NT switching capabilities are restricted to L2 switching (bridging on Ethernet-VLAN sub layer) and L2 filtering.

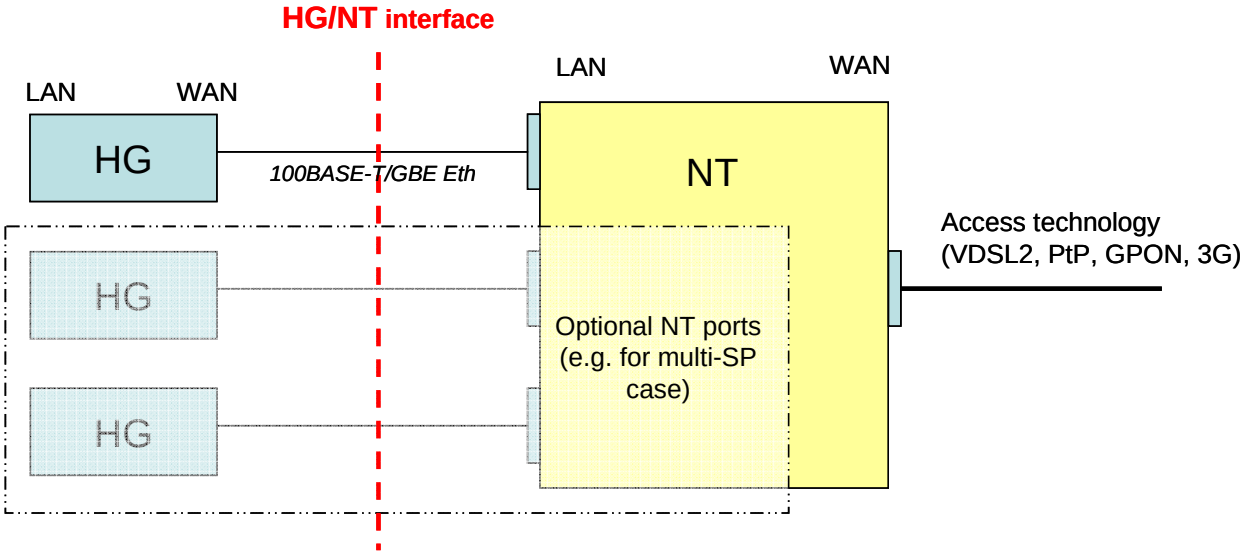

Figure 1. Single-port or multi-port NT scenario

1 As defined in HGI-RD001-R2:R30-R33 (HGI Residential Profile v1.0, R30-R33).

2 As defined in HGI-RD001-R2:R2 (HGI Residential Profilel v1.0, R2).

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5.1 HG interworking with an external NT issues

These sections consider the Architecture, Management and QoS issues which arise from the HG interworking with an external NT scenario, and the HGI approach to handle them. Requirements described in Section 6 and recommendations described in Section 7 and 8 are derived from these considerations.

5.1.1 Architecture and Management issues

There are several Architecture and Management issues to be considered in this scenario:

1. WAN interfaces on the HG.
2. Management and basic connectivity.
3. Traffic isolation in a multi-port NT.

These are described below.

5.1.1.1 WAN interfaces on the HG

The HG is provided with a 100BaseT/GBE WAN Ethernet interface. An alternative WAN interface (e.g. ADSL) could be present on the HG. These interfaces are mutually exclusive in operation (just one of them is active at once). The HG should be able to detect and enable the right one, switching to the appropriate configuration and connectivity model. The purpose is to reuse the HG with different access network, without having to change out the HG (e.g. the HG uses the WAN Ethernet interface to be connected to an external VDSL2 NT, or, alternatively, it uses the integrated WAN ADSL for connecting the ADSL network).

With regard to the type of access technologies considered for the NT (VDSL2, PtP fibre and Point to Multipoint GPON, 3G), and for the HG in HGI-RD001-R2 (HGI Residential Profile V. 1.0) [1] (ADSL, VDSL, Ethernet), it is likely that only one access network is active at once at the customer premises, so no fall-back or back-up functionalities are considered for the WAN interfaces on the HG.

Activation of the interfaces should be automatic, i.e. auto-detection of active WAN interface, without end user actions. The activation process should be identifiable to the user (e.g. status LEDs or icon display on the HG).

WAN switching should be enabled from the ACS. In this case, if WAN connectivity is not established within a timeout (eg. 5 minutes), the HG must fall-back to its auto-detection procedure. The WAN detection sequence should be configurable by the ACS.

5.1.1.2 Management and basic connectivity

The basic assumption is that there is a separate management for the HG and the NT (if it is a managed device). The HG is operated by a BSP and the NT by an ANP. For this reason, it must be always guaranteed the connectivity of both equipments to their provider network or, at least, to their management system.

In some case, the HG and NT need a coordination of configuration (use of the same VLANs, same class of service for QoS, …). The coordination of configuration may be achieved through the use of the separate management systems, or may be automatically detected by the equipments themselves (e.g. via E-LMI for VLANs coordination) or may be statically configured (e.g. VLAN pre-configuration).

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5.1.1.3 Traffic Isolation in a multi-port NT

The ANP must guarantee traffic separation at the BSPs level. In order to do that, in the case of a multi-port NT, the NT must isolate the traffic among the different HGs connected to its 100BASE-T or GBE ports.

5.1.2 Quality of Service

There are several QoS issues to consider in this scenario:

1. Bandwidth mismatches in both upstream and downstream directions.
2. Bandwidth allocation and control and SLA in a multi-HG model.
3. Time-variant QoS configuration.
4. Traffic marking policy between HG and NT.
5. Monitoring and assurance.
6. Overall QoS configuration and management.

These are described below with their impacts on both NT and HG.

5.1.2.1 Bandwidth Mismatch

QoS issues can arise in either direction because of differences between the bandwidths of the Ethernet HG-NT link (100BASE-T or GBE) and the WAN NT interface. Cases are downstream and upstream bandwidth mismatch.

Downstream bandwidth mismatch

In the downstream direction, if the HG-NT interface provides less bandwidth than the access technology interface, a bottleneck may be observed in the NT. The model is shown in Figure 2.

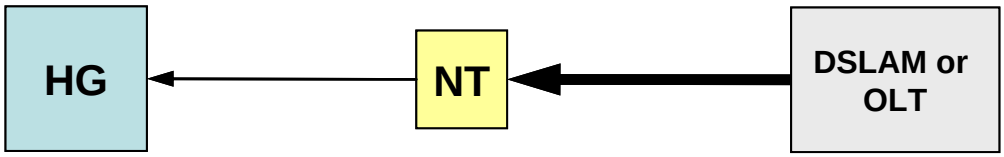

Figure 2. Downstream Bandwidth Mismatch

As an example, considering a GPON WAN link, if the downlink bursts close to GPON line rate, the 100BASE-T/GBE HG-NT interface rate is exceeded.

To solve this, the NT should be able to classify and queue according to traffic priority, schedule into the HG-NT link, and intelligently discard traffic as required.

There are no direct QoS implications on the HG.

Upstream bandwidth mismatch

In the upstream direction, the HG-NT interface may provide more bandwidth than the WAN uplink, and a bottleneck can be observed in the NT. The model is shown in Figure 3.

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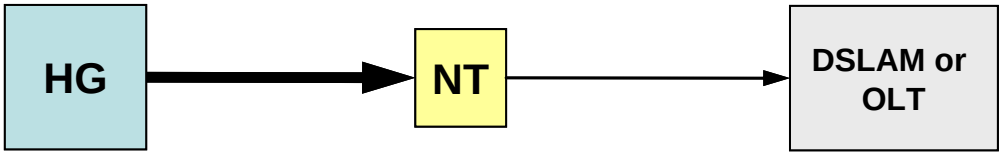

Figure 3. Upstream Bandwidth Mismatch

For example, it can happen when the WAN link is VDSL2, and the HG-NT interface is 100BASE-T. Another example is the case where the WAN link is GPON. Depending upon GPON T-CONTs configuration, the uplink bandwidth can be less than the HG-NT interface bandwidth (GBE or 100BASE-T).

To solve this, the following approaches may be used:

- The NT should be able to classify and queue according to traffic priority, schedule into the WAN link, and intelligently discard traffic as required.
- Flow-control from NT to HG can be used to control the rate of traffic delivered from the HG into the NT, based upon availability of queue space in the NT. A common protocol for the flow-control must be supported on both NT and HG.
- Shaping from the HG can be used to control the rate of traffic from the HG into the NT. This requires a specific configuration of the shaping parameters on the HG.

5.1.2.2 Bandwidth allocation and control and SLA with a multi-port NT

As shown in Figure 1, it is not excluded that multiple HGs or devices, provided by different BSPs, can be connected to a multi-port NT. In this case some SLA issues arise, and the NT is the point of resolution for bandwidth contention.

The ANP that handles the NT may wish to limit upstream and/or downstream bandwidth supplied to the multiple HGs or devices connected, according to the SLAs. To solve this, the NT may require a per-flow or aggregate policing and/or shaping function in both upstream (on the WAN) and downstream (on the Ethernet 100BASE-T or GBE) egress interfaces.

There are no direct QoS implications on the HG.

5.1.2.3 Time –variant QoS Configuration

Note that in a more complex scenario, depending on the access technology (e.g. GPON with DBA, VDSL2 with rate-adaptive profiles), the WAN NT interface available bandwidth can be time-variant. These variances may affect the bandwidth mismatches described in Section 5.1.2.1 and the bandwidth allocation and control and SLA issues described in Section 5.1.2.2, requiring a dynamic QoS response.

To solve this, the NT should be able to dynamically adjust its QoS parameters (defined for example in terms of percentage instead of absolute values), and eventually regulate the flow-control to the HG. On both HG and NT, the implementation of a HG-NT link bandwidth monitoring system can also be useful.

5.1.2.4 Traffic Marking between HG and NT

The HG QoS is based on the service class identification, where the traffic classification scheme permits the HG to identify flows for appropriate bridging and QoS treatment, including queuing, scheduling and remarking.

The NT QoS and switching capabilities, if present, are restricted to L2. Consequently, for the HG-NT QoS interwork, there is the need of maintaining at L2 the differentiation between different service classes

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flows on both equipments (e.g. in the uplink, if the HG marks service classes with L3 parameters, like ToS or DSCP, this information would be lost at the NT level).

The available solution is to use 802.1Q encapsulation with VLAN-ID and P-bit tagged traffic on the HG-NT 100BASE-T/GBE Ethernet link.

HG upstream traffic marking

In the uplink, the marking scheme must tag flows with the tags as required by the access network components, in this case the NT.

The HG must use 802.1Q VLAN tagged frames flows in the upstream direction. The VLAN-ID field must be used to maintain the information related to the BSP, while the 802.1p P-bit should map the different service classes.

There are no QoS concerns on the HG downstream traffic marking.

NT traffic marking

For a coherent handling of the QoS on the NT, the NT should be able to classify flows in the Upstream and Downstream direction on the basis of L2 parameters (i.e. VLAN-ID, 802.D P-bit) and lower parameters (i.e. physical port).

The NT should use 802.1Q VLAN tagged frames for downstream connectivity towards the HG. The VLAN-ID field should be used to maintain the information related to the BSP, while the 802.1p P-bit should map the different service classes.

As the 802.1Q parameters are predetermined and statically configured on both the HG and the NT, since no remote management dynamic synchronization between the two devices is currently taken into account, the NT should map the different class-based flows in the downstream direction with 802.1p P-bit and VLAN conforming to the expectation of the HG. In the uplink, the NT marking scheme must tag flows with the tags as required by the access network components.

5.1.2.5 Monitoring and assurance

With a HG interworking with an external NT, monitoring and assurance (bandwidth available on NT-HG link, traffic statistics per queue, dropped packets, ...) should also be essential for troubleshooting and for understanding where anomalous situations are located, whether in the HG or in the NT.

Examples where assurance could be useful are the cases of an upstream/downstream bottleneck in the NT (5.1.2.1) or for SLA in Upstream/Downstream Multi-HG Model (5.1.2.2). Monitoring could be helpful in time-variant case (Section 5.1.2.3).

These functionalities are already present in the HG, while they must be considered in the NT design.

5.1.2.6 Overall QoS Configuration and management

In case the NT is a manageable device with QoS, the QoS configuration of both NT and HG for obvious reasons has to be coordinated for the correct interworking between both entities. The Management of QoS configuration can be statically performed by the management systems or be detected by the equipments themselves. For the automatic detection, no specific protocol or mechanism is currently specified, so this will not be considered for the current document.

For the HG, QoS configuration is fully specified in HGI-RD001-R2 (HGI Residential Profile V. 1.0) document [1] . On the HG itself all the functionalities and blocks for limiting and prioritizing the bandwidth in upstream and downstream direction that could help (i.e. traffic classification, shaping, queuing) are stated in the HGI QoS section. The new QoS requirements indicated in this document are only related to the service class classification, as described in Section 5.1.2.6.

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For the NT, it is out of the scope of HGI to mandate its QoS requirements. However, as a general approach, all the NT QoS parameters should be remotely configurable, supporting QoS updates that correspond with field situations.

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6 Recommendations for the NT

The NT is basically a simple transparent L2 bridge, but a more complex NT can be obtained by adding more intelligent functionalities. The following recommendations are given.

- The NT **MUST** comply with the following characteristics.
  - It is a transparent L2 bridge, without L3 functionalities.
  - It has one LAN 100BaseT/GBE Ethernet port.
  - Network management is performed at L1 or L2.
- The NT **SHOULD** have L2 switching (bridging on Ethernet-VLAN sub layer) and L2 filtering capabilities.
- The NT **SHOULD** have IP based management. In this case there will be a need for layer 3 IP based NT addressability. IP based NT management is independent from the HG management.
- The NT **SHOULD** have more than one 100BaseT/GBE Ethernet LAN interfaces. A multi-port NT could allow the connectivity of multiple BSPs through their HGs or devices.
- The NT **SHOULD** provide QoS functionalities. These are implemented on the basis of L2 parameters (e.g. VLAN-ID, 802.1p…) or lower layers (e.g. physical port) and not on the basis of L3 or upper layers.

The following figure represents the block diagram for the basic NT. Depending on the NT complexity, other blocks can be added (i.e. enablers like QoS, firewalling, access authentication). For this reason some functionality is inserted in the picture using dotted lines.

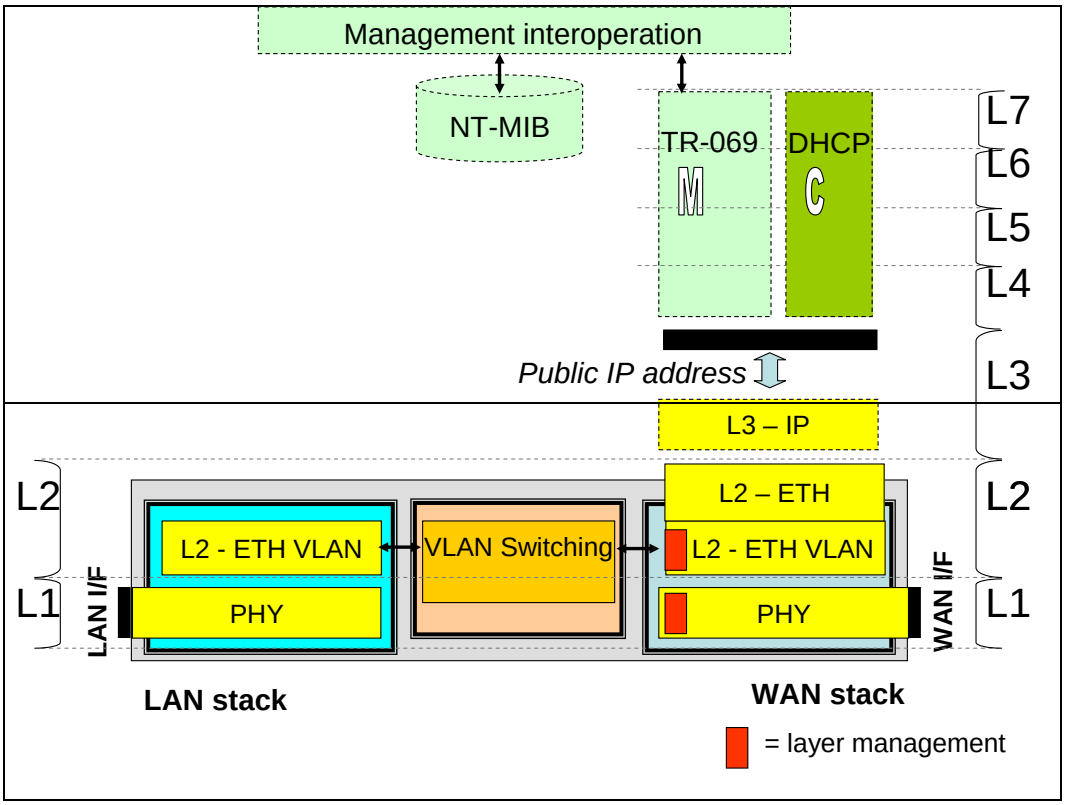

Figure 4. Possible NT block diagram

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7 Requirements for the HG

In the case of an HG interworking with an external NT, all HG WANside traffic is encapsulated in VLAN(s), and this also needs to apply to management traffic. Two approaches are possible: in-band (where User and Management traffic share the same VLAN) and out-of-band (separate VLANs). Both are included in the specification, however out-of-band management is preferred by the HGI for three reasons:

- It provides much greater security for the management traffic; it should not be possible for the User or a hacker to spoof management traffic.
- If applications operated by ASPs are present in the Home Network, the ASP traffic may also include management traffic. The out-of-band approach prevents the BSP and ASP management traffic becoming mixed and possibly confused (e.g. if they use the same protocols).
- It allows an easy way to configure and maintain a priority for the management traffic on the NT.

The VLAN connection model shown in Figure 5 illustrates both the preferred out-of-band approach, and the possible in-band alternative.

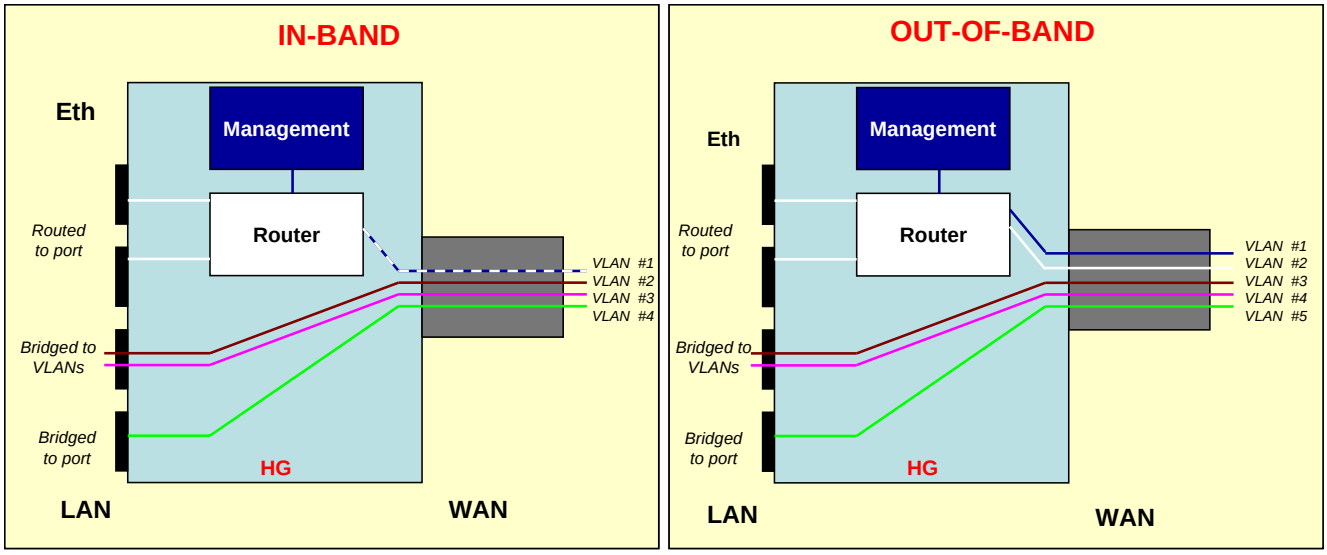

Figure 5. HG Internal connections with in-band and out-of-band management

The following HG requirements, additional to the HGI Residential Profile V.1.0 [1] ones, can be identified:

N°	Requirements
R.1	With reference to HGI-RD001-R2:R31 (HGI Residential Profile V.1.0 [1], R.31)[3], the WAN-side Ethernet interface of the HG **MUST** be able to address the full range of 4094 VLANs.

[3] HGI-RD001-R2:R31 (HGI Residential Profile v1.0, R31): The HG **MUST** support the related Ethernet protocols at layer 2, with VLAN management (support for untagged frames and 802.1Q tagged frames containing priority-tagged information (IEEE 802.1p) and VLAN-ID information).

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N°	Requirements
R.2	The HG **MUST** support at least 8 VLANs simultaneously on the WAN-side.
R.3	The HG **MUST** be able to use a pre-defined VLAN assignment for the WAN VLANs which are to be used between itself and the NT.
R.4	The HG **SHOULD** be able to use the E-LMI [3] protocol to discover the WAN VLANs which are to be used between itself and the NT.
R.5	The HG **MUST** be able to support a DHCP client (RFC 2131 [4]) for each WAN VLAN logical interface, and its options, as specified in HGI-RD001-R2:R96-97 (HGI Residential Profile V.1.0 [1], R.96-97).
R.6	The HG **MUST** support PPPoE over the encapsulated Ethernet (as defined by IETF RFC 2516 [5]) and up to 10 PPPoE sessions per each WAN VLAN logical interface.
R.7	The HG **MUST** be able to discover if PPPoE or DHCP is used for each VLAN terminated by the HG.
R.8	The HG **MUST** be able to be configure each WAN VLAN logical interface either in bridged or static routed or dynamic routed mode.
R.9	The HG **MUST** support the following WAN VLAN mappings: • WAN VLAN to/from physical LAN Ethernet port. • WAN VLAN to/from internal HG internal application (e.g. for management, voice). • WAN VLAN to/from combination of the two parameters: o physical LAN Ethernet port o VLAN (when VLANs are supported on the LAN side).
R.10	When VLANs are configured on the WAN interface, the HG **MUST** always listen to a preconfigured VLAN for an IP connection to an ACS. The HG **MUST** provide all IP functions (preconfigured or via DHCP) on this VLAN in order to support TR-069 ([2]) .
R.11	The HG diagnostics **MUST** include one appropriate test for the WAN-side Ethernet port.
R.12	When alternative mutually exclusive WAN interfaces (e.g. Eth and DSL) are present, the HG **MUST** be capable of being reconfigured to enable/disable the dedicated WAN-side 100BASE-T/GBE port and switch over to/from the DSL port.
R.13	The HG **MUST** use 802.1Q VLAN tagged frames for upstream connectivity towards the NT. The HG **MUST** use the VLAN-ID field to maintain the information related to the BSP.
R.14	The HG **SHOULD** map the different service classes in the upstream direction with the 802.1p P-bit.

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8 RMS recommendations

The following RMS recommendations are given.

- The reconfiguration in requirement in R.12 **MUST** be able to be performed via the ACS.
- If the used connection model does not allow automatic identification and (re)configuration of the HG, the RMS **MUST** issue a warning to the user (e.g. via his PC) that any locally inputted settings (e.g. time of day parental control) will need to be re-entered by the user.

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9 References

[1] HGI-RD001-R2 (Home Gateway Initiative Residential Profile V. 1.0), 14/12/2007

[2] DSL Forum TR-069 Amendment 1 “CPE WAN Management Protocol”

[3] Metro Ethernet Forum - MEF 16 - Ethernet Local Management Interface (E-LMI)

[4] IETF RFC 2131 - Dynamic Host Configuration Protocol

[5] IETF RFC 2516 - A Method for Transmitting PPP Over Ethernet (PPPoE)

[6] ETSI TS 102 973 v1.1.1: Access Terminals, Transmission and Multiplexing (ATTM); Network Termination (NT) in Next Generation Network architectures

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