

Proximus Reference Offer for Bitstream Access

Covering the technology Fiber PON

Annex 2: Technical Specifications

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Our reference: version 6.3 – integrating approved Addendum New UNI rate limiting type on XGS-PON

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1. Scope

The purpose of this document is to describe the technical specifications of the Bitstream Fiber PON service. PON in this document refers to both GPON and XGS-PON, unless otherwise specified.

To allow the Beneficiary to set up a service based on the above-mentioned service from Proximus, this document describes the interfaces.

The Beneficiary willing to offer features which require other technical characteristics than those implemented and supported by Proximus and described in the present offer can implement them but without commitment of Proximus on their correct functioning. Examples of such features are:

- non-tested protocols or protocols not supported by Proximus network equipment,
- burst sizes, delay or jitter requirements beyond the Proximus retail applications.

Proximus cannot guarantee, deliver support & be held liable regarding:

- the correct functioning of such features in its network (at whatever time),
- the future evolution of other (supported or non-supported) features than those implemented and supported by Proximus for its own services.

Any enumeration of supported or non-supported protocols or features listed in this document are not exhaustive and are based on the Proximus best knowledge available at this moment.

Unless otherwise specified, the terms “LEX” or “Local Exchange” in this document refer to both the Proximus buildings called Local EXchange or Central Office and the non-Proximus buildings called Point of Presence (PoP) in the context of the Joint Ventures (or alike). All these buildings are the locations hosting the OLT equipment. Overall, the Bitstream Fiber PON service described in the present document for the Proximus Fiber Access Network is identical to the Bitstream Fiber PON service using the non-Proximus Fiber Access Network.

2. Abbreviations

	Description
DHCP	Dynamic Host Configuration Protocol
DS	Downstream
DSCP	Differentiated Services Code Point
Fiber GPON	Point-to-multipoint shared fiber using GPON (Gigabit Passive Optical Network) technology to serve multiple homes (FTTH – Fiber To The Home) and businesses (FTTB – Fiber To The Business)
Fiber XGS-PON	Point-to-multipoint shared fiber using XGS-PON (10 Gigabit Symmetrical Passive Optical Network) technology to serve multiple homes (FTTH – Fiber To The Home) and businesses (FTTB – Fiber To The Business)
GE	Gigabit Ethernet
GUI	Graphical User Interface
IPoE	Internet Protocol over Ethernet
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation
LAN	Local Area Network
LEX	Local Exchange
MTU	Maximum Transmission Unit
OAL	<u>Q</u> LO (Ethernet) <u>A</u> ccess <u>L</u> ine
ODN	Optical Distribution Network
OLO	Other Licensed Operator (also mentioned in this document as “Beneficiary”)
OLT	Optical Line Terminal
OLT NT	Optical Line Terminal Network Termination
ONT	Optical Network Terminal (also referred to as Optical Network Termination in this document)
PON	Passive Optical Network
p-bit	Priority bit
PoP	Point of Presence
PPP	Point to Point Protocol
PPPoE	Point to Point Protocol over Ethernet
UNI	User Network Interface (the word UNI systematically refers to the UNI on the ONT)
US	Upstream
U2U	User to User (communication)
VDSL2	Very high speed Digital Subscriber Line transceivers 2 (ITU-T G.993.2)
VLAN	Virtual LAN
VULA	Virtual Unbundling Local Access

3. Overall Network Architecture of Bitstream Fiber PON with Shared VLANs

3.1 End-to-End view

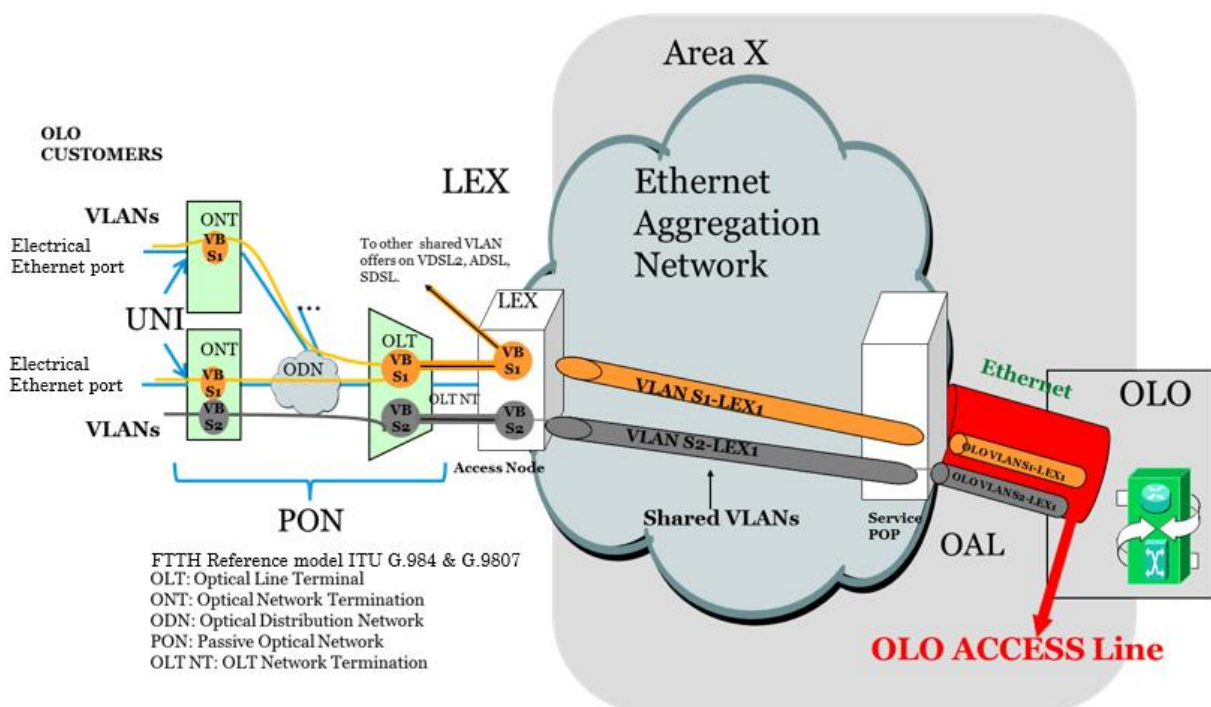


Figure 1: End-to-end overview (Shared VLANs)

This **Bitstream Fiber PON Shared VLAN** service offers an end-to-end Ethernet connectivity between one OLO Access Line and the ONT GE or 10 GE port at UNI installed at the End-User premises. Eight service classes are defined on the Ethernet Network, differentiated by the Ethernet p-bit, two service classes for each p-bit:

- P=0 : best effort (P0 & P0bis)
- P=1 : low priority (P1 & P1bis)
- P=3 : medium priority (P3 & P3bis)
- P=5 : highest priority (P5 & P5bis), and better performance for jitter and delay sensitive traffic.

Each service class can carry Bitstream Fiber PON traffic and Bitstream xDSL traffic.

Each Fiber PON UNI can offer to the End-User one or none of the two P0 service classes, one or none of the two P1 service classes, one or none of the two P3 service classes and one or none of the two P5 service classes. At least one service class needs to be configured on the Fiber PON UNI.

The service quality P=5 has the highest priority in the network and is also designed to offer better performance for jitter and delay sensitive traffic (e.g. voice and real-time traffic). This performance is obtained with a reduced size of the buffers compared to other service qualities. The traffic sent on a VLAN with P=5 should take into account that this service quality is less tolerant to burst of data. It is advised to send traffic with an appropriate shaping to avoid packet losses. An appropriate shaping can be implemented as follows: for traffic with service quality P=5 the shaper shall be configured slightly below the ordered P5 transport bandwidth and the traffic shall be sent with a constant bitrate to avoid packet loss. For P5-traffic on a Shared VLAN the sum of the shaped bandwidths shall stay slightly below the ordered P5 transport bandwidth.

The VLAN-ID scheme on all Fiber PON UNIs is common for all OLOs.

- VLAN-ID 10 = Best Effort traffic (P0 or P0bis) (note that the Ethernet frames can be p0 and p1 tagged).
- VLAN-ID 50 = Low priority traffic (P1 or P1bis).
- VLAN-ID 40 = Medium priority traffic (P3 or P3bis).
- VLAN-ID 21 = Highest priority traffic (P5 or P5bis).

The PON network works as a VLAN Ethernet bridge performing translation between the VLAN-ID on the ONT UNI, to a VLAN, dedicated for 1 service class and 1 OLO. This bridge is shared amongst all End-Users of the same service class of the same OLO.

E.g.: All Best Effort P0 traffic of OLO1 End-Users is bridged to VLAN 2200 on the OLT NT. All P0bis traffic of OLO1 End-Users is bridged to VLAN 2202 on the OLT NT.

Per service class, the VLANs of the End-User lines of a Beneficiary will be aggregated on LEX level in the Access node of the Ethernet Aggregation Network and transported in 1 VLAN to the Service PoP, where the standard OLO Access Line is connected. When a Multichassis-LAG OLO Access Line is used, two OALs are connected to the 2 different Service PoPs. There are 2 Service PoPs, located in 2 different buildings, per Aggregation Network, and 5 Aggregation Networks for whole Belgium. Each of the 5 Aggregation Networks covers 1 geographical Area.

When a standard OLO Access Line is used, the VLAN ends in 1 VLAN on the OLO Access Line.

When a Multichassis-LAG OLO Access Line is used, one link is working and the other is standby. The VLAN ends in 1 VLAN on the working OLO Access Line.

Per service class and per LEX where the Beneficiary wants to be active, he will need to order 1 separate VLAN between the LEX and one of the 2 Service PoPs of the Aggregation Network to which the LEX belongs (in case of a Multichassis LAG OLO Access Line these VLANs will dynamically be terminated on the Service PoP with the working OLO Access Line). In this LEX, all End-Users of the Beneficiary with the same service class (e.g.: P0bis) will share this same VLAN separated from the VLAN (e.g.: P0) of the same OLO or any other OLO.

The OLO will connect the OLO Access Lines to his OLO Router or other equipment. When Multichassis LAG OLO Access Lines are used the OLO Router or other equipment must support multichassis LAG.

3.2 Aggregation Network structure

The Aggregation Network structure schematized in Figure 2 below is common to Bitstream Fiber PON and Bitstream xDSL.

The Optical Line Terminal Network Termination, OLT NT, is connected to one Access node. The VLAN is routed from the OLO Access Line to the Access node of the LEX.

- Rerouting of the VLANs.
- The OLO Access Line redundancy is an option.
- The OLT NT is connected to its Access node via Gigabit or 10 Gigabit Ethernet lines.

3.3 Aggregation Areas

The Bitstream Fiber PON service shares the aggregation network defined in the document “Bitstream VDSL2 – Annex 2C – Technical Specifications”, sections “Aggregation Network structure”, “Aggregation Areas” and “VLAN characteristics”¹.

Most important characteristics:

- Up to 8 bridges (p0, p1, p3, p5, p0bis, p1bis, p3bis, p5bis) in the Ethernet node in the LEX can be used for Bitstream Fiber PON. These bridges are also used for Bitstream xDSL.
- Proximus connects the bridges in the “access nodes” to corresponding bridges in the IP-DSLAMs, GE-NT Aggregators and Fiber PON OLT NTs.
- Shared VLAN connectivity per bridge, up to an OAL, ordered by the Beneficiary.

¹ See Proximus Wholesale website at <https://www.proximus.be/wholesale/>, section “Regulated services”.

4. Overall Network Architecture of Bitstream Fiber GPON with Dedicated VLANs

4.1 End-to-End view

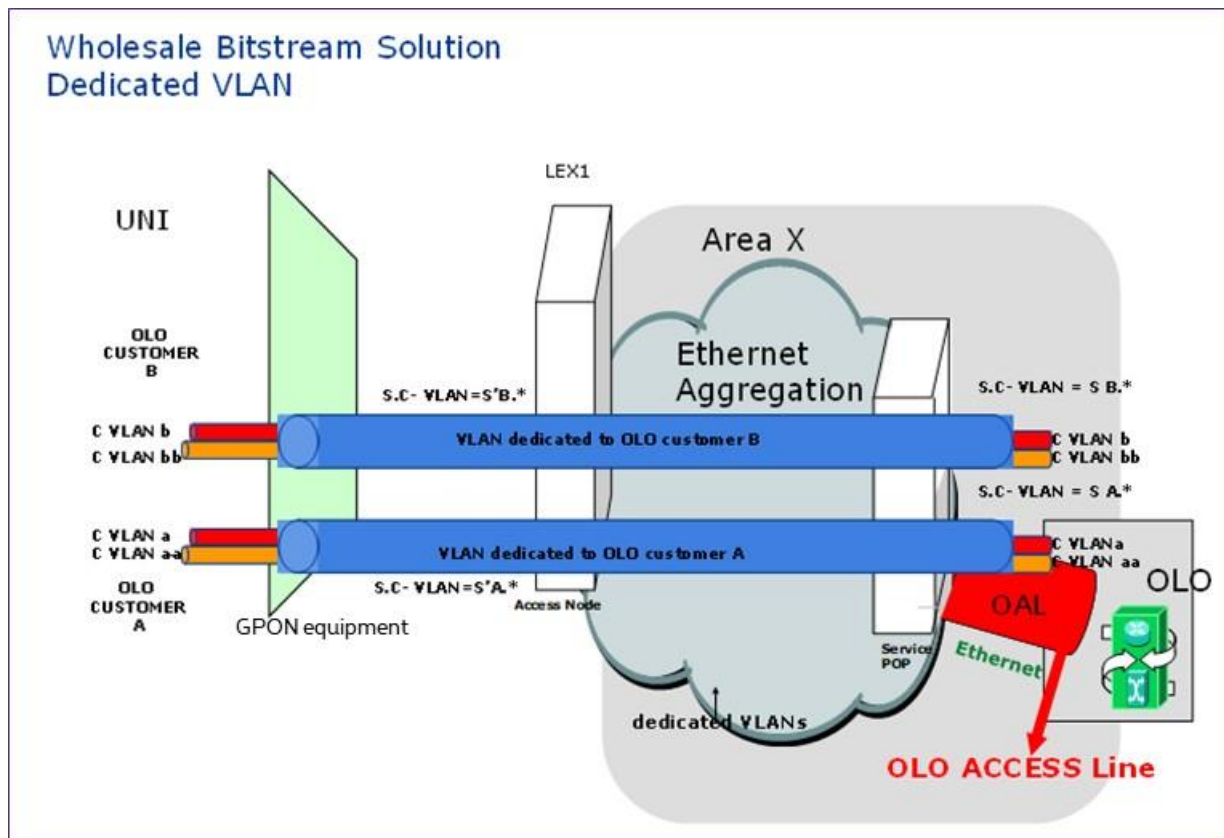


Figure 3: End-to-end overview (Dedicated VLANs)

This **Bitstream Fiber GPON** service offers an Ethernet connectivity between the OLO Access Line and the ONT GE port at UNI installed at the End-User premises. Four services are defined on the Ethernet Network, differentiated by the Ethernet p-bit :

- P=0 : best effort
- P=1 : low priority
- P=3 : medium priority
- P=5 : highest priority

The service quality P=5 has the highest priority in the network and is also designed to offer better performance for jitter and delay sensitive traffic (e.g. voice and real-time traffic). This performance is obtained with a reduced size of the buffers compared to other service qualities. The traffic sent on a VLAN with P=5 should take into account that this service quality is less tolerant to burst of data. It is advised to send traffic with an appropriate

shaping to avoid packet losses. An appropriate shaping can be implemented as follows: for traffic with service quality P=5 the shaper shall be configured slightly below the ordered P5 transport bandwidth and the traffic shall be sent with a constant bitrate to avoid packet loss. For P5-traffic on a Dedicated VLAN the sum of the shaped bandwidths shall stay slightly below the ordered P5 transport bandwidth.

The C-tag scheme on all GPON lines is free for all OLOs, because it is transparently transported towards the OAL.

For each separate Bitstream GPON line, the OLT/ONT adds in upstream an S-tag to any C-tag leaving the OLO Service Box and transports the S-tagged frame up to the MPLS network. This frame is retagged with a new S-tag on the OAL of the OLO in a **Dedicated VLAN, completely dedicated to this OLO End-User**.

The **Dedicated VLAN**, carrying the customer C-VLANs, is cross-connected in the Proximus network. The VLAN profile (see section 8.5.2), agreed upon between the OLO and Proximus, is applied and policed on the Dedicated VLAN.

The **Dedicated VLAN** ends on 1 OLO Access Line, connected to a Service PoP of the Area to which the End-User line belongs:

- No “inter Area” Dedicated VLAN is possible.
- No rerouting to any other OAL is foreseen.
- The same OAL may be used for “Shared VLAN” and for “Dedicated VLAN” services.

At the OAL, Proximus will deliver the VLAN, S-tagged carrying all C-VLANs of the GPON line, unchanged. The S-tag takes 1 VLAN-ID. The standardized VLAN-ID field size (12 bits) therefore limits the number of GPON sites, connectable to 1 OAL.

The OAL can also be of type “Multichassis LAG OAL”, which can carry a mix of “Shared VLANs”, “Dedicated VLANs” and “Single VLANs”.

4.2 Aggregation Areas

See section 3.3 “Aggregation Areas”.

As prerequisite to the ordering of the Bitstream Fiber GPON service in one of the 5 Areas, the Beneficiary must interconnect with Proximus by ordering at Proximus one or several dedicated Access Lines between the Beneficiary’s Equipment and the Proximus Service PoPs of this Area.

To collect and terminate the traffic of an Area, the Beneficiary only needs to interconnect to 1 of the 2 Service PoPs per area. The interconnection on the 2 service PoPs of a same area lets the OLO share its traffic over the 2 Service PoPs for more security. Nevertheless, this is not loadsharing: the OLO must choose himself to which Service PoP he connects each separate End-User line.

To reach a national coverage, the Beneficiary needs at least 1 interconnection in each Ethernet Aggregation area.

The OAL can also be of type “Multichassis LAG OAL”, which can carry a mix of “Shared VLANs”, “Dedicated VLANs” and “Single VLANs”.

5. Overall Network Architecture of Bitstream Fiber PON with Single VLANs

5.1 End-to-end view

- The VLAN ID at UNI is always 11 (Single VLAN).

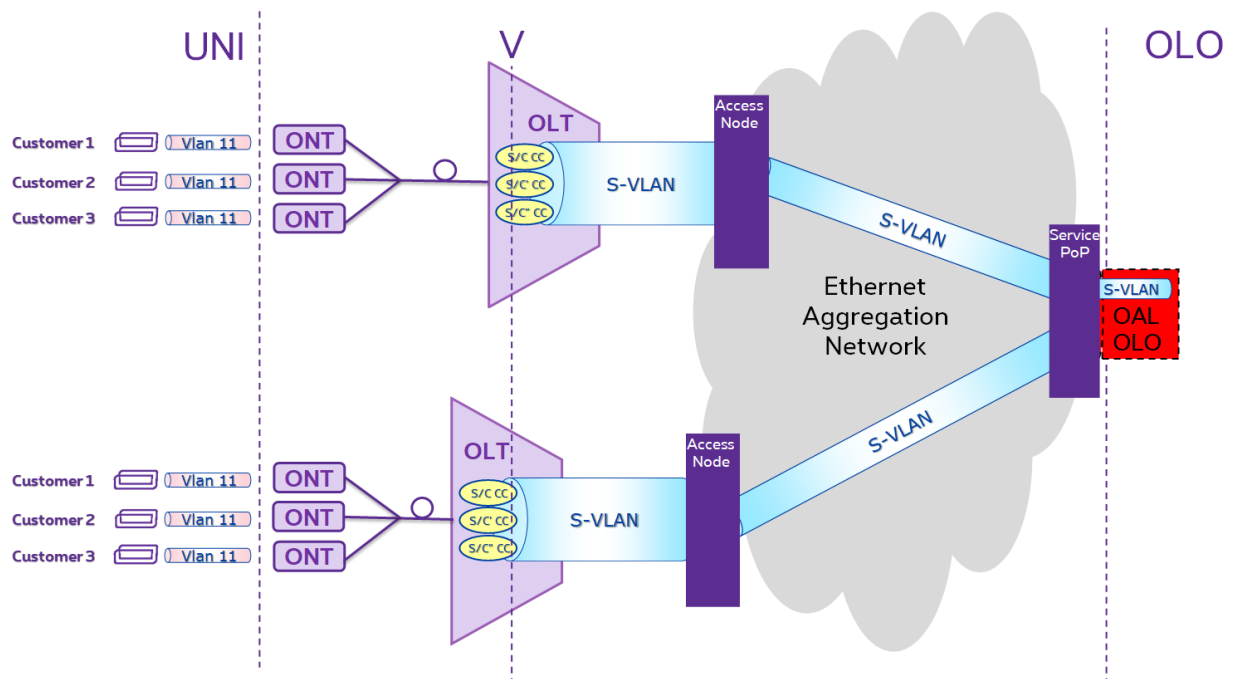


Figure 4: End-to-end overview (Single VLANs)

- In upstream the traffic from each End-User is translated from VLAN 11 at UNI to an S-tag/C-tag combination at the ingress of the network.
- The OAL is connected to an Edge Router in a Service PoP in the same Aggregation Area as the access device. On each OAL a separate S-VLAN per TITAN LEX is created. All End-Users connected to an OLT get assigned a C-VLAN within this S-VLAN.
- An S-VLAN is limited to 4094 end-users, i.e. for each block of 4094 End-Users of an OLO in a LEX, an additional S-VLAN must be ordered. Note that a number of VLAN IDs are not available for the Beneficiaries (e.g. 1, 2, 4093, 4094, ...)
- The Beneficiaries will have the possibility to order up to 2 S-tag per LEX even if a block of 4094 End-Users is not filled in.

5.2 Ethernet Aggregation Network – Aggregation Area

The Ethernet Aggregation network is divided in 5 Areas, as explained in the Bitstream xDSL reference offer – Annex 2C – “Technical Specifications”, chapter “3. Overall Network Architecture of Bitstream VDSL2 with Shared VLANs”, Section “3.3 Aggregation Areas”.

As prerequisite to the ordering of this service in one of the 5 Areas, the Beneficiary must interconnect with Proximus by ordering at Proximus one or several Access Lines (OAL) between the Beneficiary’s Equipment and the Proximus Service PoPs of this Area, dedicated to this service and/or other Bitstream services.

5.3 VLAN characteristics

Reference is made to the Bitstream xDSL reference offer – Annex 2C – “Technical Specifications”, chapter “5 Overall Network Architecture of Bitstream VDSL2 with Single VLANs”, Section “5.3 VLAN characteristics”.

6. Interconnection at LEX level

In addition to the connection of the Beneficiary on Service PoP level as described in sections 3, 4 and 5, which allows the Beneficiary to use Bitstream services to connect End-Users of the whole Service Areas, the Beneficiary may also interconnect with Proximus at LEX level (VULA)².

In case of interconnection of the Beneficiary on a LEX, the interconnection can only transport Ethernet frames of Bitstream connections serviced from that LEX.

In case of interconnection of the Beneficiary on a LEX, Proximus will provide, on behalf of the Beneficiary who will define their dimensioning, types and protection types:

- One or several OLO Access Lines between the Customer Equipment and the Proximus Service Router, sited in this LEX.
- Bandwidth (VLANs) between the Service Router of this LEX and the OAL(s) connected to this LEX. These VLANs can be either shared between several End-Users of a Beneficiary in this LEX or dedicated per individual End-User.
- The OAL at LEX level cannot be of type "Multichassis LAG".
- The OAL at LEX level cannot be of type 10GE.

6.1 With Shared VLANs

This **Bitstream** service offers an Ethernet connectivity between the OLO Access Line connected to the LEX and the PON lines in the same LEX.

For VLAN Bandwidths available in function of the service chosen by the OLO, reference is made to Table 1 of the Main Body of the present reference offer.

A Shared VLAN of a specific service in a LEX might be connected to an OAL in the same LEX, while another Shared VLAN of another specific service ending in the same LEX is connected to an OAL in the Service PoP. E.g.: Shared VLAN P0 in LEX x is connected to the OAL in the LEX x, while Shared VLAN P5 ending in the same LEX x is connected to the OAL in the Service PoP of the same Service Area.

6.2 With Dedicated VLANs

This **Bitstream** service offers an Ethernet connectivity between the OLO Access Line connected to the LEX and the GPON lines in the same LEX.

6.3 With Single VLANs

² In case a firm request is received from a Beneficiary, the creation of the Bitstream local access in the Proximus network and systems will be targeted to be executed within a timeframe of 1 year.



This Bitstream service offers an Ethernet connectivity between the OLO Access Line connected to the TITAN LEX and the PON lines in the same LEX.

7. QoS specifications for Shared, Dedicated and Single VLANs

Maximum Burst Size:

The P5 and P5bis VLAN services have the highest priority in the network and are also designed to offer better performance for jitter and delay sensitive traffic (e.g. voice and real-time traffic). This performance is obtained with a reduced size of the buffers compared to other service qualities. The traffic sent on VLANs P5 and P5bis should take into account that this service is less tolerant to bursts of data. It is advised to send traffic with an appropriate shaping to avoid packet losses. An appropriate shaping can be implemented as follows: for traffic with priority value p5 the shaper shall be configured slightly below the ordered P5 (resp. P5bis) transport bandwidth and the traffic shall be sent with a constant bitrate to avoid packet loss. For p5-tagged traffic on a Shared P5 (resp. P5bis) VLAN the sum of the shaped bandwidths shall stay slightly below the ordered P5 (resp. P5bis) transport bandwidth.

For the other VLAN services, the Maximum Burst Size is not specified or is configured in the OLT equal to the VLAN bandwidth multiplied by 5 ms. This 5 ms delay is a best practice value recommended by the industry.

8. UNI

Unless specified otherwise, this section equally refers to the three types of service: with Shared VLANs, with Dedicated VLANs or with Single VLANs.

8.1 Physical Transport (Layer 0)

The Proximus Fiber PON solution is a shared fiber solution, i.e. shared amongst a number of End-Users from Beneficiaries and from Proximus: it is an ITU-T G.984.x based Gigabit Passive Optical Network (GPON) solution or an ITU-T G.9807.x based 10 Gigabit Passive Optical Network (XGS-PON) solution composed of the following elements:

- One or more Optical Line Terminal(s) in the LEX and OLT NT interfaces to the Ethernet Access node(s) in the LEX.
- A shared fiber: Optical Distribution Network (ODN).
- An Optical Network Termination box, installed by Proximus at the Beneficiary's End-User premises. 230V AC supply must be available.
- UNI: a Gigabit Ethernet or 10 Gigabit Ethernet interface on the ONT, for connecting the Beneficiary's End-User LAN and / or Service Box.
- The UNI is the network demarcation point, which is the Ethernet port on the ONT box.

OLT: Optical Line Termination
ODN: Optical Distribution Network
ONT: Optical Network Termination

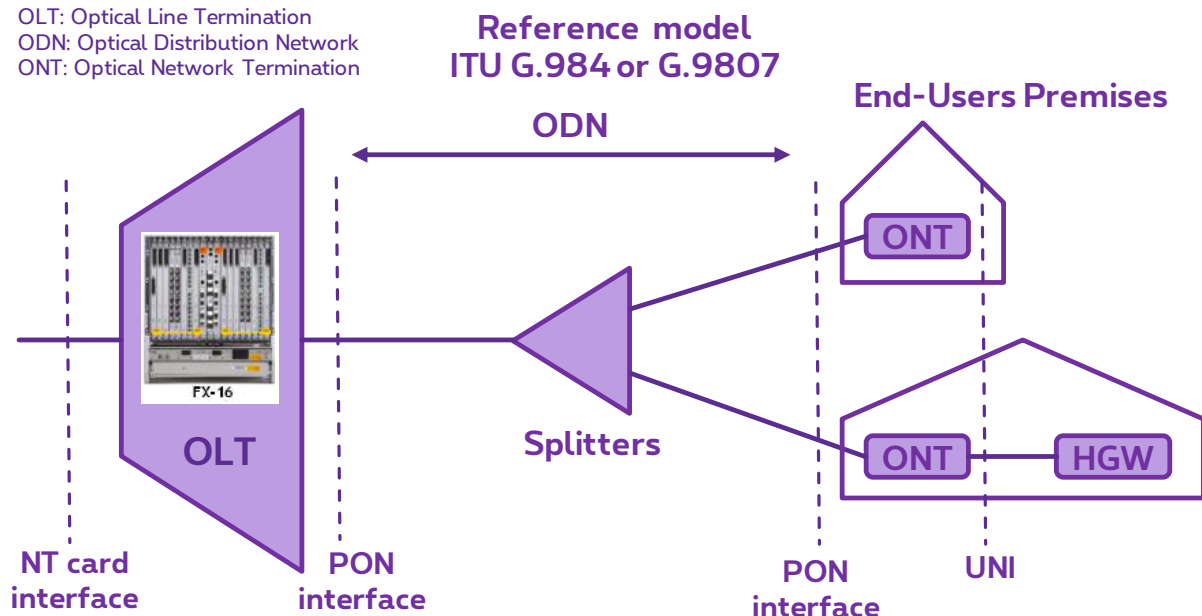


Figure 5: Fiber PON reference model ITU G.984 or G.9807

Ethernet specifications: Port 8P8C type RJ45, wiring compliant with T568B.

8.2 Port speed at UNI (Layer1)

Gigabit Ethernet specifications:

- 1000 Base-T ports, IEEE 802.3-compliant.
- Full duplex.

10 Gigabit Ethernet specifications:

- 10G Base-T ports, IEEE 802.3-compliant.
- Full duplex.

8.3 Ethernet Format on Fiber PON

Ethernet format on the UNI Ethernet port:

- Frame format

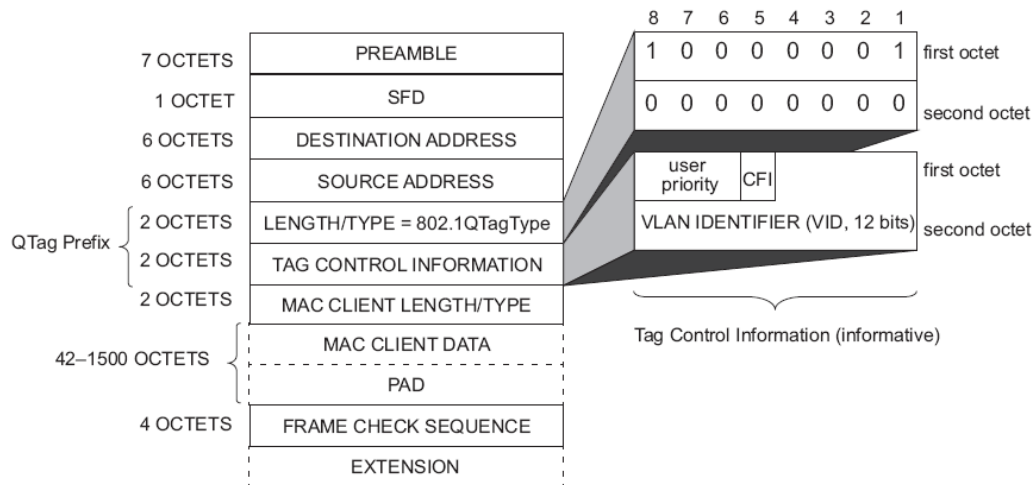


Figure 3–3—Tagged MAC frame format

Figure 6: Tagged MAC frame format

- IEEE 802.1Q also called “Tagged format”
- Ethernet MTU size: 1564 octets³ at End-User Demarcation point, including the C-tag VLAN. In this document, the MTU size is defined as the “Ethernet MTU size” and the number 1564 octets includes the following fields:
 - Destination Address: 6 octets
 - Source Address: 6 octets
 - Qtag (is Ctag): 4 octets
 - Mac Client Length/Type: 2 octets
 - MAC Client Data +PAD: 1542 octets
 - Frame Check Sequence: 4 octets
 - Total: 1564 octets
- On the UNI Ethernet port, only single tagged Ethernet Frames with pre-defined VLAN ID (cf. section 8.5 VLAN ID allocation and QoS at UNI) are accepted. Classification and marking are based upon the VLAN ID.

³ Octet: a unit of digital information that consists of eight bits.

8.4 Ethernet Forwarding mechanism

The forwarding mechanism differs in case of Shared VLANs, Dedicated VLANs or Single VLANs.

8.4.1 Shared VLAN

The forwarding model for Fiber PON with Shared VLANs can be considered as a L2 bridge with additional security features. Within this mode it is possible to associate different logical ports to one Virtual LAN. In the upstream direction, frames are forwarded from a VLAN at the user side to a service VLAN at the network side, with a MAC learning process. In the downstream direction, the frames are forwarded based on the MAC address, with a check on the correctness of the VLAN ID/MAC address usage.

Each subscriber's VLAN/Service on the UNI is mapped to the Service VLAN(s) of the respective OLO at the Fiber PON ODN & OLT NT with VLAN Translation in the ONT.

No multicast Ethernet packets are allowed in the OLO Shared VLANs!

Figure 7 shows an example of an OLO, connecting one UNI to its services: p0(bis), p1(bis), p3(bis) and p5(bis).

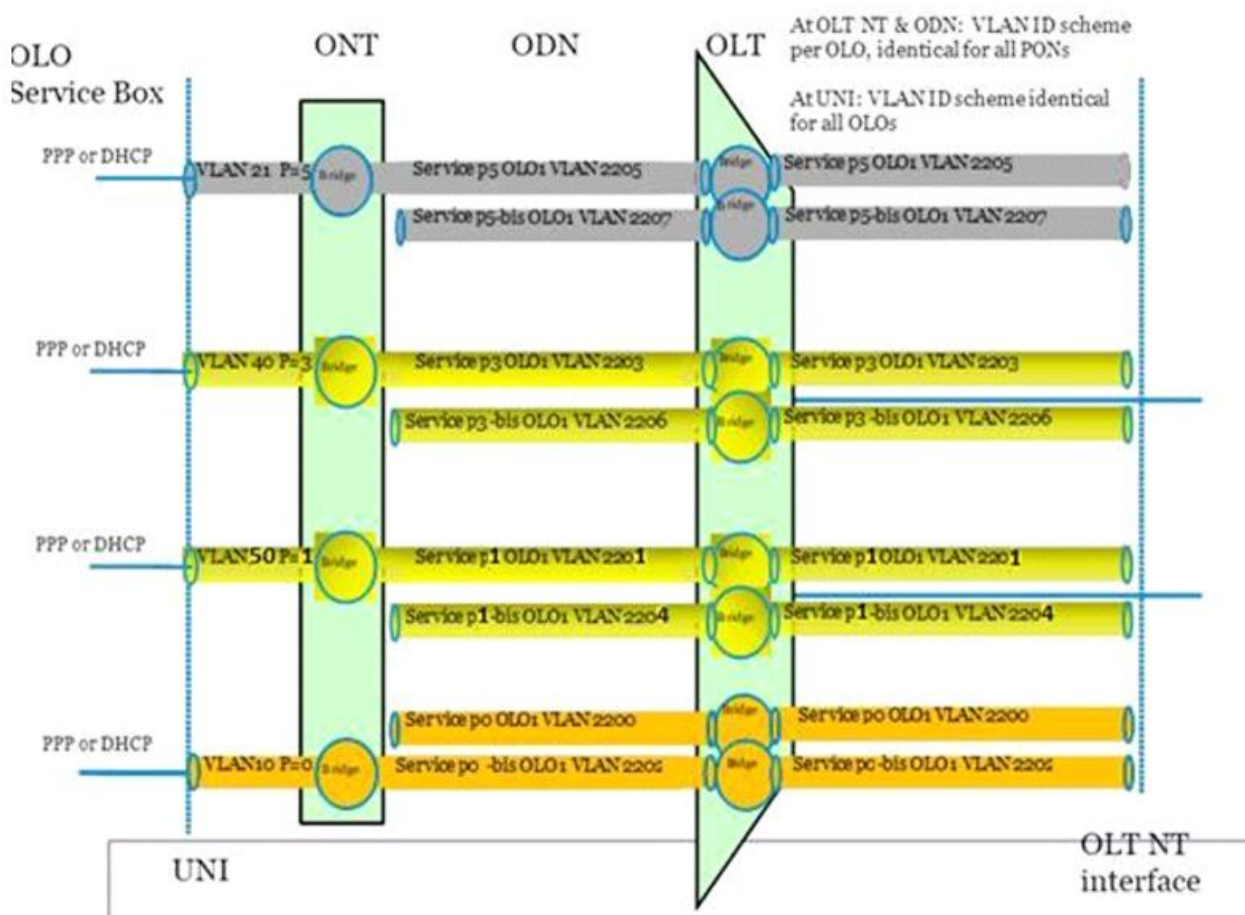


Figure 7: Ethernet Forwarding Mechanisms on Fiber PON (Shared VLANs)

8.4.2 Dedicated VLAN

The forwarding is transparent for the C-VLANs tags. The OLT/ONT applies an S-Tag per UNI port of the ONT. The S-Tag must be unique within the OLT/ONT.

The forwarding mode for GPON with Dedicated VLANs can be considered as a (S-VLAN) XC model. In S-VLAN cross-connect mode, two levels of VLAN tags are used:

- the customer VLAN: C-VLAN
- the service provider VLAN: S-VLAN

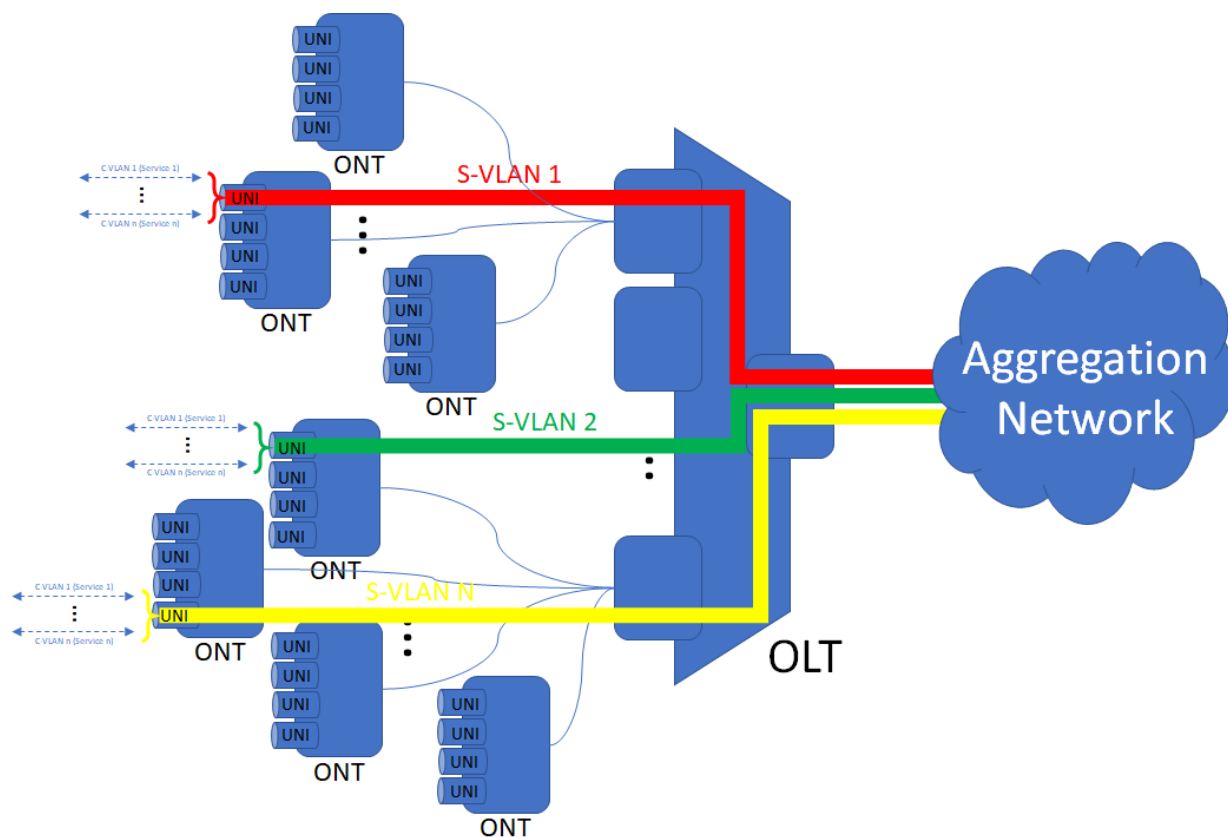


Figure 8: Ethernet Forwarding Mechanisms on Fiber GPON (Dedicated VLANs)

8.4.3 Single VLAN

For “Single VLAN”, the UNI VLAN on the End-User line is translated and cross-connected into stacked S/C – VLANs at the PON port.

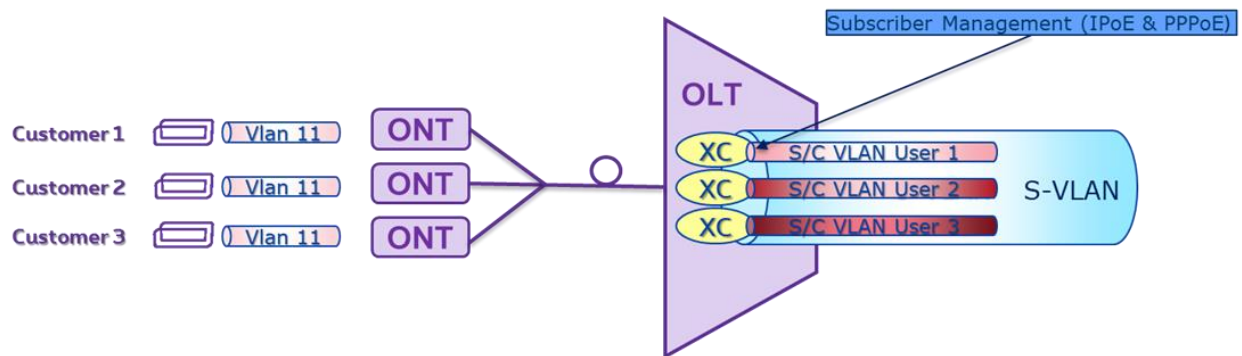


Figure 9: Ethernet forwarding mechanism on PON for Single VLAN

Remark:

- Frames on the subscriber interface must be C-VLAN tagged. In case of C-VLAN tagged frames, a check will be performed on the received C-VLAN ID. In case of untagged/priority tagged frames, the frames will be discarded.

8.5 VLAN ID allocation and QoS at UNI

The VLAN ID allocation differs in case of Shared VLANs, Dedicated VLANs or Single VLANs.

8.5.1 Shared VLAN

On UNI it is possible to provision up to 4 VLAN IDs.

p-bit	0 & 1*	1	3	5
VLAN ID =	10	50	40	21

Table 1: Mapping p-bit and VLAN ID

* Note about VLAN 10:

Downstream: in the OLT, VLAN 10 contains p0 and p1 tagged Ethernet frames, as sent by the Beneficiary. The p1 tagged frames are handled in the OLT with the same QoS as p1 tagged frames in VLAN 50.

Upstream: in VLAN 10, the OLT retags all Ethernet frames to p0.

This VLAN ID scheme is identical for all OLOs.

No multicast Ethernet packets are allowed!

Upstream Marking: p-bit setting on VLAN on bridge port.

Policing: policing at UNI in the OLT in upstream based upon rate limiting types (cf. Table 2).

Downstream Scheduling:

Hierarchical scheduler:

- P=0: best effort.
- P=1: low priority.
- P=3: medium priority.
- P=5: highest priority.

The priorities are handled on the Network Termination (NT) card of the OLT in a Strict Priority (SP) mechanism assuring that the nearly real-time applications do not suffer from too large delays. On the Line Termination (LT) card of the OLT, the two highest priorities are handled in a Strict Priority mechanism while the two lowest priorities compete in a fair manner like Weighted Fair Queuing.

Rate limiting per VLAN at UNI

A rate limiting is applied in upstream and downstream, on the flows of the UNI, as described in Table 2 below. The burst size of the rate limiter on the UNI-interface for the P5 service class is 22500 octets of contiguous packets in the upstream.

Profile In Mbps ⁴	P0 + P1 Max DS/Max US	P3 Max DS/Max US	P5 Max DS/Max US
Type 0	50/10	65/2 (Unicast)	12/12
Type 1	150/50	65/2 (Unicast)	12/12
Type 2	500/100	65/2 (Unicast)	12/12
Type 3	1000/500	65/2 (Unicast)	12/12
Type 4	2500/1000	65/2 (Unicast)	12/12
Type 5	8500/1500	65/2 (Unicast)	12/12

Table 2: Rate limiting types - Shared VLAN

No data volume limitation is applied on the different profiles and service quality.

8.5.2 Dedicated VLAN

Any VLAN at UNI (is C-VLAN ID) is transparently enveloped by the S-tag and not configured neither visible in the Proximus network.

QoS: the OLO shall associate 1 VLAN profile to every GPON line.

Rate limiting per VLAN at UNI

A rate limiting is applied in upstream and downstream, on the flows of the UNI, as described in Table 3 below. The burst size of the rate limiter on the UNI-interface for the P5 service class is 22500 octets of contiguous packets in the upstream.

Profile In Mbps	P0+P1+P3+P5 Max DS/Max US
Type 1 Dedicated	110/10
Type 2 Dedicated	250/30
Type 3 Dedicated	350/50
Type 4 Dedicated	500/100

⁴ The speed profiles are up to, without guarantee that the max speed is reached at all times.

Table 3: Rate limiting types - Dedicated VLAN

The OLO can associate profiles coming from two pools to every GPON line:

- The OLO can define an own pool with up to 10 Dedicated VLAN profiles shared between xDSL and GPON (for its own use);
- The OLO can choose from a common pool of Dedicated VLAN profiles shared between xDSL and GPON. These can be used by all OLOs. The specifications of the profiles and the related processes are documented on the secured part of the Proximus wholesale website (in the section “Operational Documentation” of the Regulated Services menu with respect to the present service).

One VLAN profile has the following attributes:

- Layer 2 (p-bit), applicable for both upstream and downstream
- P-bit
- Maximum Upstream bandwidth per p-bit (bandwidth p0, bandwidth p1, bandwidth p3, bandwidth p5)
- Maximum Downstream bandwidth per p-bit (bandwidth p0, bandwidth p1, bandwidth p3, bandwidth p5)

The attributes of a VLAN profile are identical for all GPON End-User lines using this profile.

The 4 QoS classes applicable to an Ethernet packet are the same as for the “Shared VLAN” service:

- P=0: best effort.
- P=1: low priority.
- P=3: medium priority.
- P=5: highest priority.

The upstream and downstream Ethernet flows are policed following the VLAN profiles.

Layer 2 frames with non-conforming p-bit values are retagged to the lowest priority as defined in the VLAN profile.

For example, the application of this rule to a single p-bit Layer 2 VLAN profile implies that all frames carry this single p-bit.

It is the responsibility of the OLO to underbook, match or overbook the instantaneous available physical bandwidth on the GPON line (upstream and downstream). It is recommended not to overbook higher QoS bandwidths (P5, P3, P1).

8.5.3 Single VLAN

Mapping Table:

p-bit	0	1	2	3	4	5	Session Signalling
VLAN ID =	11	11	11	11	11	11	11

Table 4: Mapping p-bit and VLAN ID

If the End-User sends other VLAN tags than VLAN ID 11, or sends native Ethernet, then the corresponding frames will be discarded.

Profile In Mbps ⁵	Sum of pbits Max DS/Max US
Type 0	127/24
Type 1	227/64
Type 2	577/114
Type 3	1000/514
Type 4	2500/1014
Type 5	8500/1514

Table 5: Rate limiting types - Single VLAN

Upstream Marking:

- Traffic entering the ISAM is supposed to be tagged with the appropriate p-bits by the CPE.
- p7 frames will be remarked to p0 in order to protect the network.
- p-bits are not derived from DSCP.
- For S/C VLAN CC, both S- and C-VLAN p-bits are set to the same value.

Upstream Policing:

The following rate limiting of traffic by p-bit at UNI interface in order to protect the network is implemented:

- Session signalling p-bit frames will be rate limited to 512 kbps
- p5 frames will be rate limited to 20 Mbps
- p4 frames will be rate limited to 4 Mbps

Downstream Scheduling/Queueing:

The downstream scheduling & queueing behaviour is based on the p-bit.

- p=0, 1, 2, 3: weighted fair queueing (WFQ)
- p=4, 5, Session signalling: strict priority with Session signalling > p5 > p4.
- p7 remarked as p0.

8.6 Line Identification

8.6.1 Shared VLAN

⁵ The speed profiles are up to, without guarantee that the max speed is reached at all times.

This section relates to a Shared VLAN topology⁶.

Line identification will be enabled for both PPPoE and IPoE (DHCP) on each service VLAN of the OLO.

IPoE:

For IPoE access, per service VLAN a layer 2 DHCP relay function is implemented on the OLT as described within Broadband Forum TR-156. The DHCP packet format is specified in RFC 2131. The DHCP Relay Agent Information option (option 82) format is specified in RFC 3046.

In upstream, the access loop identification will be encoded within the “Agent Circuit ID” sub-option 1 of DHCP Option 82 during the DHCP session setup.

In downstream, the OLT will remove DHCP option 82.

PPPoE:

For PPPoE access, per service VLAN the PPPoE Intermediate Agent function is implemented on the OLT as described within Broadband Forum TR-156.

In upstream, the access loop identification will be encoded within the “Agent Circuit ID” sub-option 1 of the PPPoE vendor specific tag in the discovery messages (PADI, PADR, PADT) of the PPPoE protocol.

Format agent circuit ID for IPoE and PPPoE:

<Access_Node_ID> eth< Rack/Frame/Slot/Port/ONU/OnuSlt/UNI:Q-VID

Example:

F03BRM00001 eth 1/1/01/01/16/1/1:10

<Access_Node Identifier >eth< Rack>/<Frame>/<Slot>/<OLT Port>/<ONU>/<OnuSlt>/<UNI>:Q-VID

Where:

- Access_Node_ID = the nickname of the OLT (e.g F64LAL00001, F11TRU00001, etc)
- Rack = 1 (fixed value)
- Frame = 1 (fixed value)
- Slot = LT board position in the OLT, from 01 to 16 (leading 0 used)
- OLT Port = PON port on the LT board, from 01 to 16 (leading 0 used)
- ONU = logical ID of the ONT, from 1 to 128 (no leading 0)

⁶ Not applicable for Dedicated VLAN. The PON doesn't add any Line IDs to eventual PPP or DHCP frames. The VLAN-ID @ OAL + OAL identity sufficiently define the identity of the line.

- OnuSlt = 1 (fixed value)
- UNI = from 1 to 4 (no leading 0)
- Q-VID = VLAN ID at UNI

8.6.2 Dedicated VLAN

It is not applicable for Dedicated VLAN. The PON doesn't add any Line IDs to eventual PPP or DHCP frames. The VLAN-ID @ OAL + OAL identity sufficiently define the identity of the line.

8.6.3 Single VLAN

Line identification will be enabled for both IPoE (DHCP) and PPPoE on each S/C cross-connect VLAN.

IPoE

For IPv4 over Ethernet access, per service VLAN a layer 2 DHCP relay function is implemented on the OLT as described within Broadband Forum TR-156. The DHCP packet format is specified in RFC 2131. The DHCP Relay Agent Information option (option 82) format is specified in RFC 3046.

In upstream, the access loop identification will be encoded within the "Agent Circuit ID" sub-option 1 of DHCP Option 82 during the DHCP session set-up.

In downstream, the OLT will remove DHCP option 82.

PPPoE

For PPPoE access, per service VLAN the PPPoE Intermediate Agent function is implemented on the OLT as described within Broadband Forum TR-156.

In upstream, the access loop identification will be encoded within the "Agent Circuit ID" sub-option 1 of the PPPoE vendor specific tag in the discovery messages (PADI, PADR, PADT) of the PPPoE protocol.

Format agent circuit ID for IPoE and PPPoE:

<Access_Node_ID> eth< Rack/Frame/Slot/Port/ONU/OnuSlt/UNI;Q-VID

Example: F03BRM00001 eth 1/1/01/01/16/1/1:10

8.7 Security

8.7.1 Shared VLAN

- No U2U communication.
- Prevention of Broadcast storms:
 - o Downstream:
 - Broadcast frames are dropped.

- Ethernet frames with unknown destination MAC@ are dropped.
Ageing timer bridge = 900s (=> application shall send a message upstream at start up and every x sec, x<900, in order to remain joinable from the network)
- Upstream:
 - Rate limiting control plane (DHCP, IGMP, ARP...).
 - Discard control frames (STP, Pause frames...).
 - Multicast blocking.
- Maximum number of MAC@ per UNI port=16
- MAC anti spoofing.

8.7.2 Dedicated VLAN

- Rate limiting control plane (ARP,...). See table in section “Limitations”.
- Layer 2 Control Protocol (L2CP) handling:

L2CP frames	
Frames with following destination MAC@ • 01-80-C2-00-00-00 through 01-80-C2-00-00-0F • 01-80-C2-00-00-10 • 01-80-C2-00-00-20 through 01-80-C2-00-00-2F	Forward
PAUSE frames with following MAC@ 01-80-C2-00-00-01	Blocked

- Transparency of the types of IEEE L2CP frames as listed in the table above has been validated upon Destination MAC address of the L2CP frame, but not on any other field of the L2CP frame.

MAC learning has been disabled. For security reasons, further information will not be publicly shared. Beneficiary shall contact Proximus if he has the need to receive the information.

8.7.3 Single VLAN

- No user to user communication
- Limiting the number of MAC address per VLAN CC (=> MAC learning will be enabled on the VLAN-CC)
- MAC address anti spoofing
- Blocking of L2CP frames (STP, LACP, EFM...)
- Rate limiting ARP, RIP
- Lightweight DHCP & PPPoE relay (insertion line ID & remote ID)

8.7.4 Protocol limitations⁷

The Bitstream Fiber GPON service is intended for transport of IP packets by Ethernet frames (IPoE or PPPoE). Some protocols do not transparently pass, as described in Table 6 below. Therefore, Proximus does not guarantee their correct functioning. Known limitations related to the current GPON equipment firmware R.5.6.02x are mentioned in Table 6 below.

Protocol	Shared VLAN	Dedicated VLAN	Single VLAN ⁸
802.1x	Blocked	Transparent	Blocked
ARP	Policed ⁷	Policed ⁷	Policed ⁷
RIP	Transparent	Transparent	Transparent
CFM	Blocked	Blocked	Blocked
ICMP	Transparent	Transparent	Transparent
DHCP	Policed ⁷	Policed ⁷	Policed ⁷
IGMP	Policed ⁷	Policed ⁷	Policed ⁷
PPPoEDiscovery	Policed ⁷	Transparent	Policed ⁷
PPP LCP	Transparent	Transparent	Transparent
PPP control	Transparent	Transparent	Transparent
PPP LCP termination ack	Transparent	Transparent	Transparent

Table 6: Known protocols limitation related to the GPON equipment

Similar limitations exist in XGS-PON. Lab tests have still to be executed. We expect the results listed in Table 7.

Protocol	Shared VLAN	Dedicated VLAN	Single VLAN ⁹
802.1x	Blocked	Not applicable	Blocked
ARP	Policed ⁷	Not applicable	Policed ⁷

⁷ For security reasons, parameters will not be publicly shared. Beneficiary shall contact Proximus if he has the need to receive the information.

⁸ The protocol limitations for Single VLAN are mainly extrapolated from the Dedicated VLAN and have been partially tested in Lab.

⁹ The protocol limitations for Single VLAN are mainly extrapolated from the Dedicated VLAN and have been partially tested in Lab.

RIP	Transparent	Not applicable	Transparent
CFM	Transparent	Not applicable	Blocked
ICMP	Transparent	Not applicable	Transparent
DHCP	Policed ⁷	Not applicable	Policed ⁷
IGMP	Policed ⁷	Not applicable	Policed ⁷
PPPoEDiscovery	Policed ⁷	Not applicable	Policed ⁷
PPP LCP	Transparent	Not applicable	Transparent
PPP control	Transparent	Not applicable	Transparent
PPP LCP termination ack	Transparent	Not applicable	Transparent

Table 7: Known protocols limitation related to the XGS-PON equipment

The lists provided here above are indicative and non-exhaustive.

The Beneficiary has the opportunity to request on a project mode basis for ad hoc testing to check the transparency of any specific protocol in the context of the Bitstream Fiber PON service.

8.8 Service aspects

The Bitstream Fiber PON service does not allow a simultaneous transport of data and classical voice services¹⁰ over the same network.

¹⁰ Classical voice services = PSTN & ISDN services on copper.

9. Service Box

The network interface of the OLO Service Box must comply with the UNI specifications, i.e. trunked Ethernet interface, no native Ethernet interface.

10. Typical power requirements

10.9 GPON ONT

The ONT is powered by 230V AC.

GPON ONT 4 ports version deployed before November 2018:

- Power Idle (ranged and no Eth connections): **4.8 W**
- Power max (UNI running traffic): **7 W**

GPON ONT 4 ports version deployed since November 2018:

- Peak Power consumption: **4.2 W**
- Minimum power consumption: **2.9 W**

GPON ONT 1 port version deployed since November 2021

Remark: the information is based on the vendor product guide and has not been measured in Lab:

- Peak Power consumption: **2.5 W**
- Minimum power consumption: **2.2 W**

10.10 XGS-PON ONT

The XGS-PON ONT under validation is powered by 230V AC.

The product datasheet indicates the following performance:

- Power Idle (ranged and no Eth connections): **5.3 W**
- Power max (UNI running traffic): **8.6 W**

11. OLO Access line

The technical specifications of the OLO Access line are detailed out in the document “Annex 2C – Technical Specifications” of the Bitstream xDSL reference offer, section “OLO Access Line”¹¹.

End of document

¹¹ See Proximus Wholesale website at <https://www.proximus.be/wholesale/>, section “Regulated services”.