



Proximus Reference Offer for Bitstream Access

## Annex 2A:

Technical Specifications of Bitstream services

Delivered by the ATM-DSLAM platform with GE\_NT aggregators

Covering the technologies ADSL, Reach Extended ADSL2, ADSL2+ and SDSL

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Our reference: MSO & Servicing version

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## 1. Scope

The purpose of this document is to describe the technical specifications of the Bitstream (Re)ADSL(2+) over ATM-DSLAM and Bitstream SDSL over ATM-DSLAM services<sup>1</sup> “with Shared VLAN” and “with Dedicated VLAN”.

Note that the description of the above-mentioned services is available in the Bitstream Main Body.

To allow the Beneficiary to set up a service based on these services from Proximus, this document describes the interfaces.

All technical specifications as described in the present document are validated and supported by Proximus unless otherwise stated.

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

- o Non tested protocols on the Proximus network,
- o Burst sizes, delay or jitter requirements, beyond the QoS specifications as documented in the chapter “QoS specifications”.

The Beneficiary can request on a project mode basis for ad hoc testing to check the transparency of any specific protocol or the correct functioning of any specific feature in the context of the Bitstream (Re)ADSL(2+) over ATM-DSLAM services.

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

Regarding the non-validated features, Proximus assumes no liability for incomplete or incorrect information provided by its equipment suppliers or for protocols or features withdrawn or modified by the latter without any prior notice (whether in the frame of a correction or an upgrade of the equipment and/or a technology evolution).

<sup>1</sup> In the remainder of this document “Bitstream (Re)ADSL(2+) over ATM-DSLAM” shall be read as “Bitstream (Re)ADSL(2+) over ATM-DSLAM and Bitstream SDSL over ATM-DSLAM”.

## 2. Abbreviations

	Description
AAL	ATM Adaptation Layer
ADSL	Asymmetric Digital Subscriber Line
ARP	Address Resolution Protocol
ASAM	ATM DSLAM
ASC	ATM Service Class
ATM	Asynchronous Transfer Mode
DHCP	Dynamic Host Configuration Protocol
DS	Downstream
DSLAM	Digital Subscriber Line Access Multiplexer
GE	Gigabit Ethernet
GE_NT	Gigabit Ethernet Network Termination
GUI	Graphical User Interface
IWF	Interworking Function
IPoE	Internet Protocol over Ethernet
LACP	Link Aggregation Control Protocol
LAG	Link Aggregation
LAN	Local Access Network
LEX	Local Exchange
MAC@	MAC address
MC- LAG	Multichassis LAG
MTU	Maximum Transmission Unit
OAL	<u>O</u> LO (Ethernet) <u>A</u> ccess <u>L</u> ine
OLO	Other Licensed Operator (also mentioned in this document as "Beneficiary")

p-bit	Priority bit
PoP	Point of Presence
PPP	Point to Point Protocol
PPPoA	Point to Point Protocol over ATM
PPPoE	Point to Point Protocol over Ethernet
PVC	Permanent Virtual Circuit
PXS	Proximus
QoS	Quality of Service
SDSL	Symmetric Digital Subscriber Line
UNI	User Network Interface
US	Upstream
U2U	User to User (communication)
VC	Virtual Circuit
VDSL2	Very High Speed Digital Subscriber Line 2
VP	Virtual Path
VLAN	Virtual LAN. It may refer to a "Shared VLAN" or to a "Dedicated VLAN".
VLL	Virtual Leased Line
xDSL	ADSL, Re-ADSL2 (Reach Extended ADSL2), ADSL2+, SDSL and/or VDSL2

### 3. Overall Network Architecture for “Shared VLAN”

#### 3.1 End-to-End View

##### 3.1.1 Introduction

The Bitstream (Re)ADSL(2+) over ATM-DSLAM service allows a Beneficiary to groom Bitstream (Re)ADSL(2+) over ATM-DSLAM traffic together with Bitstream (Re)ADSL(2+) over IP-DSLAM and Bitstream VDSL2 traffic in Shared VLANs, maximum two per OLO and per LEX and per p-bit (p=0, p=1, p=3, p=5). The wording “shared” has here a double meaning: shared amongst different users and shared amongst Bitstream (Re)ADSL(2+) over ATM-DSLAM, Bitstream (Re)ADSL(2+) over IP-DSLAM & Bitstream VDSL2 users (see Figure 1).

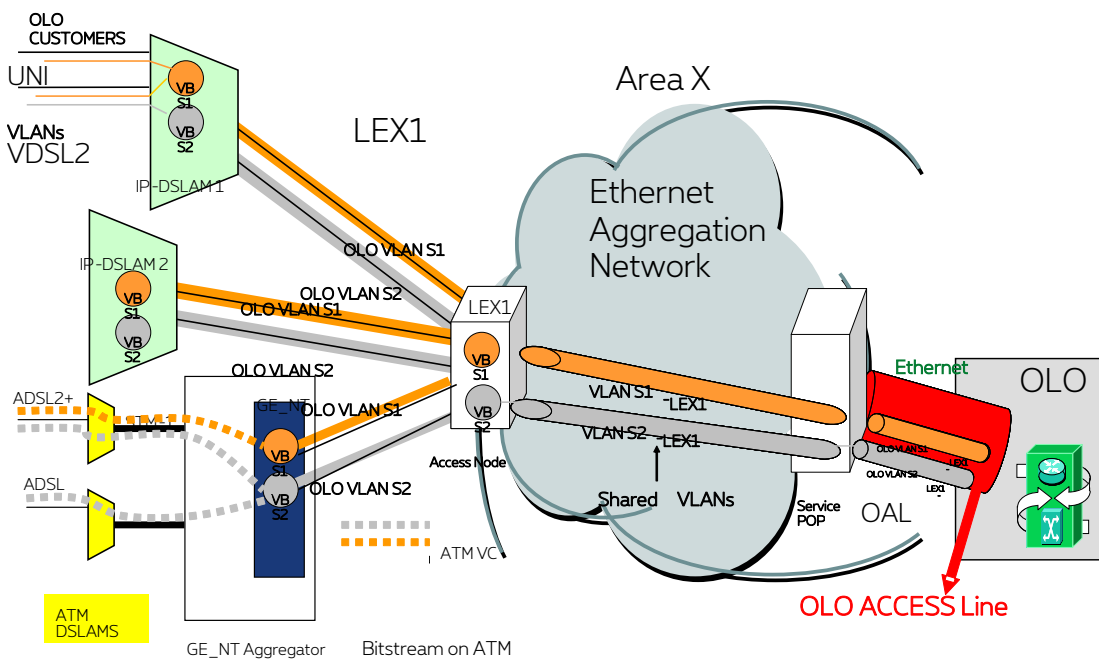


Figure 1: end-to-end overview

Eight VLAN services are defined in the Ethernet Aggregation Network, differentiated by a priority level, two VLAN services for each priority:

- Best Effort (PO & PObis)
- Low priority (P1 & P1bis)
- Medium priority (P3 & P3bis)
- Highest priority (P5 & P5bis) and better performance for delay and jitter sensitive traffic.

The PO & PObis VLAN services:

-**transport** in **downstream** p0-tagged Ethernet in Best Effort QoS. Ethernet frames tagged with p1 will be retagged to p0.

-**discard in downstream** Ethernet frames, tagged otherwise than p0 & p1, except small volumes<sup>2</sup> of control frames which can be received from the OAL with a priority different from p0 or p1. These control frames are not discarded but retagged to p0.

-**retag in upstream** all Ethernet Frames to p0.

The P1 & P1bis, P3 & P3bis and P5 & P5bis VLAN services transport Ethernet frames tagged respectively with p1, p3 & p5 priority values. Ethernet frames not tagged with the corresponding priority values p1, p3 or p5 are retagged to respectively p1, p3 & p5.

In the following sections we walk from left (xDSL side) to right (Ethernet OAL) through Figure 1.

### 3.1.2 (Subtended) ATM DSLAM

The **Bitstream (Re)ADSL(2+) over ATM-DSLAM** users are connected through (Re)ADSL(2+) or SDSL lines to ATM DSLAMs.

The ATM VC connections carried by the DSL line can be groomed by Shared VLANs (orange & gray dotted lines in Figure 1).

### 3.1.3 Ethernet Aggregator:

The connectivity in the Ethernet aggregator has the following aspects:

- The ATM VC between the LT and the forwarding port on the GE\_NT card.
- The forwarding port on the GE\_NT card, which is a converter function dedicated to 1 ATM VC and 1 VLAN. The VLAN is connected to more forwarding ports, while it is shared.
- The VLAN at Ethernet side of the GE\_NT card.
- QOS ( ATM Qos ⇔ Ethernet p-bit).
- Relation Qos ⇔ forwarding port converter function.

#### The ATM VC

The subtended ATM DSLAM NT is connected via an STM-1 link to the LT of a “GE\_NT Aggregator”, which is an ATM VC cross-connect, equipped with ATM LTs at the access side and a GE\_NT card and more ATM LTs at the network side.

Each ATM VC from the Bitstream (Re)ADSL(2+) over ATM-DSLAM user is

VC cross-connected to 1 forwarding port on the GE\_NT card, forwarding the data in the VC connection to a VLAN, shared by different users.

<sup>2</sup> For security reasons, parameters will not be publicly shared. Beneficiary shall contact Proximus if he has the need to receive this information.



### The forwarding port

The forwarding port is the termination of the ATM VC on the GE\_NT card and has the following characteristics:

- A 1 to 1 relation to each ATM VC.
- A protocol converter function :
  - PPP aware bridge: supports PPPoA and PPPoE.
  - Residential Bridge: supports IPoE.
- VLAN at Ethernet side: one VLAN supports multiple forwarding ports with the same protocol converter function.

### VLANs at Ethernet side

Eight VLANs per OLO are preconfigured in each GE-NT card, conforming to the Bitstream VDSL2 with Shared VLANs service, differentiated by a priority level, two VLANs for each priority:

- Best effort, for p0-tagged Ethernet frames (two bridges: P0 & P0bis),
- Low priority, for p1-tagged Ethernet frames (two bridges: P1 & P1bis),
- Medium priority, for p3-tagged Ethernet frames (two bridges: P3 & P3bis),
- Highest priority, for p5-tagged Ethernet frames, and better performance for jitter and delay sensitive traffic (two bridges: P5 & P5bis).

### QoS

The ATM QoS (ATM Transfer Capability) in the subtended DSLAM, the GE\_NT aggregator and the VLAN will be the same and linked to the Ethernet p-bit service in a fixed manner (see Table 1 below).

### Relation QoS ⇔ forwarding port converter function

Following relation is fixed:

- To limit the number of combinations,
- Because PPP is mostly used for Fast Internet Access, using UBR/PO.

ATM QoS in subtended DSLAM	ATM QoS in aggregator	VLAN Service	Forwarding port converter function
CBR	CBR	P5 & P5bis	Residential bridge
VBR-rt	VBR-rt	P3 & P3bis	Residential bridge
VBR-nrt	VBR-nrt	P1 & P1bis	Residential bridge
UBR	UBR	P0 & P0bis	PPP-aware bridge

**Table 1: Fixed relation between QoS and protocol converter function**

## 3.2 Aggregation Network

The Bitstream (Re)ADSL(2+) over ATM-DSLAM service shares the Aggregation Network defined in the document “Bitstream VDSL2 – Annex 2C – Technical Specifications”, sections “Aggregation Network structure”, “Aggregation Areas” and “VLAN characteristics” with the other Bitstream services ((Re)ADSL(2+) over IP-DSLAM and VDSL2).

Most important characteristics:

- Max 8 bridges (p0, p1, p3, p5, p0bis, p1bis, p3bis, p5bis) in the Ethernet node in the LEX, for all Bitstream services.
- VLAN connectivity per bridge, up to an OAL, ordered by the OLO.

Proximus connects the bridges in the “access nodes” (see Figure 1) to corresponding bridges in the GE\_NT aggregator via VLANs, for the Bitstream (Re)ADSL(2+) over ATM-DSLAM service.

The traffic in those VLANs will be shaped in the downstream direction to preconfigured bandwidths, in order to protect the service on the STM-1 links (150Mbps) situated further in the downstream direction, between the Ethernet Aggregator and the subtended DSLAMs:

- P0 or P0bis VLAN: shaped to 90 Mbps per GE\_NT aggregator.
- P1 or P1bis VLAN: shaped to 40 Mbps per GE\_NT aggregator.
- P3 (or P3bis) or P5 (or P5bis) VLAN: shaped to 20 Mbps per GE\_NT aggregator.

As described in the document “Bitstream VDSL2 – Annex 2C – Technical Specifications”, the OAL can also be of the type “Multichassis LAG OAL”. The “Multichassis LAG OLO Access Line” has 2 links, one to each of the two Service PoPs of the Area. One link is working, the other is standby.

## 3.3 Protocol architecture

### 3.3.1 Bitstream (Re)ADSL(2+) over ATM-DSLAM

Bitstream (Re)ADSL(2+) over ATM-DSLAM is an Ethernet service. The protocol architecture applied in a specific ATM VC depends on the protocol converter function of the forwarding port.

#### PPP-aware bridge

The “PPP-aware bridge” mode on the GE\_NT allows for the PPPoE and PPPoA protocol stacks at DSL side, with an automatic detection and line identification addition.

It does not offer a transparent Ethernet service, but a PPP service =>

- The PPP session from the CPE (PPPoA or PPPoE) is terminated on the GE\_NT and the GE\_NT starts a new PPPoE session (always PPPoE) with the upstream router at the OLO BAS.
- Rigorous compatibility is required with :
  - the PPP client in the CPE or Computer (case of PPP pass through by the modem),
  - the PPP server in the OLO BAS.
- The MAC address is the MAC address of the GE\_NT card => all PPP sessions related to the same R5 GENT aggregator have the same MAC address @ OLO BAS.
- The session can only be started by the customer PPP client, not by the PPP server in the OLO-BAS.
- Session time out: after 300 sec without traffic, the PPP function in the GE\_NT closes the session.
- Limitation of the number of PPP sessions: 1 in case of PPPoA, 1 PPP session per MAC address in case of PPPoE.

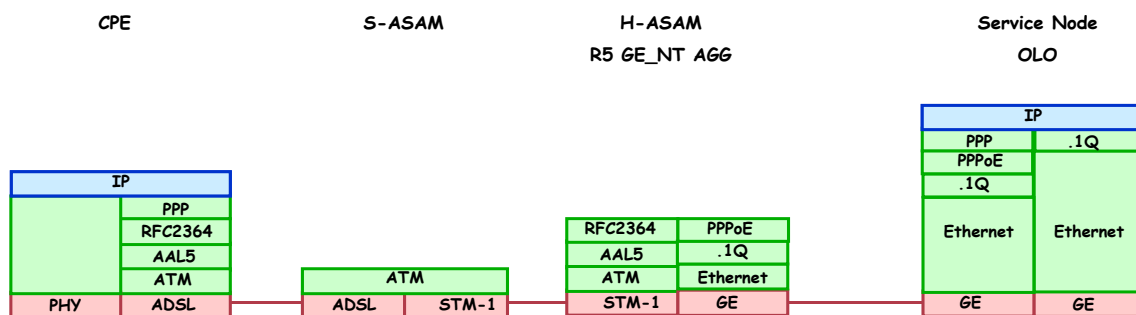


Figure 2: Bitstream (Re)ADSL(2+) over ATM-DSLAM (with PPPoA) protocol stack

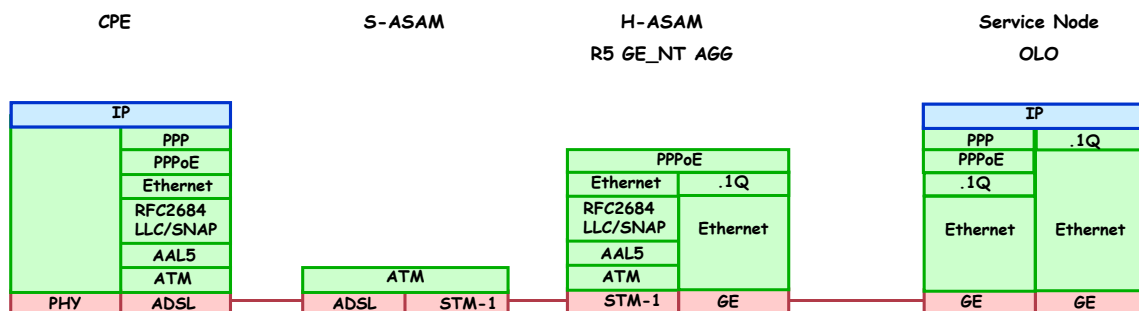


Figure 3: Bitstream (Re)ADSL(2+) over ATM-DSLAM (with PPPoE) protocol stack

## Residential Bridge

The “Residential Bridge” mode on the GE\_NT allows for IPoEoA, with an automatic detection and line identification addition: this is transparent, just as was ATM, but now at Ethernet level.

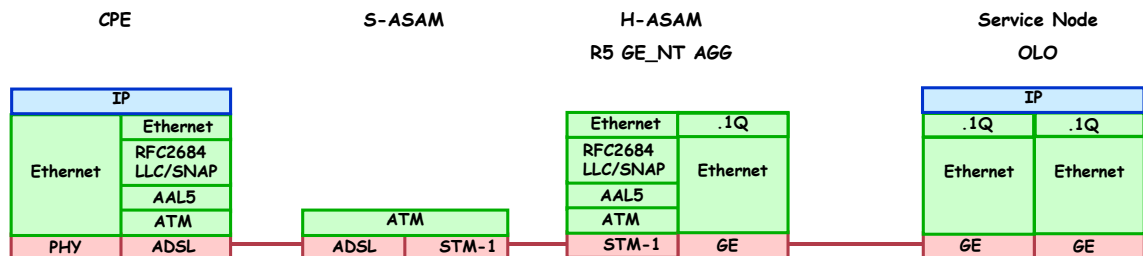


Figure 4: Bitstream (Re)ADSL(2+) over ATM-DSLAM (with IPoE) protocol stack

- The line identification will be added for DHCP (Option 82).
- The session must be set up by the user CPE, in order to allow the bridge to learn the source MAC address. Sessions initiated via the network are not allowed by the Residential Bridge (as this would cause broadcast to all customers).
- Meaning of Forwarding mode: “Residential Bridge”:
  - Upstream MAC learning.
  - Downstream forwarding to the correct forwarding port (ATM VC) based on learned MAC addresses. The MAC address is kept learned until it is flushed (timer actually on 900 sec).
  - Client (user) server behaviour.
  - Discard of downstream broadcast and multicast.
  - Discard of downstream unknown Destination MAC addresses.
  - Discard of upstream multicast.
  - Forwarding of upstream broadcast to the VLAN, connected to the forwarding port, only (not to other users).
  - Limitation of the number of MAC addresses.

### 3.3.2 Limitations to protocol stacks

The limitation in protocol stack for Bitstream (Re)ADSL(2+) over ATM-DSLAM makes that all other protocol stacks (than listed above) are not supported, e.g. following ATM applications:

- IP/AAL5 RFC2684 routed/ATM (IPoA),
- Circuit Emulation/AAL1/ATM,
- Voice on ATM/AAL2/ATM (used in UMTS),
- Signalling/SSCOP/AAL5/ATM (used in UMTS),
- Frame Relay/AAL5/ATM,
- OAM/ATM: use of OAM cells is not possible anymore.

Other protocol related limitations:

- R5 GE-NT AGG supports Ethernet II and 802.3 LLC/SNAP (LLC=SNAP) frames. 802.3 frames with 802.2 LLC encapsulation (without 802.2 SNAP) are not supported.
- R5 GE-NT AGG only transmits Ethernet frames with Ethernet v2 encapsulation. 802.3 LLC/SNAP frames will be converted to Ethernet II frames by R5 GE-NT AGG.

- Frames with destination MAC address in the range 01-80-C2-00-00-0x(x=0...F) are dropped.

## 4. Overall Network Architecture for “Dedicated VLAN”

### 4.1 End-to-End View

#### 4.1.1 Architecture

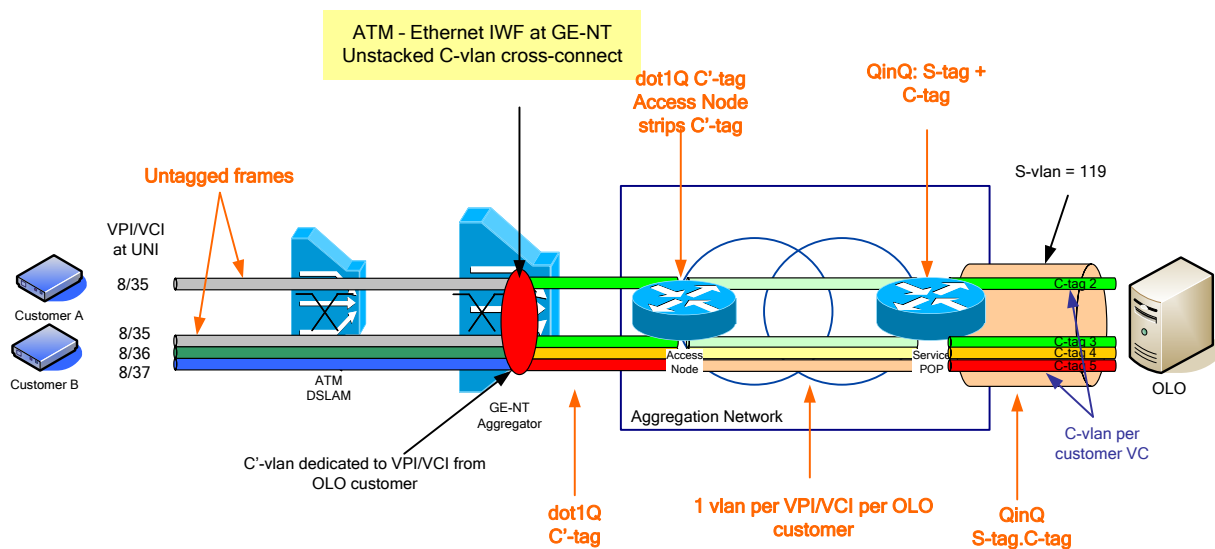


Figure 5: E2E Architecture

#### Upstream:

In the GE-NT aggregator each ATM VC is mapped to a unique C'-tag. At the ingress of the Aggregation Network (Access Node), the C'-tag is removed. The traffic of each VPI/VCI is mapped within a VLL. At the egress interface of the Aggregation Network (Service POP), a C-tag per VPI/VCI and a S-tag is added.

This implies that the OLO receives S/C tagged frames at the OAL.

#### Downstream:

At the OLO service node S/C-tagged frames are sent. At the ingress of the Aggregation Network (Service POP), the S/C tags are removed. At the egress of the Aggregation Network (Access Node), a dedicated C'-tag is added. In the GE-NT each C'-VLAN is mapped to 1 ATM VPI/VCI at UNI.

## 4.1.2 Encapsulation

Protocol stack - IPoE

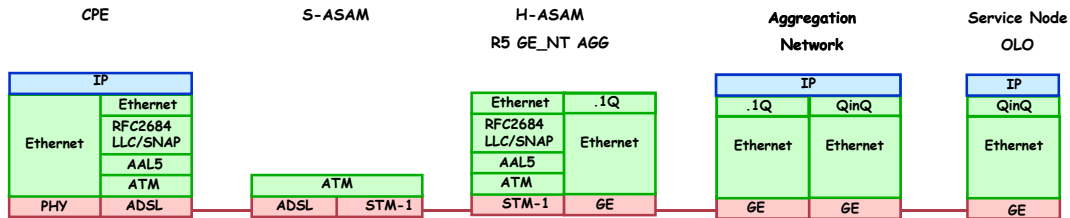


Figure 6: Protocol Stack

Limitations to protocol stacks:

See chapter 3.3.2.

## 4.1.3 Quality of Service

### 4.1.3.1 Layer 2 QoS

#### 4.1.3.1.1 Layer 2 QoS upstream

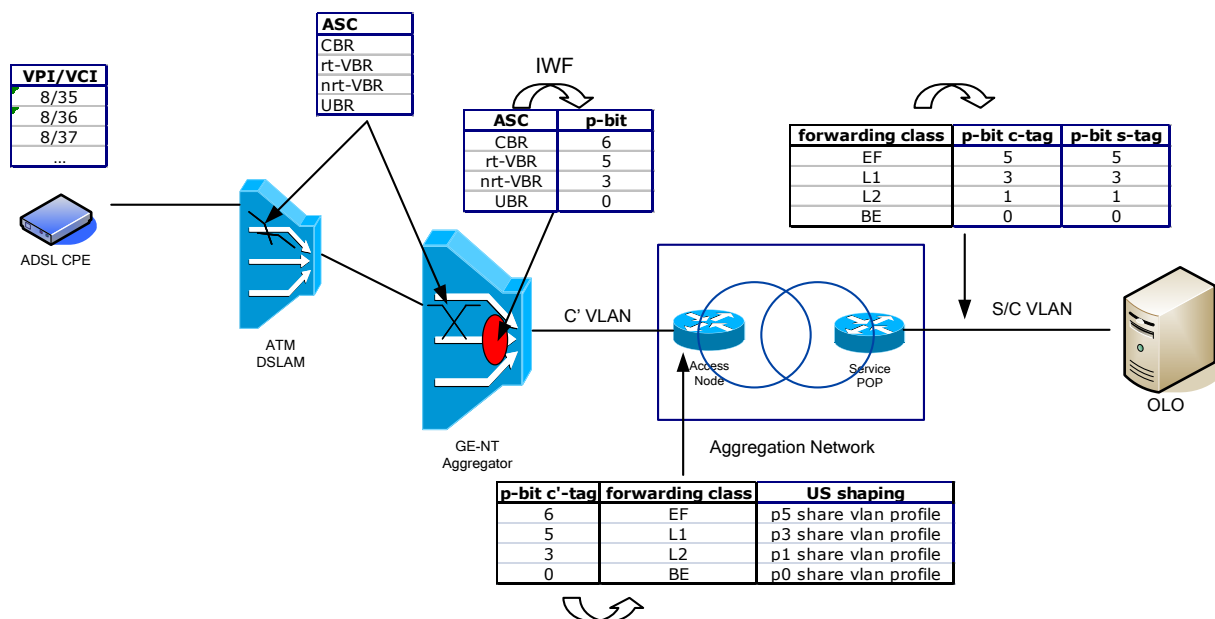


Figure 7: Layer 2 QoS upstream Un-stacked C-VLAN with S-VLAN at OAL

Each VPI/VCI from the OLO receives a dedicated C-VLAN. On top of this it receives at the OAL an S-tag. The p-bit of both S- and C-tag corresponds with the ATM Service Category of the VPI/VCI on the UNI. See table below.

ATM Service Category	p-bit S- and C-VLAN @ OAL
UBR	0
Nrt-VBR	1
Rt-VBR	3



CBR	5
-----	---

Example:

User A

UNI		OAL	
VPI/VCI@UNI	ATM profile	C-tag + p-bit	S-tag + p-bit
8/35	Nrt-VBR-2048_512	2 + p1	119 + p1

User B

UNI		OAL	
VPI/VCI@UNI	ATM profile	C-tag + p-bit	S-tag + p-bit
8/35	UBR_128_0	3 + p0	119 + p0
8/36	Rt_VBR 2048_512	4 + p3	119 + p3
8/37	CBR_64	5 + p5	119 + p5

An example for the upstream shaping of VLAN profiles of users A & B could be:

VLAN profiles	Up speed p0	Up speed p1	Up speed p3	Up speed p5
User A – 119/2	0	2048	0	0
User B – 119/3	128	0	0	0
User B – 119/4	0	0	512	0
User B – 119/5	0	0	0	64

# 4.13.12 Layer 2 QoS downstream

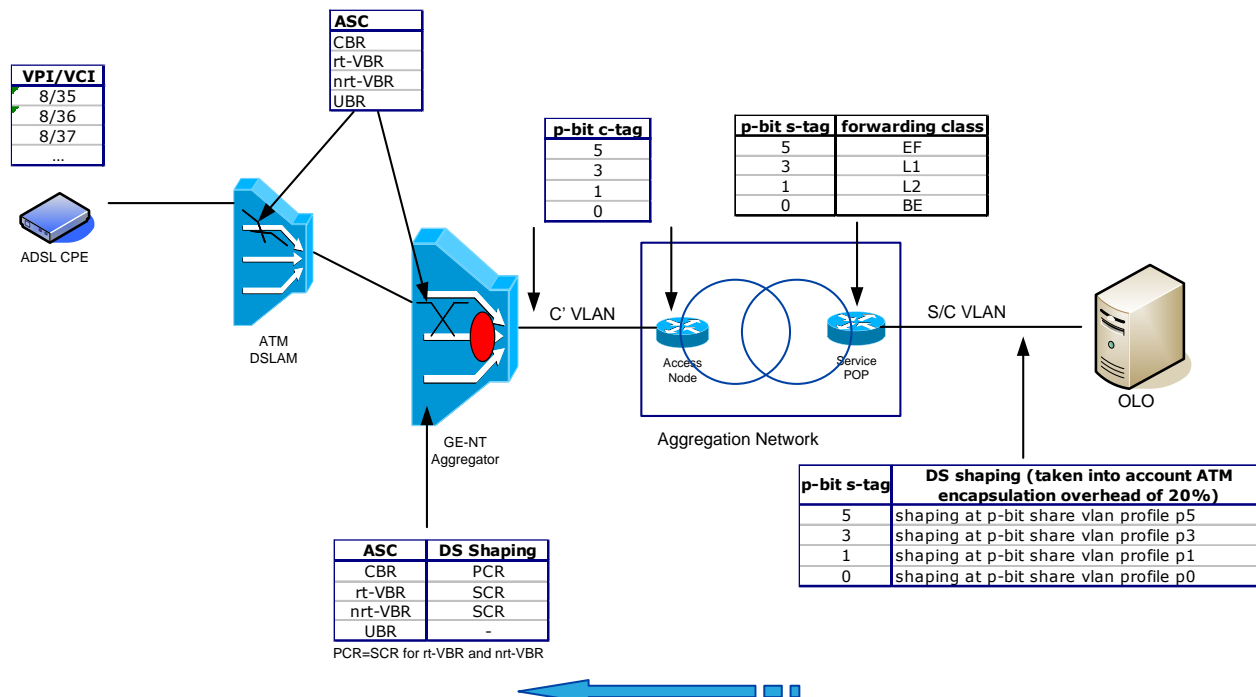


Figure 8: Layer 2 QoS downstream Un-stacked C-VLAN with S-VLAN at OAL

Example:

UNI				OAL	
User	VP/VC	ATM profile		C-tag + pbit	S-tag + p-bit
		upstream	down		
A	8/35	NrtVBR-512_256	nrtVBR_8192_2048	2 + p1	119 + p1
B	8/35	UBR_2048_512	UBR_2048_512	3 + p0	119 + p0
B	8/36	Rt-VBR 512_256	Rt-VBR 512_256	4 + p3	119 + p3
B	8/37	CBR_64	CBR_64	5 + p5	119 + p5

Example of shaping downstream per p-bit

	S/C-tag	p-bit	reference (kbps)	taken into account ATM overhead (kbps)
user A	119/2	1	8192	6554
user B	119/3	0	2048	1638
	119/4	3	512	410
	119/5	5	64	51

Note: per S/C-tag the shaping should take into account the ATM overhead inserted by the IWF in the GE-NT (circa 20%).

## 4.1.3.2 Layer 3 QoS

### 4.1.3.2.1 Layer 3 QoS upstream

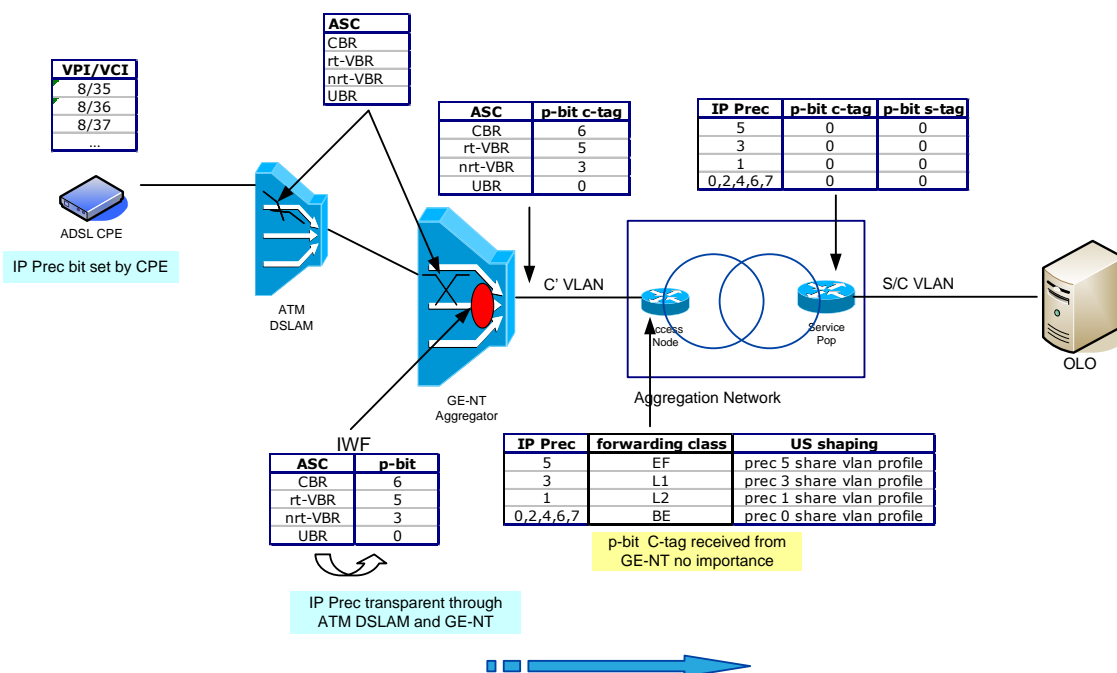


Figure 9: Layer 3 QoS upstream Un-stacked C-VLAN with S-VLAN at OAL

Each VPI/VCI from the OLO receives a dedicated C-VLAN. At the OAL on top of the C-tag an S-tag is added. Both S- and C-tag have a p-bit of '0'.

The VLAN (corresponding to each VC) can bear different IP-precedence types of traffic as for instance:

UNI				OAL	
User	VP/VC	ATM profile			S/C-tag + p-bit
		upstream	down	precedence	
A	8/35	NrtVBR-512_256	nrtVBR_8192_2048	0	119/2 + p0
				3	119/2 + p0
B	8/35	UBR_2048_512	UBR_2048_512	1	119/3 + p0
				3	119/3 + p0
B	8/36	Rt-VBR 512_256	Rt-VBR 512_256	3	119/4 + p0
				5	119/4 + p0

### Example of a VLAN upstream share

(based on the example here above)

User	VLAN	IP-precedence	kbps
A	119/2	0	512
		3	64
B	119/3	1	2048
		3	64
B	119/4	3	256
		5	64

### 4.13.2.2 Layer 3 QoS downstream

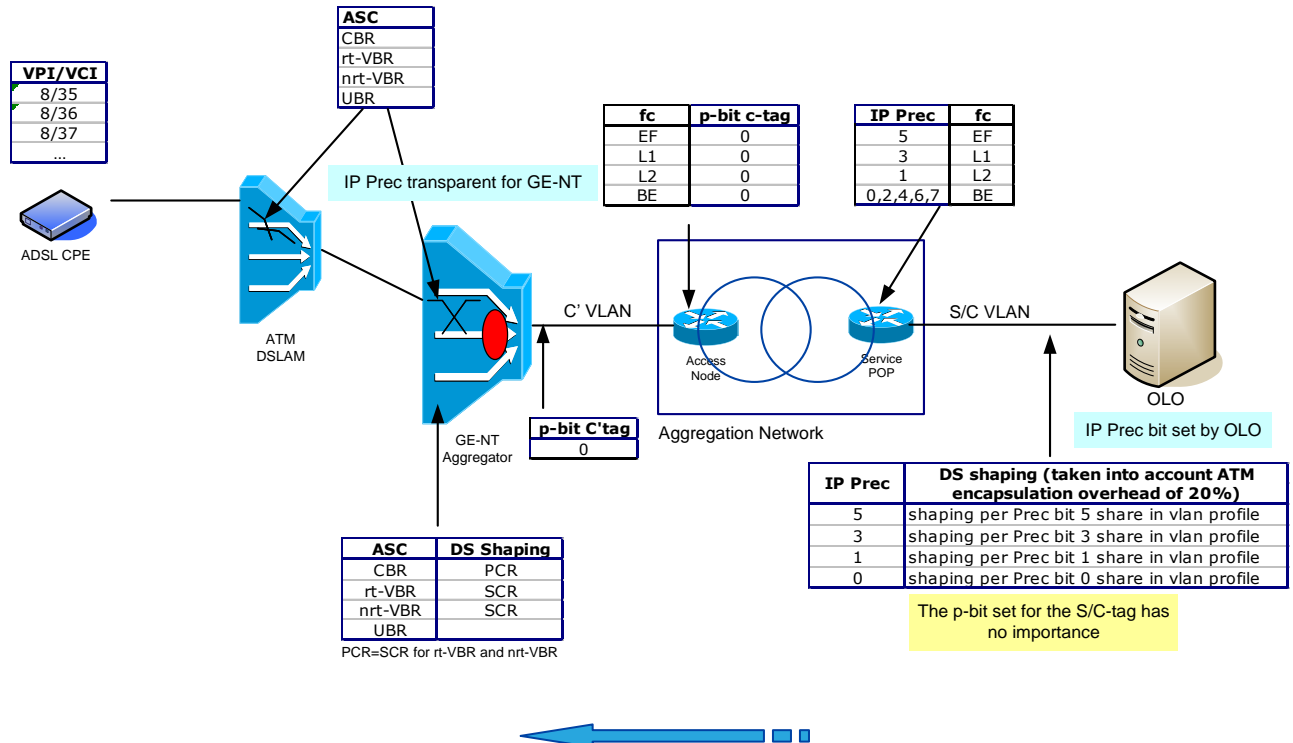


Figure 10: Layer 3 QoS downstream Un-stacked C-VLAN with S-VLAN at OAL

User	VP/VC	ATM profile		OAL	
		upstream	down	IP-precedence	S/C-tag +p-bit
A	8/35	NrtVBR_512_256	nrtVBR_8192_2048	0	119/2+ p0
				3	119/2+ p0
B	8/35	UBR_2048_512	UBR_2048_512	1	119/3 + p0
				3	119/3 + p0
B	8/36	RtVBR 512_256	RtVBR 512_256	3	119/4 + p0
				5	119/4 + p0

Example of shaping profile per IP-precedence bit at OAL:

User	S/C VLAN	IP-precedence	kbps
A	119/2	0	8192
	119/2	3	64
B	119/3	1	2048
	119/3	3	64
B	119/4	3	512
	119/4	5	64

Example of shaping per S/C-tag at OLO:

User	S/C VLAN	Reference (kbps)	taking overhead into account (kbps)
A	119/2	8192	6553
B	119/3	2048	1638

	119/4	512	409
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This type of QoS handling allows to use different IP-precedence bits for marking the traffic in one VC upstream or in one VLAN downstream.

## 4.2 (Subtended) ATM DSLAM

The **Bitstream (Re)ADSL(2+) over ATM-DSLAM** users are connected through (Re)ADSL(2+) or SDSL lines to ATM DSLAMs.

## 4.3 GE-NT Aggregator

The subtended ATM DSLAM NT is connected via an STM-1 link to the LT of a “GE-NT Aggregator”.

### 4.3.1 Forwarding Mechanism

On the GE-NT, the un-stacked C-VLAN cross-connect model is used. This means that each ATM VC is mapped to a unique C'-tag by the GE-NT.

The main advantage is the clear segregation of customer traffic.

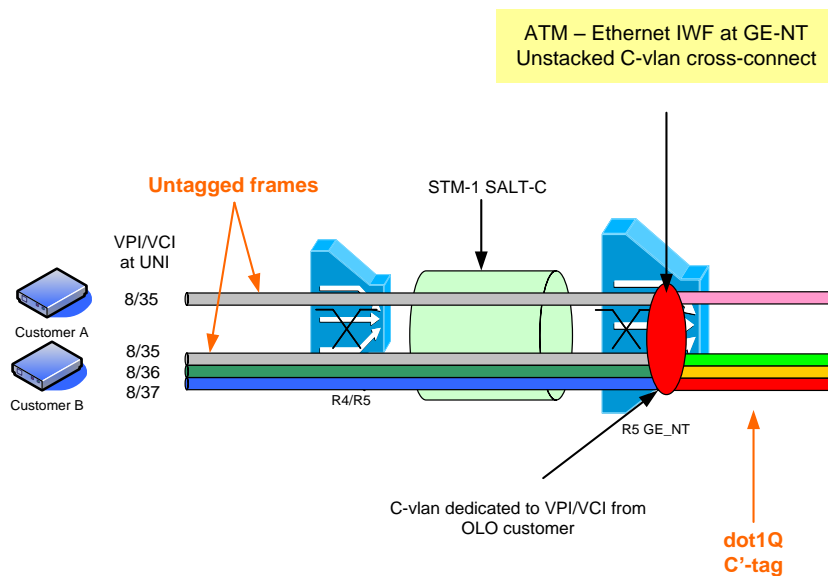


Figure 11: GE-NT unstacked C-VLAN model

Each ATM VC from the Bitstream (Re)ADSL(2+) over ATM-DSLAM user is VC cross-connected to 1 forwarding port on the GE-NT card, forwarding the data in the VC connection to the C-VLAN cross-connect.

The forwarding port is the termination of the ATM VC on the GE-NT card and has the following characteristics:

- 1 to 1 relation to each ATM VC
- ATM/Ethernet Interworking Function

## 4.3.2 Quality of Service

### 4.3.2.1 ATM

The ATM traffic descriptor of the cross-connections configured on the GE-NT is aligned with the traffic descriptor of the End-User cross-connections on the subtended ATM-DSLAM.

However, due to downstream shaping at SCR for nrt-VBR and rt-VBR of the PVC, the SCR will be aligned with the PCR for nrt-VBR and rt-VBR.

Example:

ATM profile	S-ATM-DSLAM	GE-NT AGG
Up (ASC / PCR / SCR)	Nrt-VBR / 2048 / 512	Nrt-VBR / 2048 / 512
Dn (ASC / PCR / SCR)	Nrt-VBR / 2048 / 512	Nrt-VBR / 2048 / 2048

Policing/Shaping:

- Upstream:  
Policing in upstream performed on LT subtended DSLAM on PVC level according to the traffic descriptor. Implicitly, there is rate limitation to the DSL synchronisation rate.
- Downstream:  
Traffic coming from the interworking function on GE-NT is shaped at SCR according to the traffic descriptor associated with the PVC.

#### 4.3.2.2 Ethernet QoS

Classification & Marking:

- Upstream:  
P-bit marking at GE-NT is performed according to the default ASC to P-bit mapping table defined at system level:

ASC	P-bit
CBR	6
rt-VBR	5
nrt-VBR	3
UBR	0

It is not possible to classify based upon DSCP.

- Downstream:  
Frames arriving downstream to the GE-NT are assumed to be correctly marked.



#### Mapping & Queuing:

The GE-NT supports 4 queues, one per traffic class. Following P-bit to queue mapping is implemented on the GE-NT. The latter is not configurable.

802.1p value	Traffic Class
111 110	High
101 100	Medium
011 010	Low
001 000	Lowest

#### Scheduling:

Priority Scheduling (not configurable):

- High traffic class traffic gets scheduled first (Strict Priority)
- Medium traffic class is scheduled next (Strict Priority)
- Packets from Low and Lowest traffic class compete for BW in a fair manner (WFQ with hard-coded weights of respectively 10 and 1).

## 4.4 Aggregation Network

The Bitstream (Re)ADSL(2+) over ATM-DSLAM service “with Dedicated VLAN” is deployed in the Aggregation Network as defined in Annex 2C – Technical Specifications, sections “Aggregation Network structure” and “Aggregation Areas”.

## 5. QoS specifications

The QoS specifications as set out hereafter are applicable to both Shared VLAN and Dedicated VLAN. They are to be considered indicative values which serve only for reference purposes.

Service quality	Type	ADSL	SDSL
CBR	Delay	< 32 ms	< 16 ms
	Jitter	< 9 ms	< 9 ms
rt-VBR	Delay	< 36 ms	< 20 ms
	Jitter	/	/
nrt-VBR	Delay	< 56 ms	< 40 ms
	Jitter	/	/
UBR	Delay	/	/
	Jitter	/	/

### 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 ATM part (R5 GENT SALT-C and subtented ATM-DSLAM part): CBR, rt-VBR, nrt-VBR services policing & shaping is based upon the ATM traffic profile taking into account the PCR, SCR, CDVT, MBS.

Main assumptions:

- Averages over 5 min.
- Frame sizes:

p5 service quality	128 octets
p3 service quality	512 octets
p1 service quality	1400 octets

- Ethernet Service speed of 2Mbps.
- Ethernet traffic aligned with VLAN profile.
- Outside saturation, max 80% load on OAL and DSL line. Max 50% p5 service quality.

## 6. UNI

Unless specified otherwise, this section equally refers to the two types of service: with Shared and with Dedicated VLANs.

### 6.1 Physical Transport (Layer 0)

#### With and without voice products

- “With voice” means: data service offered in combination with a Proximus PSTN/ISDN line.
- “Without voice” means: data service offered without combination with a Proximus PSTN/ISDN line.

### 6.2 NTP & Splitters

Reference is made to the chapter “Network Termination Point for ADSL, Re-ADSL2, ADSL2+ and SDSL” in the Main Body.

### 6.3 DSL profiles at UNI (Layer 1)

The (Re)ADSL(2+) and SDSL line profiles are documented in the chapter “Activation of ADSL, Reach Extended ADSL2, ADSL2+ or SDSL on a specific End-User line” in the Main Body.

### 6.4 ATM profiles at UNI (Layer 2)

The ATM profiles are defined in the Main Body.

The ATM Transfer Capabilities (CBR, VBR-rt, VBR-nrt, and UBR) are valid.

Number of VCs: max 4 VCs.

E2E ATM OAM (I.610): not supported

CLP bit: not supported in downstream, can be set in upstream.

### Policing/Shaping

- Upstream: ADSL synchronisation rate.
- No policing is applied to UBR PVCs. In case of VC with ATM transport capability different from UBR, the modem must perform upstream shaping per VC.
- Downstream: traffic coming from the interworking function on GE\_NT is shaped to PCR, except for UBR.

## 6.5 AAL (ATM Adaptation Layer)

AAL 5 only.

RFC 2684 bridged mode & PPPoE.

RFC2364 in case of PPPoA (Shared VLAN only and for pO/UBR).

## 6.6 Ethernet

Native Ethernet only. MTU size: the maximum length of the Data – Field is 1500 octets.

### “Shared VLAN”:

The MAC address needs to be **unique** within a bridge (VLAN at OAL). Two VCs on the same bridge (= same p-bit) will be allowed => MAC address uniqueness within the same bridge is an important requirement for the CPE, which shall have different MAC addresses on different VC's !

### “Dedicated VLAN”:

Because no MAC learning is applied in the Proximus network, MAC address uniqueness is not required (at least not for the PXS network, maybe for the OLO network).

## 6.7 Security

This chapter documents the known limitations based on tests performed on the current ATM-DSLAM firmware.

### 6.7.1 Shared VLAN

#### No user-to-user communication

- Frames received from a user will always be sent towards the network and never to another user.

#### Prevention of Broadcast storms

- Downstream:
  - All broadcast frames are dropped including specific control protocol e.g. ARP Requests
  - Ethernet frames with unknown destination MAC@ are dropped and not flooded as within a standard L2 bridge.

#### Limit number of MAC@ per PVC (Residential Bridge): max 4

#### MAC anti-spoofing (Residential Bridge)

It prevents duplicate MAC addresses within the same VLAN during a certain session. Traffic of the duplicate MAC address is blocked. No alarm is generated. Bridge port of the End-User is blocked.

The MAC anti spoofing feature cannot be disabled. The duplicate MAC is removed after ageing timer. It is not possible to clear the duplicate MAC.

### 6.7.2 Dedicated VLAN

- Frames with destination MAC address in the range 01-80-C2-00-00-0x(x=0..F) are dropped.
- All traffic that is processed in the GE-NT aggregator (incl. PADx, DHCP) is protected through a DoS protection mechanism.

## 7. Modem

### 7.1 Required modem

The OLO user can keep on using the Bitstream (Re)ADSL(2+) over ATM-DSLAM modems as far as these support the UNI specifications, especially the protocol stack.

For Residential bridge only

MAC address issue: the OLO shall be well aware of the MAC address uniqueness requirement per Bridge.

E.g.: (Re)ADSL(2+) over ATM-DSLAM modems having all the same MAC address for Internet => not allowed.

E.g.: (Re)ADSL(2+) over ATM-DSLAM modems having the same MAC address for VoIP VC and Internet => not allowed to connect VoIP and Internet on the same bridge (will happen if OLO orders the same ATM QoS for both services).

### 7.2 ATM OAM pings

Interworking between I.610 F5 loopback end-to-end to IEEE 802.1ag (CFM) is not supported by GE\_NT.

### 7.3 CPE non compliance (non exhaustive)

Following CPEs are not compatible with the Bitstream (Re)ADSL(2+) over ATM-DSLAM implementation:

- All modems configured to use ATM OAM (ATM OAM is not supported),
- USB modem with PC equipped with the operating system "Windows 98" or "Windows Millennium".

The latest version of the "white list" of tested and compatible CPEs is published on the secured part of the Proximus wholesale website.



## 8. OLO Access line

The OLO Access Line (OAL) is the OAL defined in Annex 2C – Technical Specifications, section “OLO Access Line”.

### 8.1 “Shared VLAN”

A VLAN @ OAL can carry a mix of Bitstream (Re)ADSL(2+) over ATM-DSLAM traffic and other Bitstream xDSL traffic ((Re)ADSL(2+) over IP-DSLAM and VDSL2).

Reference is made to the document “Bitstream VDSL2, Annex 2C – Technical Specifications”, section “VLAN characteristics” for the offered VLAN bandwidths and granularities.

#### 8.1.1 Line identification

The line identification is similar as in Bitstream VDSL2 but the format is different.

##### Agent Circuit ID

- Format:  
The PPPoE discovery procedure is lined up with the DHCP session set-up (in option 82) regarding the format of the “Agent Circuit ID”:

**“<Access-Node-Identifier> ATM <rack>/<shelf>/<slot>/<Port>:<VPI>.<VCI>”**

Example: “C02STR00001 atm 3/2/03/01:10.333”

Naming convention of “Access-Node-Identifier” for R5 GENT AGG:

**C(1) & <BCT>(5) & <subnet number>(3) & <DSLAM number> (2)**

- Difference with IP-DSLAM VDSL2 “Agent Circuit ID” in Bitstream VDSL2:
  - The name of the DSLAM will be the Ethernet Aggregator (see graph 1) .
  - “Eth” => “ATM”.
  - Instead of VLAN you will have VPI/VCI. The VPI/VCI will be the one configured on STM-1 port of the SALT-C so identical to the VPI/VCI on the subtended DSLAM.
- Auto generated : yes in upstream and removed in downstream.
- Unique: yes. The information in the resp. fields of the Agent Circuit ID are of little importance for the OLO but the whole Agent Circuit ID forms a unique key to identify 1 specific ATM VC on any (Re)ADSL(2+) over ATM-DSLAM line (i.e. 2 VC connections on the same (Re)ADSL(2+) over ATM-DSLAM line will have different Agent Circuit IDs) (at least the VCI field will be different, e.g.: C02STR00001 atm 3/2/03/01:10.2333).

## 8.2 “Dedicated VLAN”

### 8.2.1 VLAN ID range

Per OAL, the S-VLAN ID is unique per OAL and allocated by Proximus per decreasing order in the range [119, 110], for all Dedicated VLANs.

The C-VLAN ID is unique per S-VLAN-ID and allocated “first free” in the range [2,4094] .

The next free C-tag on a fixed sequence of S-tags is taken, descending from 119, 118, 117,... 110:

S=119 C=2,3,...4094, which allows 4093 Dedicated VLANs or VCs, then go to

S=118 C=2,3,...4094 which allows another 4093,...

S=117 C=2,3,...4094

...

S=110 C=2,3,...4094

### 8.2.2 Line identification

The customer is identified via the S+C-tag.

### 8.2.3 VLAN profile (QoS)

QoS: the OLO shall associate 1 MonoQoS VLAN profile to every VLAN at OAL.

The OLO can choose profiles coming from two pools:

- The OLO can define an own pool with up to 10 Dedicated MonoQoS VLAN profiles (for its own use);
- The OLO can choose from a common pool of Dedicated MonoQoS VLAN profiles. These profiles 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 “MonoQoS VLAN profile” has the following attributes:
  - Layer 2 (p-bit) or Layer 3 QoS (IP-precedence); applicable for both upstream and downstream
  - P-bit
  - Maximum Upstream bandwidth for one chosen p-bit (bandwidth p0, bandwidth p1, bandwidth p3 or bandwidth p5)
  - Maximum Downstream bandwidth for the same chosen p-bit (bandwidth p0, bandwidth p1, bandwidth p3 or bandwidth p5)

The OLO can order different MonoQoS VLAN profiles on different ATM VCs of a single Bitstream (Re)ADSL(2+) over ATM-DSLAM line.

The attributes of a VLAN profile are identical for all xDSL End-Users 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.

The service offers primarily a layer 2 QoS (p-bit based) but also allows a layer 3 QoS. The following table shows the baseline of the equivalence:

Equivalence of Layer 2 QoS / Layer 3 QoS		
	Layer 2 QoS (p-bits)	Layer 3 QoS (IP-precedence bits)
Best effort	0	0
Low priority	1	1
Medium priority	3	3
Highest priority	5	5

The VLAN profile is policing all Ethernet packets of the Dedicated VLAN.

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

Shaping at OLO network in the downstream direction towards the OLO customer shall take into account:

- ☐ The ordered VLAN profile of the VLAN.
- ☐ The downstream shaping of ATM traffic on the ATM VC in the GE-NT aggregator, taking into account the ATM overhead of about 20% !
- ☐ The physical bandwidth of the DSL line.

Shaping at the OLO customer CPE in the upstream direction shall take into account:

- ☐ Policing on ATM VC:
  - CBR: on PCR
  - Rt-VBR: on PCR/SCR/MBS following VBR1
  - Nrt-VBR: on PCR/SCR/MBS following VBR3
  - UBR: no policing

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