



Proximus Reference Offer for Wholesale Multicast Services

Annex 2: Technical specifications

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1. Glossary

Only the terminology not described in the Main Body of the present Multicast offer is added below:

- **CAC** Connection Admission Control
- **DHCP** Dynamic Host Configuration Protocol
- **DS** Downstream
- **GE** Gigabit Ethernet
- **IPoE** Internet Protocol over Ethernet
- **LACP** Link Aggregation Control Protocol
- **LAG** Link Aggregation
- **LAN** Local Access Network
- **LTE** Line Termination Equipment
- **MTU** Maximum Transmission Unit
- **PoP** Point of Presence
- **PPP** Point to Point Protocol
- **PPPoE** Point to Point Protocol over Ethernet
- **US** Upstream
- **U2U** User to User (communication)

2. Scope

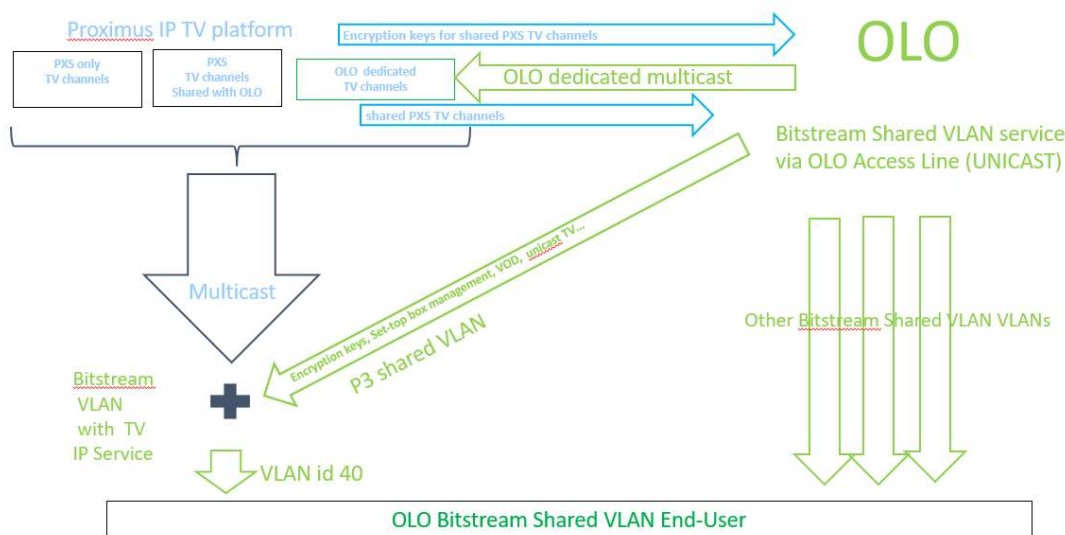
1. The purpose of this document is:
 - To describe the technical specifications of the Wholesale Multicast Central Access Service. Note that the description of the service is available in the Wholesale Multicast Services offer, Main Body.
 - To allow the Beneficiary to setup a service based on this service from Proximus, describing the interfaces in detail.
2. Multicast TV Services are based on the Bitstream VDSL2 and Bitstream Fiber GPON offer. Only deltas and specific issues are repeated here further.
3. Prerequisite for a Beneficiary willing to offer this service to its End-Users in a specific LEX, is to have activated a shared VLAN "P3" to this LEX.
4. The Bitstream VDSL2 and Bitstream Fiber GPON "with dedicated VLAN" is not compatible with this service.

3. End-to-end view

5. The End-User, for whom the Beneficiary has ordered Multicast TV Services, will have access to:
 - Multicast Dedicated streams injected by its operator in the Proximus PIM Core network, in a specific way as described further, together with other multicast (e.g. STB update) data. Proximus will allocate to each Multicast Beneficiary a dedicated Multicast Group IP address range for this purpose.
 - Shared TV Channels, shared between Proximus and the multicast Beneficiaries.
6. Both flows are transported together in the Proximus PIM Core network and the aggregation networks, up to the VLAN 40 of the Bitstream lines for which the Beneficiary has ordered Multicast.
7. The TV related unicast to this End-User (e.g. encryption keys, unicast Set-Top Box management, VOD, Unicast TV...) shall be transported via the shared VLAN "P3" and will also be delivered via VLAN id 40 on the Bitstream lines.

Figure 1: Multicast Central Access service

Wholesale multicast with shared TV channels, Central Access



8. The Beneficiary shall obtain encryption keys for the encrypted Shared TV channels, agreed with Proximus and shall distribute them to its End-Users. All Shared TV channels are encrypted.

4. IP-DSLAM / Fiber GPON Platforms

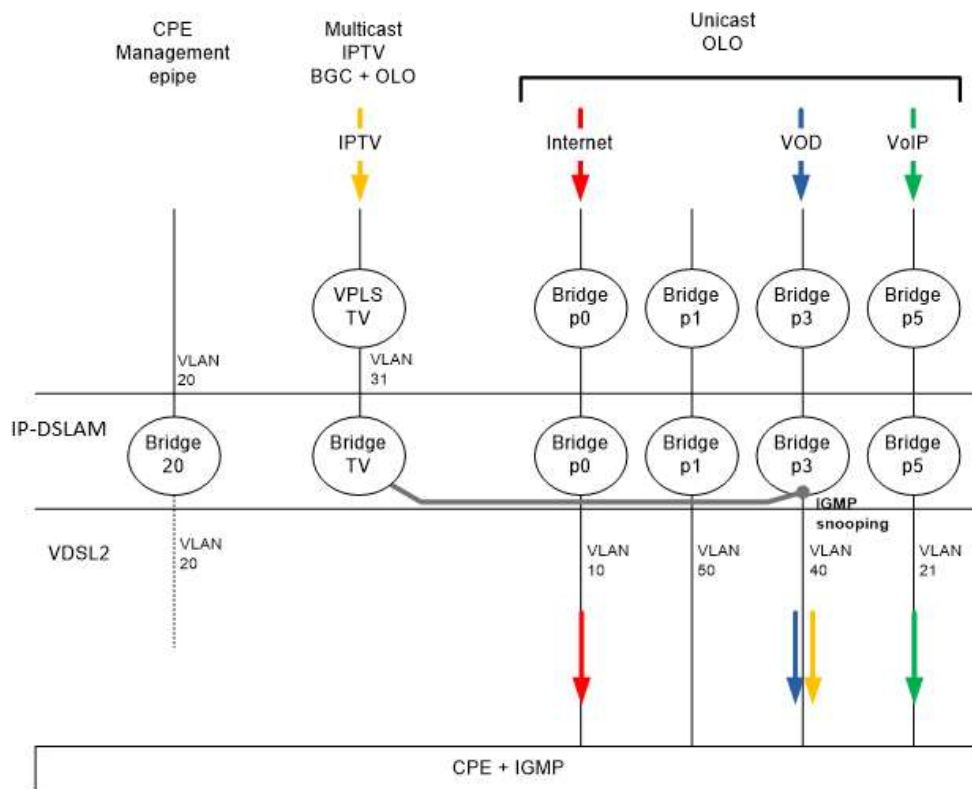
4.1 VLAN ID ALLOCATION

9. The IP-DSLAM/Fiber GPON platforms perform two major functions:

- The Beneficiary's End-User VLAN (VLAN ID 40) is mapped to the Beneficiary's unicast TV VLAN at the uplink with VLAN Translation.
- Multiplexing of Beneficiary's unicast TV VLAN and MC VLAN (uplink) to one VLAN (TV unicast/MC) at the subscriber port.

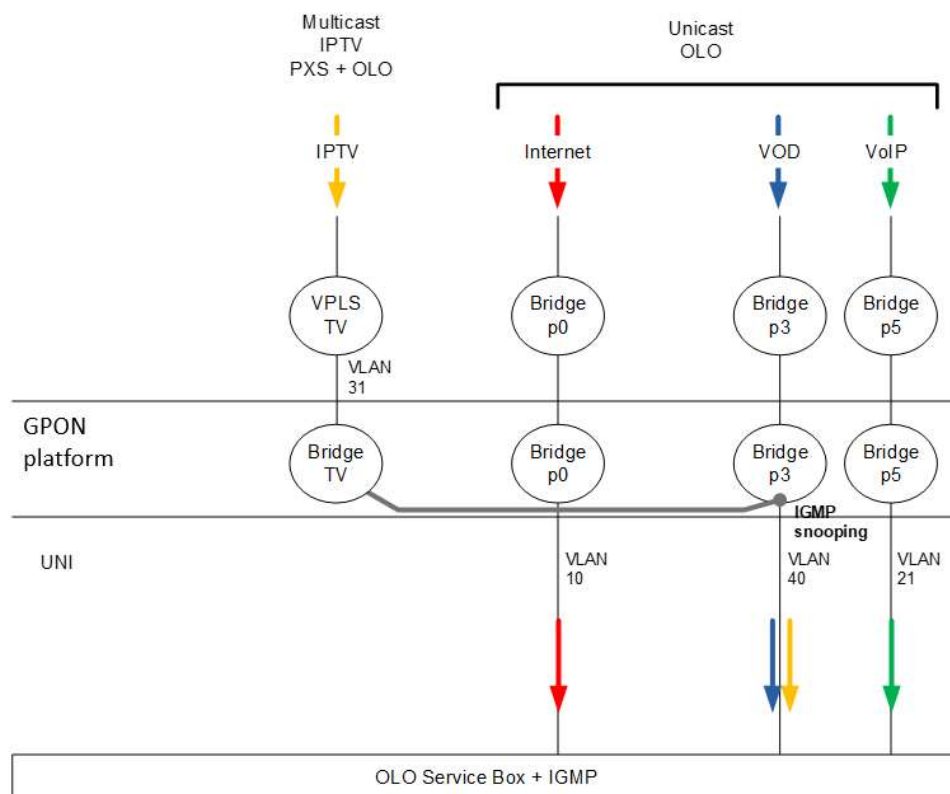
10. For VDSL2: On the UNI 4 VLANs are foreseen in the Bitstream VDSL2 Offer. Multicast will be offered on VLAN 40 (p-bit 3). The latter will be translated to the respective Beneficiary shared VLAN (P3). VLAN 40 will be connected only to the "P3" shared VLAN. The VLAN 40 will contain P3 unicast traffic and P4 Multicast traffic.

Figure 2: IP-DSLAM VLAN ID Allocation



11. For Fiber GPON: On the UNI 3 VLANs are foreseen in the Bitstream Fiber GPON Offer. Multicast will be offered on VLAN 40 (p-bit 3). The latter will be translated to the respective Beneficiary shared VLAN (P3). VLAN 40 will be connected only to the "P3" shared VLAN. The VLAN 40 will contain P3 unicast traffic and P4 Multicast traffic.

Figure 3: Fiber GPON platform VLAN ID Allocation



4.2 Multicast configuration

12. All channels (Proximus Shared TV Channels and the Beneficiary's Multicast Dedicated streams) are configured with ethernet bandwidth in order to provide multicast CAC on Bitstream lines.
13. A Fast leave mechanism is enabled for a multicast stream so the stream is immediately stopped on reception of the leave message if no other users on that line have joined the same stream.
14. IGMP system parameters
 - IGMP proxy. The source IP@ of the IGMP proxy function: 195.13.31.34
 - IGMPv3 with backward compatibility towards IGMPv2.
 - IGMP default system parameters

Table 1: IGMP system parameters

Parameter	Value
Robustness	2
Query interval	125s
Query maximum response time	10s

4.3 Multicast CAC (Connection Admission Control) on the first mile (Bitstream lines)

15. Each multicast group is configured with its respective bandwidth at IP-DSLAM level for VDSL2 and at Fiber GPON platform level for GPON. The latter is expressed as Ethernet bandwidth and corresponds to the peak rate.
16. For VDSL2 upon every IGMP join request, the bandwidth of the requested multicast stream is checked with the available bandwidth on the VDSL2 line. If the available bandwidth is lower than the bandwidth of the requested multicast stream and the stream would still be forwarded towards the End-User, all services of the End-User would be impacted through packet drops.
17. For VDSL2 the available multicast bandwidth is derived from the Actual Line Rate (ALR) and the EFM overhead. The Ethernet EFM overhead factor is used to calculate EFM bandwidth required by streams for which bandwidth parameters are specified as Ethernet bandwidth. A typical overhead of 3% for EFM encapsulation is configured at system level.
18. For Fiber GPON the available multicast bandwidth is derived from ... (will be confirmed later).
19. Formula applied in order to calculate the available multicast bandwidth (BW) on Bitstream lines:
 - For non-vectorized VDSL2 lines: available BW = (Actual Line Rate (ALR) * 97%) – (sum of configured bandwidths for the multicast streams currently received)
 - For vectorized VDSL2 lines: available BW = (Max Expected Throughput rate * 90%) – (sum of configured bandwidths for the multicast streams currently received)
 - For GPON lines: ... (will be confirmed later)
20. There is no portion reserved for voice and data on the line. Only multicast traffic is controlled by the CAC functionality.
21. Formula applied in order to allow a connection (join):

Configured bandwidth of the new stream <= available BW

22. The CAC on VDSL2 and GPON is enabled at system level (will be confirmed later).

4.4 **Beneficiary's End-User configuration**

23. The IGMP control channel on VLAN 40.

24. The configuration of the policer for control traffic like IGMP (/DHCP/PADx messages/802.1x...) is aligned with the Proximus TV implementation.

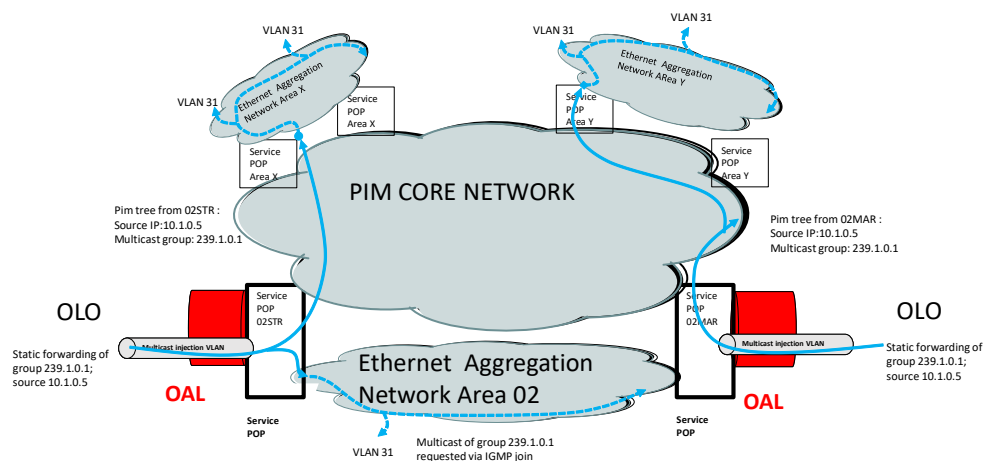
25. Bandwidth CAC on VDSL2 lines: CAC profiles are used primarily for multicast video admission control.

26. The limitation of the maximum number of multicast channels per Bitstream line is aligned with the Proximus implementation. At present the limitation is set to 10 multicast groups for VDSL2 and to 20 multicast groups for GPON.

5. Bitstream transport in the Proximus Ethernet network

27. Multicast is only possible in a specific LEX if the Beneficiary has an active “P3” (not P3bis”) shared VLAN to this LEX, otherwise no VLAN 40 VLANs, neither TV, can be configured in this LEX for its End-Users.
28. The P3 “shared VLAN” is configured as defined in the Bitstream Offer.
29. The dimensioning of the “P3” VLAN is under responsibility of the Beneficiary.
30. All multicast Proximus Shared TV Channels and the Beneficiaries Multicast Dedicated streams, are transported by the Proximus “PIM Core” network, offering national coverage, towards the Service POPs.
31. IGMP from a specific VLAN (31 on figure) at IP-DSLAM is requesting the multicast (Proximus Shared TV Channels or Beneficiary’s Multicast Dedicated streams) in the aggregation rings up to the Service POPs.
32. The figure below shows the multicast of a specific Multicast Group, injected by a Beneficiary.

Figure 4: Multicast Group injected by a Beneficiary



Sensitivity: Confidential

5.1 Multicast injection by the Beneficiary

33. The Beneficiary can optionally inject a limited number of Multicast Dedicated streams in the Proximus network, which will be transported and delivered to its TV enabled End-Users via Bitstream access lines, together with Shared TV channels.
34. Injected bandwidth will be limited to the Multicast Dedicated Capacity as ordered by the Beneficiary.
35. The Beneficiary can inject Multicast Dedicated streams contained within the /27 multicast address range allocated to him by Proximus. Other traffic and Unicast flows will be blocked at the ingress of the injection point in the Proximus network. For the sake of stability of the Proximus PIM core network, no PIM protocol is allowed on the injection point, just static injection is allowed.
36. The Beneficiary shall provide the following information for the configuration at IP-DSLAM / Fiber GPON platform level of its Multicast Dedicated streams:
 - Multicast group
 - Name of the Multicast Dedicated channel
 - Ethernet bandwidth
37. For both VDSL2 and GPON the Beneficiary is allowed to define a maximum of 6 subranges for which it can specify a different Ethernet bandwidth per multicast group. A subrange must be defined within the range of the 32 multicast IP addresses allocated to the Beneficiary for its Multicast Dedicated Channels.
38. The Beneficiary shall use one assigned public unicast IP address /x (x to be decided by the Beneficiary) as source for its multicast. Proximus will route this in its network for both injection points.
39. VLAN 106 on an OAL on the service nodes O2STR and / or O2MAR must be used for injection. The Beneficiary can use these OALs (with other VLAN IDs) for other regulated services, under its own responsibility. The Ethernet QoS of all multicast traffic is p4. Two injection points are meant for redundancy and must transport exactly the same flows, because some End-Users will get multicast originating from a PIM tree at one injection point and other End-Users from the second injection point, which is decided by PIM routing. A link protocol will indicate to the routing in the Proximus network if the injection point is alive or not. If the link protocol at one injection point fails, then it will release all its PIM trees and these will be rebuilt from the PIM tree on the other injection point.

5.2 Shared TV Channel interface

40. The Beneficiary can receive the encrypted shared TV Channels which the Beneficiary is entitled to deliver to its End-Users:
 - VLAN 107 on an OAL in service node O2STR and / or O2MAR must be used for this flow. The Beneficiary can decide to use these OALs (with other VLAN ids) for other regulated services under its own responsibility. The Ethernet QoS p-bit value of all multicast traffic is 4.

- The data flow is obtained by a static IGMP configuration of the multicast groups, to which the Beneficiary is entitled, at the side of Proximus. No protocol is allowed (e.g. no IGMP). All ingress traffic into the Proximus network will be blocked.

6. MULTICAST CHANNELS

41. As part of this Wholesale offer, Proximus provides Shared TV Channels.

6.1 MPEG 2 Multicast stream

42. Each channel is conveyed in a separate MPEG-2 multicast stream which can contain video, audio and teletext.

43. Normative references:

- MPEG 2 Transport stream: ISO/IEC standard 13818-1
- MPEG 2 measurement guidelines: ETSI EN 101290
- Teletext: Teletext based on ETSI EN300294,
ETSI EN 300472 & ETSI EN 300706 for Enhanced Teletext
- WSS carriage : ETSI EN 301775
- Mapping of audio & video in MPEG2 system: ETSI EN 101154
- Mapping of AC-3: ETSI EN 300468

44. The following table shows the codecs used for video and audio, at the time of writing:

Table 2: codecs

Radio channels	Audio: Musicam (MP1L2) stereo
SD TV	Video: H.264 MP@L3 Audio: Musicam (MP1L2) stereo
HD TV	Video: H.264 HP@L4 Audio: AAC (MP2) stereo; or Dolby Digital
Note: H.264 is referring to ISO/IEC 14496.10	

45. Proximus reserves the right to change codecs. The process to be followed in case of a codec change will be specified in the future Annex 3 – Planning and Operations.

46. Bitrates at the MPEG 2 TS level are:

- Standard Definition: 2,5 Mb/s
- High-Definition: 6,2 Mb/s
- 3D: 8,6 Mb/s
- Radio channel: 0,28 Mb/s

47. Proximus reserves the right to change bitrates. The Beneficiary will be notified of any bitrate change at least three months before the modification is brought live for Proximus retail End-Users.

6.2 IP encapsulation

48. The MPEG-2 transport stream is encapsulated:

- for the TV channels: in RTP/UDP/IP.
- for the radio channels: in UDP/IP

49. Normative references:

- RTP: A Transport Protocol for Real-Time Applications (RFC 1889)
- RTP Payload Format for MPEG1/MPEG2 Video (RFC 2250)

50. Each channel is mapped into a specific multicast IP group. The multicast addresses are taken from the administratively scoped IPv4 multicast space, as defined in RFC 2365; and more specifically from:

- The IPv4 Organization Local Scope -- 239.192.0.0/14
- The IPv4 Local Scope -- 239.255.0.0/16

6.3 Verimatrix Encryption

51. The payload of the MPEG 2 transport packets is encrypted by means of the Verimatrix "Video Content Authority System (VCAS™) for IPTV" solution.

52. The provider of this solution is Verimatrix Inc (www.verimatrix.com).

6.4 Verimatrix Components

53. A Beneficiary that wishes to use the Wholesale Multicast Central Access Services needs to deploy a Verimatrix "Video Content Authority System (VCAS™) for IPTV" system with a Remote Stream Manager component.

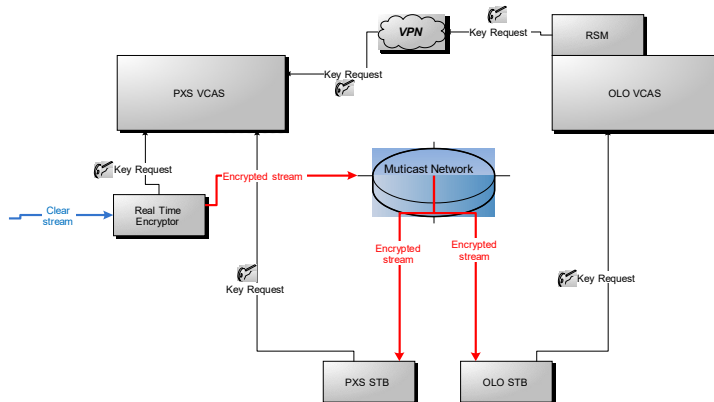
6.4.1 VCAS™ for IPTV

54. The VCAS™ for IPTV performs stream formatting and real-time encryption of multicast IP transport streams containing compressed video in an MPEG-2 Transport stream format. The VCAS™ solution also generates and distributes the necessary encryption keys to End-User devices such as Set-Top Boxes.
55. In the context of this offer, the VCAS™ of the Beneficiary will be used to store and distribute the encryption keys for the Shared TV channels. For its dedicated channels, the Beneficiary can use the conditional access technology (encryption) of its choice.

6.4.2 The Remote Stream Manager

56. The Verimatrix Remote Stream Manager (RSM) is an optional component within the VCAS™. The RSM optimizes IPTV configurations by enabling seamless end-to-end encryption of broadcast channels combined with secure, locally-originated content.
57. The Verimatrix RSM will periodically fetch the decryption keys for the shared channels that the Beneficiary is entitled to from the Proximus VCAS™ servers via a virtual private network. This enables the Beneficiary to store these keys for further distribution to its own End-Users.

Figure 5: Encryption



Sensitivity: Confidential

58. It is the responsibility of the Beneficiary to securely store the encryption keys for further use.

6.5 VPN between the Beneficiary and Proximus Verimatrix Components

59. The virtual private network that connects the RSM component of the Beneficiary to the VCAS™ servers of Proximus is implemented via VLANs on one or two (for redundancy) OALs. Proximus has two redundant accesses to its VCAS™ platform, one in O2EVE (Brussels Area) and one in 15MEC (Antwerp Area).

- VLAN id 104: to O2EVE
- VLAN id 105: to 15MEC

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