

TP-255

G-PON & XG-PON & XGS-PON Interoperability Test Plan

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Executive Summary

In order to create a process for the ongoing promotion of GPON interoperability the Broadband Forum has produced TP-255, describing a number of detailed test cases based upon the requirements defined in Broadband Forum TR-156 [2], "Using GPON Access in the context of TR-101" specification. The test cases are intended to verify: the OLT is able to perform any required actions; the OLT is able to configure the ONU via OMCI; and using that configuration, the ONU is able to perform any required actions; to meet each of the requirements defined in the TR-156 [2] document. The result of this testing should prove the OLT and ONU pair is interoperable within the TR-101 [1] / TR-156 [2] architecture.

This test plan may be applicable to ITU-T PON systems, including G.984 G-PON, G.987 XG-PON, and G.9807 XGS-PON.

For the interoperability testing described in this document to have the greatest positive impact, the ONU device must already meet the BBF.247 GPON ONU Certification requirements. This will help ensure the OLT is able to configure the ONU using the appropriate OMCI standard interfaces and not require the use of proprietary interfaces or vendor extensions.

Equipment manufacturers, service providers, chipset manufacturers, and software providers may use this test plan to complete internal and/or private testing. Public statements about interoperability according to this document may only be made if all requirements within this document have been met, including the use of an ONU device previously certified according to BBF.247. In consideration of the complexity of this testing, the Forum encourages all participants to strongly consider consulting with one of the approved laboratories before beginning internal testing. The Broadband Forum approved GPON labs are active members with the Forum and have significant experience in testing GPON systems. Additionally, service providers wishing to verify interoperability are encouraged to request test reports from Broadband Forum approved GPON laboratories.

TP-255 Issue 2 is updated to include TP-247 Issue 4 test cases which include:

- Support of ITU-T G.988 2017 OMCI Specification
- Support of XG/XGS PON
- Support of TR-280 Issue 2 PON Requirements Specification

1 Purpose and Scope

1.1 Purpose

This test plan describes a series of test cases that may be used to verify the interoperability of an OLT and ONU pairing according to the functional requirements of BBF TR-101 [1], BBF TR-156 [2], BBF TR-280 [10], and ITU-T G.988 [7]. It is intended these test cases be used with an ONU already awarded the BBF.247 GPON ONU Certification and an OLT known to use standardized OMCI managed entities to implement the configuration under test.

1.2 Scope

The test cases defined in this document are dedicated to interoperability testing an OLT and ONU pairing with respect to the standards based requirements defined in BBF TR-101 [1], BBF TR-156 [2], BBF TR-280 [10], and ITU-T G.988 [7].

The test cases verify the functionality of the system under test, OLT and ONU pair, where each test stimulus is applied and measured at the edges of the system, typically described as the V-interface and U-interface within the TR-156 [2] architecture.

ITU-T G.984 G-PON, G.987 XG-PON, and G.9807 XGS-PON systems may be tested using the test cases defined within this document to verify their interoperability with respect to the BBF TR-101 [1], BBF TR-156 [2], BBF TR-280 [10], and ITU-T G.988 [7] specifications.

Note: The remainder of this document uses the term GPON in a generic manner to refer to any ITU-T TDM PON including G-PON, XG-PON, and XGS-PON. In the same way, the term GEM port refers to GEM port and XGEM port, the term GTC refers to GTC and XGTC, and the term PLOAM refers to PLOAM and XPLOAM.

2 References and Terminology

2.1 Conventions

In this Test Plan, several words are used to signify the requirements of the specification. These words are always capitalized. More information can be found in RFC 2119 [9].

MUST	This word, or the term "REQUIRED", means that the definition is an absolute requirement of the specification.
MUST NOT	This phrase means that the definition is an absolute prohibition of the specification.
SHOULD	This word, or the term "RECOMMENDED", means that there could exist valid reasons in particular circumstances to ignore this item, but the full implications need to be understood and carefully weighed before choosing a different course.
SHOULD NOT	This phrase, or the phrase "NOT RECOMMENDED" means that there could exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications need to be understood and the case carefully weighed before implementing any behavior described with this label.
MAY	This word, or the term "OPTIONAL", means that this item is one of an allowed set of alternatives. An implementation that does not include this option MUST be prepared to inter-operate with another implementation that does include the option.

2.2 References

The following references are of relevance to this Test Plan. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Test Plan are therefore encouraged to investigate the possibility of applying the most recent edition of the references listed below.

A list of currently valid Broadband Forum Technical Reports is published at www.broadband-forum.org.

Document	Title	Source	Year
[1] TR-101 Issue 2	<i>Migration to Ethernet-Based Broadband Aggregation</i>	BBF	2011
[2] TR-156 Issue 4	<i>Using GPON Access in the context of TR-101</i>	BBF	2017
[3] G.984.1	<i>Gigabit-capable Passive Optical Networks (GPON): General Characteristics</i>	ITU-T	2008
[4] G.984.3	<i>Gigabit-capable Passive Optical Networks (GPON): Transmission convergence layer specification</i>	ITU-T	2008
[5] G.984.3 Amendment 1	<i>Gigabit-capable Passive Optical Networks (GPON): Transmission convergence layer specification – Amendment 1</i>	ITU-T	2009

[6] G.984.2	<i>Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification</i>	ITU-T	2003
[7] G.988	<i>ONU Management and Control Interface Specification (OMCI)</i>	ITU-T	2022
[8] TP-247 Issue 4	<i>G-PON & XG-PON & XGS-PON ONU Conformance Test Plan</i>	BBF	2020
[9] RFC 2119	<i>Key words for use in RFCs to Indicate Requirement Levels</i>	IETF	1997
[10] TR-280 Issue 2	<i>ITU-T PON in the context of TR-178</i>	BBF	2022
[11] TR-167 Issue 3	<i>GPON-fed TR-101 Ethernet Access Node Architecture and Requirements for Fiber to the Distribution Point</i>	BBF	2017
[12] TR-301 Issue 2 Amendment 2		BBF	2023
[13] G.9807.1	<i>10-Gigabit-capable symmetric passive optical network (XGS-PON)</i>	ITU-T	2023
[14] G.987.3	<i>10-Gigabit-capable passive optical networks (XG-PON): Transmission convergence (TC) layer specification</i>	ITU-T	2014

2.3 Definitions

The following terminology is used throughout this Test Plan.

Ethernet Traffic Generator	A device that generates and captures well-formed Ethernet frames as defined by test personnel.
GEM Port	An abstraction on the GTC adaptation sublayer representing a logical connection associated with a specific client traffic flow. The GTC adaptation sublayer is a sublayer of the GPON Transmission Convergence layer that supports the functions of user data fragmentation and de-fragmentation, GEM encapsulation, GEM frame delineation, and GEM Port-ID filtering.
GEM Port Id	A 12-bit value which is assigned by the OLT to the individual logical connections transported over the GPON interface and which is carried in the header of all the GEM frames associated with the given logical connection.
GPON Analyzer	An external device, which may be included in a non-intrusive manner, between the R/S and S/R-interfaces to capture and analyze the traffic present in the ODN
GPON Network	An OLT connected using an Optical Distribution Network (ODN) to one or more ONUs or ONTs. A GPON network is a subset of the Access Network.
ODN	Optical Distribution Network including the fibers, splitters and connectors.
OLT	Optical Line Termination (OLT): A device that terminates the common (root) endpoint of an ODN, implements a PON protocol, such as that defined by G.984.1 [3], and adapts PON PDUs for uplink communications over the provider service interface. The OLT provides management and maintenance functions for the subtended ODN and ONUs.
ONU	Optical Network Unit (ONU): A generic term denoting a device that terminates any one of the distributed (leaf) endpoints of an ODN, implements a PON protocol, and adapts PON PDUs to subscriber service interfaces.

ONU/L2	A generic term denoting a Layer-2 device that terminates any one of the distributed (leaf) endpoints of an ODN, implements a PON protocol, and adapts PON PDUs to subscriber service interfaces. An ONU, within the context of TR-156 [2], does not include any Layer-3 (IP router) functions.
ONU/RG	An ONU (as defined above) that includes additional Layer-3 (IP routing) functionality as defined as “RG” below. The connection between the ONU subcomponent and RG subcomponent is made through a VEIP managed entity.
RG	A Residential Gateway is a device that interfaces between the WAN and LAN IP environment for a consumer broadband customer. It may route or bridge traffic, depending on its configuration and specifications.
T-CONT	A traffic-bearing object within an ONU that represents a group of logical connections, is managed via the ONU Management and Control Channel (OMCC) and is treated as a single entity for the purpose of upstream bandwidth assignment on the PON.
Traffic Classes	(TC) - Traffic Classes are the set of upstream and downstream supported forwarding behaviors in the network element.
Traffic Flow	A sequence of frames or packets traversing a particular reference point within a network that shares a specific frame/packet header pattern. For example, an Ethernet traffic flow can be identified by any combination of specific source MAC address, destination MAC, VLAN ID, 802.1p bits, etc.
U-interface	U-interface is a short form of expressing one or more of the interfaces defined in this Test Plan or in TR-101 [1] at the U reference point. It is also essentially equivalent to a subscriber-facing interface at the access node.
V-interface	V-interface is a short form of expressing one or more of the interfaces defined in TR-101 [1] at the V reference point. It is also essentially equivalent to a network-facing interface at the access node.

2.4 Abbreviations

This Test Plan uses the following abbreviations:

AES	Advanced Encryption Standard
AN	Access Node
DSCP	DiffServ Code Point
GEM	Generic Encapsulation Method
GPON	Gigabit-capable Passive Optical Network
GTC	GPON Transmission Convergence layer – as defined in G.984.3 [4]
MAC	Media Access Control
ME	Managed Entity
ODN	Optical Distribution Network – as defined in G.984.1 [3]
OLT	Optical Line Termination – as defined in G.984.1 [3]
OMCI	ONU Management and Control Interface
ONT	Optical Network Termination – as defined in G.984.1 [3]
ONU	Optical Network Unit – as defined in G.984.1 [3]

RG	Residential Gateway
TLS	Transparent LAN Service – a common synonym for Business Ethernet Services
TR	Technical Report

3 Test Plan Impact

3.1 Energy Efficiency

TP-255 has no impact on energy efficiency.

3.2 IPv6

TP-255 has no impact on IPv6.

3.3 Security

TP-255 has no impact on security.

3.4 Privacy

TP-255 has no impact on privacy.

4 Test Methodology

4.1 Interoperability Testing

Interoperability testing is intended to verify an ONU/ONT and OLT pair can interoperate, while the ONU/ONT configuration is performed by the OLT using OMCI. It is assumed the ONU/ONT have each previously passed the conformance tests defined within TP-247 [8]. Section 4.2 defines the test setup used for interoperability testing.

- R-1 All configuration of the ONU MUST be performed using OMCI controlled/generated by the OLT.
- R-2 All configuration of the OLT MUST be performed using a normal available interface, as would be provided to a customer (i.e. configuration commands should not be entered through a debugger or other such interface).

4.2 Test Setup

4.2.1 Test Equipment

GPON Analyzer

The GPON Analyzer is an optional piece of equipment, which MAY be included in the ODN during conformance or interoperability testing to capture and analyze the traffic present on that network.

- R-3 The GPON Analyzer MUST NOT alter, correct, or otherwise disturb any of the traffic present on the ODN.
- R-4 The GPON Analyzer MUST NOT also significantly attenuate the optical signals such that the requirements of §4.2.1 cannot be met.

Optical Distribution Network

The optical distribution network (ODN) is outside of the scope of this test plan; however, care should be taken to ensure each optical receiver is operating in roughly the mid-point of its dynamic range; ensuring the receiver is not operating in a stressed mode, which could cause bit errors. This may be accomplished using either real fiber or an optical attenuator.

4.2.2 Interoperability Test Setup

When an ONU/ONT and OLT pair is being tested for interoperability, Figure 4-1 defines the basic test setup for interoperability testing.

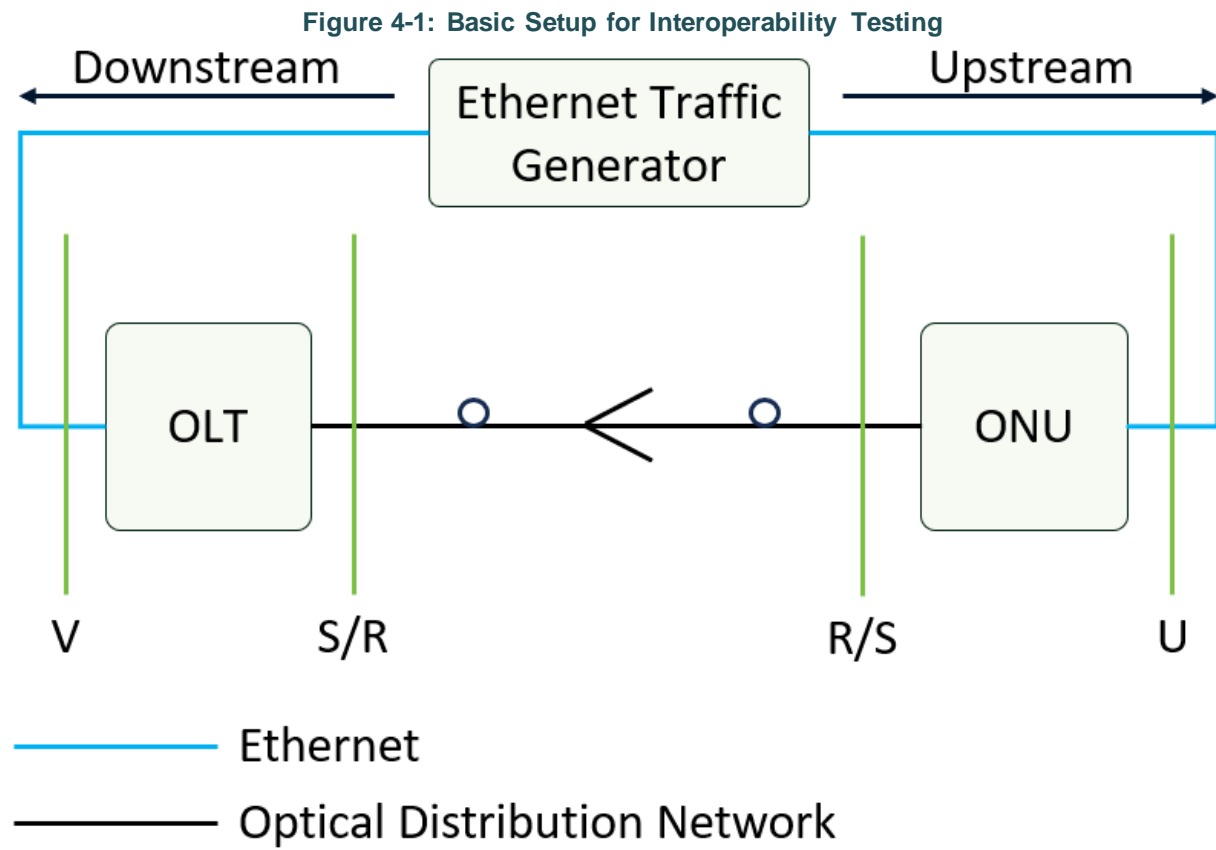


Figure 4-2: Setup for Interoperability Tests Requiring Multiple ONUs

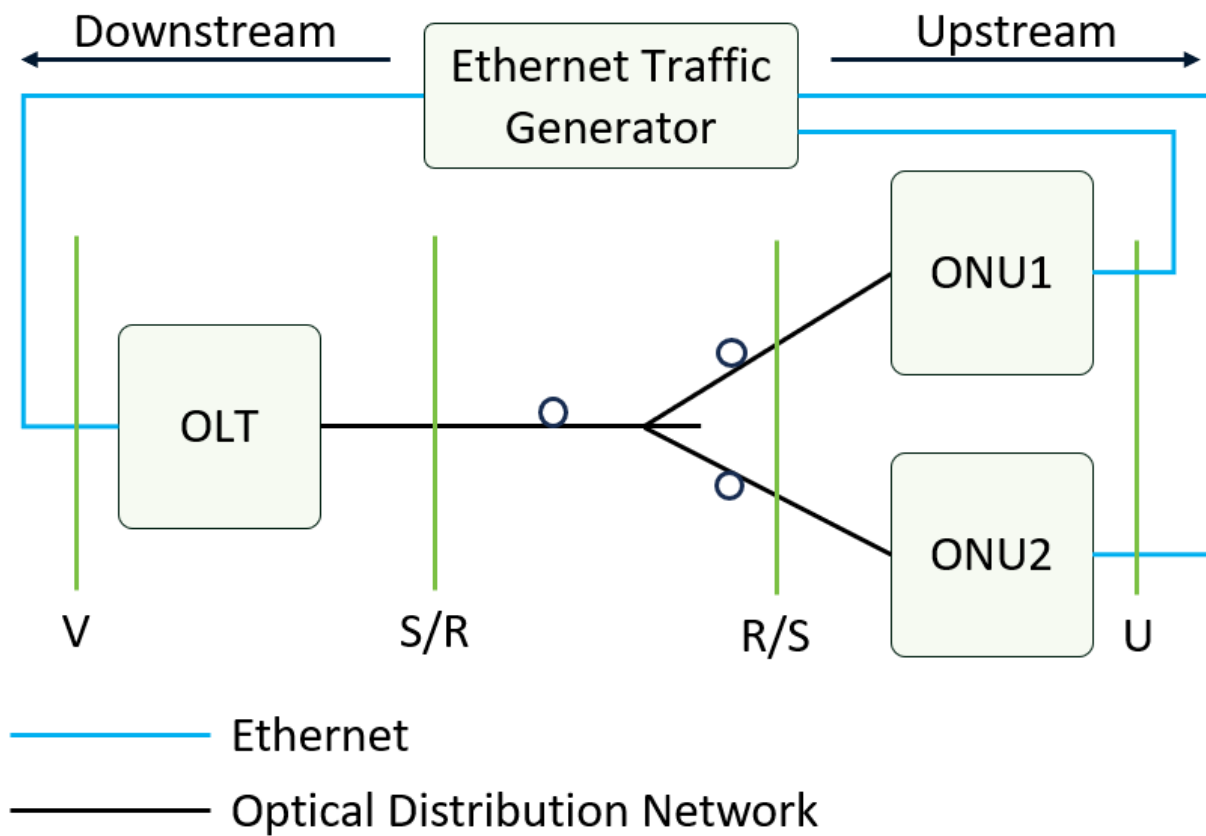
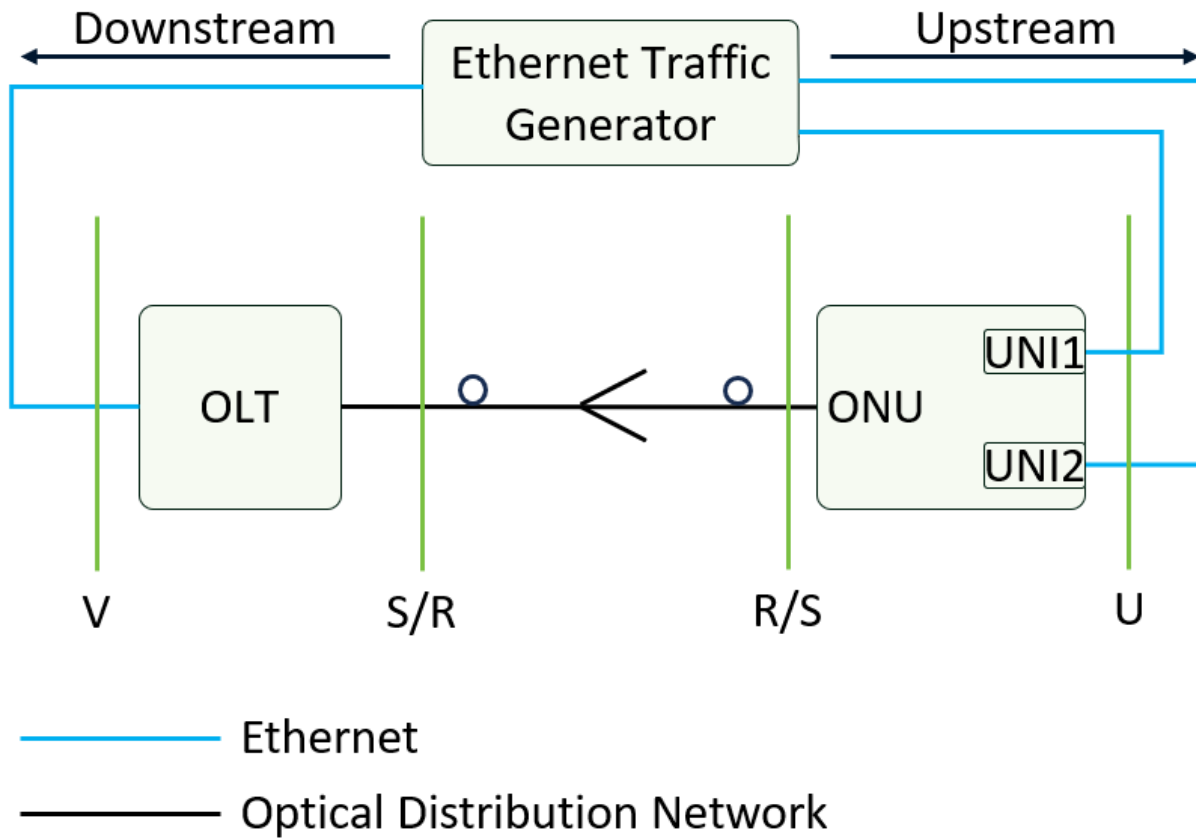


Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces



4.3 Extended OMCI Format Testing

For OLTs that support both OMCI Baseline and Extended Message Format, the support of Extended OMCI Message Format must be enabled. This applies to both ONUs supporting OMCI Baseline only and ONUs supporting OMCI Baseline and Extended message formats, as the intent is to verify that the enabling of the OMCI Extended Message Format support on the OLT does not cause configuration failures, regardless of the OMCI format supported by the ONU. This testing does not target the policies controlling the use of Baseline and OMCI Extended OMCI at the OLT, nor its actual implementation.

5 Test Case Summary

5.1 Interoperability Tests

Test ID	Test Name	Mandatory/ Optional
6.1	VLAN Manipulation	
6.1.1	N:1 Architecture	
6.1.1.1	Untagged U-interface Test Case	Mandatory
6.1.1.2	Priority-tagged U-interface Test Case	Mandatory
6.1.1.3	Q-tagged U-interface Test Case	Mandatory
6.1.1.4	User Isolation Test Case	Mandatory
6.1.1.5	Configurable Value of the S-tag TPID Value Test Case	Optional
6.1.2	1:1 Architecture	
6.1.2.1	Untagged U-interface, Single Tagged V-interface Test Case	Mandatory
6.1.2.2	Untagged U-interface, Double Tagged V-interface Test Case	Mandatory
6.1.2.3	Tagged U-interface, Single Tagged V-interface Test Case	Mandatory
6.1.2.4	Tagged U-interface, Double Tagged V-interface Test Case	Mandatory
6.1.2.5	Deactivate MAC Learning for 1:1 VLANs Test Case	Mandatory
6.1.2.6	Setting of VID Value Based on Received EtherType (Double-Tagged at the V Interface)	Mandatory
6.1.2.7	Setting of VID Value with Priority Preservation Based on Received EtherType (Double-Tagged at the V Interface)	Mandatory
6.1.2.8	Setting of VID Value without Priority Preservation Based on Received EtherType (Double-Tagged at the V Interface)	Mandatory
6.1.3	VLANs for Business Ethernet Services	
6.1.3.1	Untagged U-interface, Single Tagged V-interface Test Case	Mandatory
6.1.3.2	Priority-tagged U-interface, Single Tagged V-interface Test Case	Mandatory
6.1.3.3	Q-tagged U-interface, Double Tagged V-interface Test Case	Mandatory
6.1.3.4	S-tagged U-interface, Single Tagged V-interface Test Case	Mandatory
6.1.3.5	Double Tagged U-interface, Double Tagged V-interface Test Case	Mandatory
6.1.3.6	Hairpin Turn for VBES at OLT Test Case	Mandatory
6.1.3.7	S-Tag Validation Test Case	Mandatory
6.1.4	N:1 or 1:1 Architecture	
6.1.4.1	Setting of VID Value Based on Received EtherType (Single-Tagged at the V Interface)	Mandatory
6.1.4.2	Setting of VID Value with Priority Preservation Based on Received EtherType (Single-Tagged at the V Interface)	Mandatory
6.1.4.3	Setting of VID Value without Priority Preservation Based on Received EtherType (Single-Tagged at the V Interface)	Mandatory
6.1.4.4	Verifying MAC Address use as a Classification Criterion	Mandatory

6.1.5	Extended VLAN Tagging Operation Downstream Modes	
6.1.5.1	Downstream Translation for Code Point 0	Mandatory
6.1.5.2	Downstream Translation for Code Point 1	Mandatory
6.1.5.3	Downstream Translation for Code Point 2	Mandatory
6.1.5.4	Downstream Translation for Code Point 3	Mandatory
6.1.5.5	Downstream Translation for Code Point 4	Mandatory
6.1.5.6	Downstream Translation for Code Point 5	Mandatory
6.1.5.7	Downstream Translation for Code Point 6	Mandatory
6.1.5.8	Downstream Translation for Code Point 7	Mandatory
6.1.5.9	Downstream Translation for Code Point 8	Mandatory
6.2	Quality of Service Functions	
6.2.1	Frame Classification (Derivation and Manipulation of P-bits)	
6.2.1.1	Setting of P-bit Value Based on Received VID	Mandatory
6.2.1.2	Setting of P-bit Value Based on Received P-bit	Mandatory
6.2.1.3	Setting of P-bit Value Based on Received EtherType	Mandatory
6.2.1.4	Setting of P-bit Value Based on UNI Port	Conditionally Mandatory
6.2.1.5	Setting of P-bit Value Based on Received DSCP Value	Optional
6.2.2	Frame Mapping	
6.2.2.1	Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on P-bit Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.2	Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.3	Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID and P-bit Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.4	Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit, and U-interface Values (1:1 VLAN, Multiple User Port)	Conditionally Mandatory
6.2.2.5	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on P-bit Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.6	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.7	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID and P-bit Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.8	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on SVID, CVID, and P-bit Values (1:1 VLAN, Single User Port)	Mandatory
6.2.2.9	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit Values, and MAC DA (VBES, Single User Port)	Mandatory
6.2.2.10	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on SVID, CVID, and P-bit Values (1:1 VLAN, Multiple User Port)	Conditionally Mandatory
6.2.2.11	Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit Values, and MAC DA (VBES, Multiple User Port)	Conditionally Mandatory
6.2.3	Drop Precedence	
6.2.3.1	Indicating Drop Precedence Using P-bit Upstream	Mandatory
6.2.3.2	Indicating Drop Precedence Using DEI Bit Upstream	Mandatory

6.2.3.3	Indicating Drop Precedence Using P-bits Downstream	Mandatory
6.2.3.4	Indicating Drop Precedence Using DEI Bits Downstream	Mandatory
6.3	IGMP Controlled Multicast	
6.3.1	Downstream Transport of IGMP Messages	Mandatory
6.3.2	Upstream Transport of IGMP Messages	Mandatory
6.3.3	Configurable Discard of Upstream IGMP Messages	Mandatory
6.3.4	White and Black Listing of Multicast Channels	Mandatory
6.3.5	Blocking of User Generated Multicast Traffic	Mandatory
6.3.6	Rate-limiting of User Generated IGMP Messages	Mandatory
6.3.7	IGMPv3 Transparent Snooping Functions	Mandatory
6.3.8	IGMP Immediate Leave	Mandatory
6.3.9	Discard of User Generated Proxy Query Solicitations	Mandatory
6.3.10	Marking of Upstream IGMP Messages with Ethernet P-bits	Mandatory
6.3.11	Configurable Maximum Number of Simultaneous Multicast Groups	Mandatory
6.3.12	Silent Discard of Upstream IGMPv1 Messages	Mandatory
6.3.13	Maximum Multicast Bandwidth	Mandatory
6.3.14	VID and P-bit Translation in Upstream and Downstream for IGMP/MLD and Multicast Packets	Mandatory
6.3.15	Create and Remove Multicast Groups in the Dynamic Access Control List Table	Mandatory
6.3.16	Maximum Multicast Bandwidth Modification	Mandatory
6.3.17	Individual Multicast Groups in Dynamic Access Control List Table	Mandatory
6.3.18	Whole Multicast Range in Dynamic Access Control List Table	Mandatory
6.3.19	Maximum Number of Dynamic Multicast Groups Modification	Mandatory
6.3.20	IGMP Transparent Forwarding	Mandatory
6.3.21	Multicast VLAN Membership Based on User Ports (Multiple User Ports)	Conditionally Mandatory
6.3.22	IGMPv3 Transparent Snooping Functions (Multiple User Ports)	Conditionally Mandatory
6.4	Non-IGMP Controlled Multicast and Broadcast	
6.4.1	Silent Discard of Frames with Unknown MAC Addresses	Mandatory
6.4.2	Flooding of Frames with Unknown MAC Addresses	Mandatory
6.4.3	Silent Discard of Downstream Broadcast Frames	Mandatory
6.4.4	Flooding of Downstream Broadcast Frames	Mandatory
6.4.5	Downstream Broadcast Handling, Single U-interface	Mandatory
6.4.6	Downstream Broadcast Handling, Multiple U-interfaces	Conditionally Mandatory
6.5	Security	
6.5.1	Test for Providing Service to Users with Duplicate MAC Addresses	Optional
6.5.2	Test for Denying Service to Users with Duplicate MAC Addresses	Optional

6.5.3	Test for Mechanism to Prevent Broadband Network Gateway MAC Address Spoofing	Optional
6.5.4	Test for Mechanism to Handle ARP Broadcasts	Optional
6.5.5	Test for Mechanism to Prevent IP Address Spoofing	Optional
6.5.6	Test for Mechanism to Prevent MAC Flooding Attacks	Optional
6.5.7	Unicast GEM Port Encryption Downstream	Mandatory
6.5.8	Unicast GEM Port Encryption Upstream	Conditionally Mandatory
6.6	Filtering	
6.6.1	MAC Source Address Allowing Filter	Optional
6.6.2	MAC Source Address Denying Filter	Optional
6.6.3	MAC Destination Address Allowing Filter	Optional
6.6.4	MAC Destination Address Denying Filter	Optional
6.6.5	Group MAC Destination Address Filter	Optional
6.6.6	EtherType Allowing Filter (IPoE)	Optional
6.6.7	EtherType Allowing Filter (PPPoE)	Optional
6.6.8	EtherType Denying Filter (IPoE)	Optional
6.6.9	EtherType Denying Filter (PPPoE)	Optional
6.7	Port Identification and Characterization	
6.7.1	Basic PPPoE Intermediate Function	Optional
6.7.2	PPPoE Intermediate Function Option 82 Overwriting	Optional
6.7.3	PPPoE Intermediate Function with Multiple Clients	Optional
6.7.4	PPPoE Intermediate Function with Unicast PADI Message	Optional
6.7.5	Basic DHCP Relay Agent Functions	Optional
6.7.6	DHCP Relay Agent Functions Option 82 Overwriting	Optional
6.7.7	DHCP Relay Agent Functions with Multiple Clients	Optional
6.7.8	DHCP Relay Agent Functions with Unicast DHCP Discover Message	Optional
6.8	Initial Provisioning of ONU	
6.8.1	ONU Provisioning According to Serial Number Test Case	Mandatory
6.8.2	ONU Provisioning According to the Registration-ID Test Case	Mandatory
6.9	ONU Bring-up	
6.9.1	ONU Bring-up for New ONU	Mandatory
6.9.2	ONU Bring-up Method for Old ONU	Mandatory
6.9.3	ONU Bring-up Method with Encrypted OMCC	Mandatory
6.9.4	MIB Synchronization	Mandatory
6.9.5	OMCI MIB Reset	Mandatory
6.9.6	OMCI Reboot	Mandatory
6.10	Alarms	

6.10.1	Alarms Synchronization	Mandatory
6.10.2	ONU Electrical Reboot	Mandatory
6.10.3	Lower Optical Thresholds Setting and Alarm Generation	Mandatory
6.10.4	Upper Optical Thresholds Setting and Alarm Generation	Mandatory
6.11	Software Download	
6.11.1	Software Download, Valid Image	Mandatory
6.11.2	Software Download, Corrupt Image	Mandatory
6.11.3	Switch Active Software Instance	Mandatory
6.11.4	Switch Committed Software Instance	Mandatory
6.12	Performance Monitoring	
6.12.1	Performance Monitoring on Ethernet Frames	Conditionally Mandatory
6.12.2	Performance Monitoring on Multicast Ethernet Frames	Mandatory
6.12.3	Optical Parameters Reporting	Mandatory
6.13	Enhanced Functionalities	
6.13.1	Create, Delete, and Add New Services	Mandatory
6.13.2	Create and Modify Configuration	Mandatory
6.13.3	Create, Delete, and Add New Services in Strict Priority Scheduling Context	Mandatory
6.14	PON to Ethernet Adaptation	
6.14.1	2000-Byte Frames Support	Conditionally Mandatory

6 Interoperability Tests

6.1 VLAN Manipulation

Broadband Forum documents TR-101 [1] and TR-156 [2] describe three of VLAN architectures that may be used in broadband networks with Ethernet based aggregation. Specifically, these architectures are referred to as: the N:1 architecture, the 1:1 architecture, and the VLANs for Business Ethernet Services (VBES). Within a GPON system, the functions of the access node defined within TR-101 [1] are distributed between the ONU and OLT, with each responsible for performing some manipulations of the VLAN headers to implement the overall architecture. Table 6-1 below provides a summary of the required manipulations and the associated requirement within TR-156 [2]. Table 6-1 only shows the operations performed on the upstream traffic, operations are assumed to be symmetric, with the inverse of the listed operation being performed on the downstream traffic (i.e., removal for S-tag by the ONU, R-11).

Table 6-1: VLAN Manipulation Operations

N:1 VLAN Architecture				
Config	Frame Structure at U-interface	Operation at ONU	Operation at OLT	Frame Structure at V-interface
1	Untagged	Add S-tag (R-10) Set VID value (R-9)	Pass S-tag (R-15)	S-tagged
2	Priority-tagged	Translate to S-tag (R-10) Set VID value (R-9)	Pass S-tag (R-15)	S-tagged
3	Q-tagged	Translate to S-tag (R-12)	Pass S-tag (R-15)	S-tagged
1:1 VLAN Architecture				
Config	Frame Structure at U-interface	Operation at ONU	Operation at OLT	Frame Structure at V-interface
4	Untagged	Add S-tag (R-20) Set VID value (R-9)	Pass S-tag (R-25)	S-tagged
5	Untagged	Add C-tag (R-20) Set VID value (R-9)	Add S-tag (R-24)	S-tagged & C-tagged
6	Q-tagged	Translate to S-tag (R-22)	Pass S-tag (R-25)	S-tagged
7	Q-tagged	Translate to C-tag (R-22)	Add S-tag (R-24)	S-tagged & C-tagged
VLANs for Business Ethernet Services Architecture				
Config	Frame Structure at U-interface	Operation at ONU	Operation at OLT	Frame Structure at V-interface
8	Untagged	Add S-tag (R-34)	Pass S-tag (R-38)	S-tagged
9	Priority-tagged	Add S-tag (R-34)	Pass S-tag (R-38)	S-tagged

10	Q-tagged	Add S-tag (R-34)	Pass S-tag (R-38)	S-tagged & C-tagged
11	S-tagged	Translate S-tag VID (R-35)	Pass S-tag (R-38)	S-tagged
12	S-tagged & C-tagged	Translate S-tag VID (R-42)	Pass S-tag (R-38)	S-tagged & C-tagged
13	S-tagged & C-tagged	Validate S-tag VID (R-35)	Pass S-tag (R-38)	S-tagged & C-tagged

6.1.1 N:1 Architecture

6.1.1.1 Untagged U-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.
- **R-10:** The ONU MUST support adding an S-Tag to upstream-untagged traffic received from the U interface.
- **R-11:** The ONU MUST support removing an S-Tag from downstream traffic received from the OLT.
- **R-15:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-16:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the N:1 VLAN architecture when the U-interface of the ONU is configured as an untagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to insert an S-tag for untagged upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-2: Test 6.1.1.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-3: Test 6.1.1.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)										U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	PbIts	DEI	VID	TPID	PbIts	DEI	VID						TPID	PbIts	DEI	VID	TPID	PbIts	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-2.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-3.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.1.2 Priority-tagged U-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.
- **R-10:** The ONU MUST support adding an S-Tag to upstream-untagged traffic received from the U interface.
- **R-11:** The ONU MUST support removing an S-Tag from downstream traffic received from the OLT.
- **R-15:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-16:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the N:1 VLAN architecture when the U-interface of the ONU is configured as a priority-tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 2. The ONU must be configured to set the VID value for priority-tagged frames to VID1 (this also implies translating the TPID value from 0x8100 to 0x88a8). In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-4: Test 6.1.1.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-5: Test 6.1.1.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-4.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-5.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.1.3 Q-tagged U-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-12:** The ONU MUST support unique, symmetric translation of Q-Tag VIDs received from the U interface into S-Tag VIDs.
- **R-13:** The ONU MUST support unique, symmetric translation of the S-Tag VIDs used in the downstream-tagged traffic into the Q-Tag VIDs sent to the U interface.
- **R-15:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-16:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the N:1 VLAN architecture when the U-interface of the ONU is configured as a Q-tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to set translate a received Q-tag (QVID value VID1) into an S-tag (SVID value VID2) in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-6: Test 6.1.1.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800											

Table 6-7: Test 6.1.1.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID3	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-6.
2. Upstream frames from Traffic Streams Bus through Eus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-7.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.1.4 User Isolation Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-18:** The OLT MUST be able to prevent forwarding traffic between user ports (user isolation). This behavior MUST be configurable per S-VID.

Test Objective:

- To verify the ONU/OLT combination correctly implements the user isolation functions required by the N:1 architecture, and that this functionality is configurable.

Test Setup:

- Figure 4-2: Setup for Interoperability Tests Requiring Multiple ONUs

Pretest Conditions:

1. The ONUs is powered and connected to the ODN as shown in Figure 4-2.
2. The ONUs has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1, using multiple ONUs. The ONUs must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONUs must perform the reverse operation. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions. The OLT must be configured to prevent direct user connections between U-interfaces at layer 2 (user isolation).

Table 6-8: Test 6.1.1.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800												
Bus	2	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800												

Test Procedure:

1. Select a random value for VID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on the ONU.

4. Configure the Ethernet Traffic Generator to transmit the upstream frames defined above into the respective ONU U-interface.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream frames.
7. Reconfigure the OLT to disable any user isolation functionality for VLAN VID1 (allow users to directly connect at layer 2).
8. Repeat steps 5 & 6.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. After procedure step 6, frames from Traffic Streams Aus and Bus must not be received from the U-interface.
2. After procedure step 8, frames from Traffic Streams Aus and Bus must be received from the appropriate U-interface.

Remarks:

- None

6.1.1.5 Configurable Value of the S-tag TPID Value Test Case

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]

For Reference:

- **R-17:** The Ethertype field for the 802.1ad tagging, i.e., S-Tags, MUST by default use the standardized value 0x88a8. However, for backward compatibility, this field SHOULD be configurable per Port.

Test Objective:

- To verify the ONU/OLT combination can configure the TPID value used within an S-tag.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions. The configuration will require the TPID value 0x8100 be used for S-tags instead of the default value of 0x88a8.

Table 6-9: Test 6.1.1.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-10: Test 6.1.1.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on the ONU.
4. Configure the OLT to use the value of 0x8100 for S-tag TPID values.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-9.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-10.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.2 1:1 Architecture

6.1.2.1 Untagged U-interface, Single Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-20:** The ONU MUST support adding a C-Tag or S-Tag to upstream untagged traffic.
- **R-21:** The ONU MUST support removing the tag from downstream traffic.
- **R-25:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-26:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the 1:1 VLAN architecture listed as configuration 4 in Table 6-1, when the U-interface of the ONU is configured as an untagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 4. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-11: Test 6.1.2.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-12: Test 6.1.2.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)										U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-11.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-12.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.2.2 Untagged U-interface, Double Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-20:** The ONU MUST support adding a C-Tag or S-Tag to upstream untagged traffic.
- **R-21:** The ONU MUST support removing the tag from downstream traffic.
- **R-24:** The OLT MUST support adding an S-Tag in the upstream direction for C-tagged traffic.
- **R-30:** The OLT MUST support removal of an S-Tag in the downstream direction when traffic is double-tagged.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the 1:1 VLAN architecture listed as configuration 5 in Table 6-1, when the U-interface of the ONU is configured as an untagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 5. The ONU must be configured to insert a C-tag for upstream frames, with VID value set to VID1. The OLT is configured to support adding an outer S-tag to the C-tag frames. In the downstream direction, the OLT and ONU must perform the reverse operations. The OLT must be configured for 1:1 operation.

Table 6-13: Test 6.1.2.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-14: Test 6.1.2.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800													
Cds	MAC2	MAC1	0x88a8	Any	Any	VID3	0x8100	Any	Any	VID1	0x0800													
Dds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800													
Eds	MAC2	MAC1	0x8100	Any	Any	VID2	0x8100	Any	Any	VID1	0x0800													
Fds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x88a8	Any	Any	VID1	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-13.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-14.
4. Downstream frames from Traffic Streams Bds through Fds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.2.3 Tagged U-interface, Single Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-22:** The ONU MUST support VID translation of the Q-Tag received from the U interface into the C-Tag or S-Tag for upstream-tagged traffic.
- **R-23:** The ONU MUST support VID translation of the tag used in the downstream-tagged traffic into the Q-Tag sent to the U interface.
- **R-25:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-26:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the 1:1 VLAN architecture listed as configuration 6 in Table 6-1, when the U-interface of the ONU is configured as a tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 6. The ONU must be configured to translate a received Q-tag into an S-tag for upstream frames, translating VID1 into VID2. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-15: Test 6.1.2.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID3	0x0800											

Table 6-16: Test 6.1.2.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800														
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID3	0x0800														

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-15.
2. Upstream frames from Traffic Streams Bus through Eus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-16.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.2.4 Tagged U-interface, Double Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-22:** The ONU MUST support VID translation of the Q-Tag received from the U interface into the C-Tag or S-Tag for upstream-tagged traffic.
- **R-23:** The ONU MUST support VID translation of the tag used in the downstream-tagged traffic into the Q-Tag sent to the U interface.
- **R-24:** The OLT MUST support adding an S-Tag in the upstream direction for C-tagged traffic.
- **R-30:** The OLT MUST support removal of an S-Tag in the downstream direction when traffic is double-tagged.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the 1:1 VLAN architecture listed as configuration 7 in Table 6-1, when the U-interface of the ONU is configured as a tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to translate a received Q-tag into a C-tag for upstream frames, translating VID1 to VID2. The OLT is configured to support adding an outer S-tag to the C-tag frames. In the downstream direction, the OLT and ONU must perform the reverse operations. The OLT must be configured for 1:1 operation.

Table 6-17: Test 6.1.2.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID3	0x8100	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID3	0x0800											

Table 6-18: Test 6.1.2.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Any	Any	VID3	0x8100	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID3	0x0800													
Cds	MAC2	MAC1	0x88a8	Any	Any	VID4	0x8100	Any	Any	VID2	0x0800													
Dds	MAC2	MAC1	0x88a8	Any	Any	VID3	0x8100	Any	Any	VID4	0x0800													
Eds	MAC2	MAC1	0x8100	Any	Any	VID3	0x8100	Any	Any	VID2	0x0800													
Fds	MAC2	MAC1	0x88a8	Any	Any	VID3	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-17.
2. Upstream frames from Traffic Streams Bus through Eus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-18.
4. Downstream frames from Traffic Streams Bds through Fds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.2.5 Deactivate MAC Learning for 1:1 VLANs Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-32:** The OLT MUST support deactivating MAC learning, for 1:1 VLANs

Test Objective:

- To verify the OLT can disable MAC learning on VLANs configured for the 1:1 architecture.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 4. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 operation, supporting passing of the S-tag in the upstream/downstream directions. Additionally, the OLT should be configured to disable MAC address learning for the 1:1 VLANs configured.

Table 6-19: Test 6.1.2.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC5	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC5	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC2	MAC6	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC2	MAC6	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Cus	1	1	MAC3	MAC7	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC3	MAC7	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Dus	1	1	MAC4	MAC8	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC4	MAC8	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800

Table 6-20: Test 6.1.2.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC5	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC5	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Bds	MAC6	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC6	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Cds	MAC7	MAC3	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC7	MAC3	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800
Dds	MAC8	MAC4	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC8	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800

Test Procedure:

1. Select a random value for VID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC8, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
4. Configure the OLT to disable MAC address learning for the 1:1 VLAN.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame capture mechanisms on the Ethernet Traffic Generator.
7. Using the OLT interface, display the bridge forwarding table for all configured VLANs, if necessary, use the OLT interface to clear the table.
8. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.
9. Using the OLT interface, display the bridge forwarding table for all configured VLANs.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Dus must be received from the V-interface as defined in Table 6-19.
2. Downstream frames from Traffic Streams Ads through Dds must be received from the U-interface as defined in Table 6-20.
3. The bridge forwarding table displayed in step 9 MUST not include any of the MAC addressed used in Traffic Streams.

Remarks:

- None

6.1.2.6 Setting of VID Value Based on Received EtherType (Double-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.
- **R-20:** The ONU MUST support adding a C-Tag or S-Tag to upstream untagged traffic.
- **R-24:** The OLT MUST support adding an S-Tag in the upstream direction for C-tagged traffic.
- **R-30:** The OLT MUST support removal of an S-Tag in the downstream direction when traffic is double-tagged.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for untagged frames in the upstream direction based on EtherType.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to insert a C-tag for upstream frames, with VID value set based upon the received EtherType. The OLT is configured to support adding an outer S-tag to the C-tag frames. In the downstream direction, the ONU and OLT must perform the reverse operations. The OLT must be configured for 1:1 operation.

255i2 Table 6.1.2-1: Test 6.1.2.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x0800	MAC1	MAC2	0x88a8	Pbit1	Any	VID1	0x8100	Pbit1	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8863	MAC1	MAC2	0x88a8	Pbit1	Any	VID1	0x8100	Pbit1	Any	VID3	0x8863

255i2 Table 6.1.2-2: Test 6.1.2.6 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	0x88a8	Pbit1	Any	VID1	0x8100	Pbit1	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x0800
Bds	MAC2	MAC1	0x88a8	Pbit1	Any	VID1	0x8100	Pbit1	Any	VID3	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8863

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select a random value for Pbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.2-1.
2. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.2-2.

Remarks:

- None

6.1.2.7 Setting of VID Value with Priority Preservation Based on Received EtherType (Double-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for priority-tagged frames in the upstream direction based on EtherType with priority preservation.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 10. The ONU must be configured to set the VID value for priority-tagged frames based on received EtherType, with priority preservation (this also implies translating the TPID value from 0x8100 to 0x88a8). In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.2-3: Test 6.1.2.7 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)										
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800	MAC1	MAC2	0x88a8	Pbit4	Any	VID3	0x8100	Pbit1	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863	MAC1	MAC2	0x88a8	Pbit4	Any	VID3	0x8100	Pbit2	Any	VID2	0x8863
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x8863	MAC1	MAC2	0x88a8	Pbit4	Any	VID3	0x8100	Pbit3	Any	VID2	0x8863

255i2 Table 6.1.2-4: Test 6.1.2.7 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Pbit4	Any	VID3	0x8100	Pbit1	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800
Bds	MAC2	MAC1	0x88a8	Pbit4	Any	VID3	0x8100	Pbit2	Any	VID2	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863
Cds	MAC2	MAC1	0x88a8	Pbit4	Any	VID3	0x8100	Pbit3	Any	VID2	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x8863

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus must be received from the V-interface as defined in 255i2 Table 6.1.2-3.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.2-4.

Remarks:

- None

6.1.2.8 Setting of VID Value without Priority Preservation Based on Received EtherType (Double-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for priority-tagged frames in the upstream direction based on EtherType without priority preservation.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 10. The ONU must be configured to set the VID value for priority-tagged frames based on received EtherType, without priority preservation (this also implies translating the TPID value from 0x8100 to 0x88a8). In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.2-5: Test 6.1.2.8 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)										
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800	MAC1	MAC2	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863	MAC1	MAC2	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID2	0x8863
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x86DD	MAC1	MAC2	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID3	0x86DD

255i2 Table 6.1.2-6: Test 6.1.2.8 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800
Bds	MAC2	MAC1	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID2	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x8863
Cds	MAC2	MAC1	0x88a8	Pbit4	Any	VID4	0x8100	Pbit1	Any	VID3	0x86DD	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x86DD

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus must be received from the V-interface as defined in 255i2 Table 6.1.2-5.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.2-6.

Remarks:

- None

6.1.3 VLANs for Business Ethernet Services

6.1.3.1 Untagged U-interface, Single Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-34:** The ONU MUST support adding an S-Tag in the upstream direction for Q-tagged, untagged, and priority-tagged frames.
- **R-36:** The ONU MUST support removing an S-Tag in the downstream direction.
- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture listed as configuration 8 in Table 6-1, when the U-interface of the ONU is configured as an untagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 8. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-21: Test 6.1.3.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-22: Test 6.1.3.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800														
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800														

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-21.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-22.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.3.2 Priority-tagged U-interface, Single Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-34:** The ONU MUST support adding an S-Tag in the upstream direction for Q-tagged, untagged, and priority-tagged frames.
- **R-36:** The ONU MUST support removing an S-Tag in the downstream direction.
- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture listed as configuration 9 in Table 6-1, when the U-interface of the ONU is configured as a priority-tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 9. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-23: Test 6.1.3.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)										
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-24: Test 6.1.3.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-23.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-24.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.3.3 Q-tagged U-interface, Double Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-34:** The ONU MUST support adding an S-Tag in the upstream direction for Q-tagged, untagged, and priority-tagged frames.
- **R-36:** The ONU MUST support removing an S-Tag in the downstream direction.
- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture listed as configuration 10 in Table 6-1, when the U-interface of the ONU is configured as a tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 10. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions. This configuration implies the ONU does not require the Q-tag VID to be a specific value and will insert the S-tag “in front of” any Q-tag.

Table 6-25: Test 6.1.3.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID3	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID3	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID4	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID4	0x0800
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID5	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID5	0x0800
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
Fus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											

Table 6-26: Test 6.1.3.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800
Bds	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID3	0x0800
Cds	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID4	0x0800
Dds	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID5	0x0800
Eds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800													
Fds	MAC2	MAC1	0x88a8	Any	Any	VID6	0x8100	Any	Any	VID2	0x0800													
Gds	MAC2	MAC1	0x8100	Any	Any	VID1	0x8100	Any	Any	VID2	0x0800													
Hds	MAC2	MAC1	0x88a8	Any	Any	VID1	0x88a8	Any	Any	VID2	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID6 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Dus must be received from the V-interface as defined in Table 6-25.
2. Upstream frames from Traffic Streams Eus and Fus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Streams Ads through Dds must be received from the U-interface as defined in Table 6-26.
4. Downstream frames from Traffic Streams Eds through Hds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.3.4 S-tagged U-interface, Single Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-35:** The ONU MUST support validating and translating an S-Tag in the upstream direction for S-tagged frames.
- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture listed as configuration 11 in Table 6-1, when the U-interface of the ONU is configured as an S-tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to translate a received S-tag for upstream frames, translating VID1 to VID2. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

Table 6-27: Test 6.1.3.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)										
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Table 6-28: Test 6.1.3.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800													

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the V-interface as defined in Table 6-27.
2. Upstream frames from Traffic Streams Bus through Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Stream Ads must be received from the U-interface as defined in Table 6-28.
4. Downstream frames from Traffic Streams Bds and Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.3.5 Double Tagged U-interface, Double Tagged V-interface Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.
- **R-42:** The ONU MUST support VID translation of the S-tag received from the U interface into a new S-tag for upstream double-tagged traffic.
- **R-43:** The ONU MUST support VID translation of the S-Tag received from the GPON interface into a new S-Tag for downstream double-tagged traffic sent to the U interface.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture listed as configuration 12 in Table 6-1, when the U-interface of the ONU is configured as a double-tagged interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 12. The ONU must be configured to translate the S-VID for upstream double-tagged frames, translating S-VID=VID1 to S-VID=VID2. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions. This configuration implies the ONU does not require the C-tag VID to be a specific value and will translate the S-tag of any double-tagged frame.

Table 6-29: Test 6.1.3.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID3	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID4	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID4	0x0800
Cus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID5	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID5	0x0800
Dus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID6	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID6	0x0800
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800											
Fus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID7	0x8100	Any	Any	VID3	0x0800											
Gus	1	1	MAC1	MAC2	0x8100	Any	Any	VID1	0x8100	Any	Any	VID3	0x0800											
Hus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID1	0x88a8	Any	Any	VID3	0x0800											

Table 6-30: Test 6.1.3.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800	1	1	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID3	0x0800
Bds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID4	0x0800	1	1	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID4	0x0800
Cds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID5	0x0800	1	1	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID5	0x0800
Dds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID6	0x0800	1	1	MAC2	MAC1	0x88a8	Any	Any	VID1	0x8100	Any	Any	VID6	0x0800
Eds	MAC2	MAC1	0x88a8	Any	Any	VID7	0x8100	Any	Any	VID2	0x0800													
Fds	MAC2	MAC1	0x8100	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800													
Gds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x88a8	Any	Any	VID3	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID7 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Dus must be received from the V-interface as defined in Table 6-29.
2. Upstream frames from Traffic Streams Eus through Hus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Streams Ads through Dds must be received from the U-interface as defined in Table 6-30.

4. Downstream frames from Traffic Streams Eds through Gds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.3.6 Hairpin Turn for VBES at OLT Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-39:** The OLT MUST support forwarding traffic in the downstream direction to GEM Ports based on the S-Tag, including P-bits, when needed, and destination MAC address.
 - NOTE: This requirement applies to traffic received both from V interface and GEM ports where TLS VLAN topologies require forwarding among GEM ports in a single OLT.

Test Objective:

- To verify the ONU/OLT combination correctly supports/implements the VBES VLAN architecture when the OLT is required to “hair in turn” upstream traffic received from one ONU, sending the traffic back down the same PON to a second ONU.

Test Setup:

- Figure 4-2: Setup for Interoperability Tests Requiring Multiple ONUs

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-2.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 8. The ONU must be configured to insert an S-tag for upstream frames, with VID value set to VID1. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions. The test setup requires two ONU devices, configured to belong to the same VBES service.

Table 6-31: Test 6.1.3.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800												
Bus	2	1	MAC2	MAC1	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800												

Test Procedure:

1. Select a random value for VID1 between 1 and 4094.

2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream frames through the two ONU devices.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream Aus must be received from the U-interface of ONU 2 as untagged Ethernet Frames.
2. Upstream frames from Traffic Stream Bus must be received from the U-interface of ONU 1 as untagged Ethernet Frames.

Remarks:

- None

6.1.3.7 S-Tag Validation Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-35:** The ONU MUST support validating and translating an S-Tag in the upstream direction for S-tagged frames.
- **R-38:** The OLT MUST support passing an S-Tag in the upstream direction.
- **R-39:** The OLT MUST support forwarding traffic in the downstream direction to GEM Ports based on the S-Tag, including P-bits, when needed, and destination MAC address.
- **R-40:** The OLT MUST support passing an S-Tag in the downstream direction.

Test Objective:

- To verify the ONU/OLT combination correctly validates S-Tags in the upstream and downstream directions for S-tagged frames.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 13. The ONU must be configured to validate/pass VID1 and VID2 only. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.3-1: Test 6.1.3.7 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800	MAC1	MAC2	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID4	0x0800											

255i2 Table 6.1.3-2: Test 6.1.3.7 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
Bds	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800	1	1	MAC2	MAC1	0x88a8	Any	Any	VID2	0x8100	Any	Any	VID3	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID4	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Enter the configuration commands on the OLT to cause the VBES VLAN configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.3-1.
2. Upstream frames from Traffic Stream Cus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.3-2.
4. Downstream frames from Traffic Stream Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.4 N:1 or 1:1 Architecture

6.1.4.1 Setting of VID Value Based on Received EtherType (Single-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for untagged frames in the upstream direction based on EtherType.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to insert an S-tag for upstream frames, with VID value set based upon the received EtherType. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.4-1: Test 6.1.4.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8863	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID2	0x8863
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8864	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x8864
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x86DD											

255i2 Table 6.1.4-2: Test 6.1.4.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x0800
Bds	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID2	0x8863	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8863
Cds	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x8864	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	0x8864
Dds	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x86DD														

Test Procedure:

1. Select distinct random values for VID1 through VID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select a random value for Pbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus must be received from the V-interface as defined in 255i2 Table 6.1.4-1.
2. Upstream frames from Traffic Stream Dus must be silently discarded (e.g., not received from the V-interface).
3. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.4-2.
4. Downstream frames from Traffic Stream Dds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.4.2 Setting of VID Value with Priority Preservation Based on Received EtherType (Single-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for priority-tagged frames in the upstream direction based on EtherType with priority preservation.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 2. The ONU must be configured to set the VID value for priority-tagged frames based on received EtherType, with priority preservation (this also implies translating the TPID value from 0x8100 to 0x88a8). In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.4-3: Test 6.1.4.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x8863
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x8864	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x8864
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit4	Any	0	0x86DD	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x86DD

255i2 Table 6.1.4-4: Test 6.1.4.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x8864	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x8864
Dds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x86DD	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit4	Any	0	0x86DD

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Dus must be received from the V-interface as defined in 255i2 Table 6.1.4-3.
2. Downstream frames from Traffic Streams Ads through Dds must be received from the U-interface as defined in 255i2 Table 6.1.4-4.

Remarks:

- None

6.1.4.3 Setting of VID Value without Priority Preservation Based on Received EtherType (Single-Tagged at the V Interface)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-9:** The ONU MUST support setting the VID for untagged and priority-tagged frames in the upstream direction based on EtherType, except on VLANs used for Business Ethernet Services.

Test Objective:

- To verify the ONU/OLT combination supports setting VID for priority-tagged frames in the upstream direction based on EtherType without priority preservation.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 2. The ONU must be configured to set the VID value for priority-tagged frames based on received EtherType, without priority preservation (this also implies translating the TPID value from 0x8100 to 0x88a8). In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.1.4-5: Test 6.1.4.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	0	0x8863	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID2	0x8863
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	0	0x8864	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x8864
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit4	Any	0	0x86DD	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID4	0x86DD

255i2 Table 6.1.4-6: Test 6.1.4.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID2	0x8863	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x8863
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x8864	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x8864
Dds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID4	0x86DD	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	0	0x86DD

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Dus must be received from the V-interface as defined in 255i2 Table 6.1.4-5.
2. Downstream frames from Traffic Streams Ads through Dds must be received from the U-interface as defined in 255i2 Table 6.1.4-6.

Remarks:

- None

6.1.4.4 Verifying MAC Address use as a Classification Criterion

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-16:** The OLT MUST support passing an S-Tag in the downstream direction.
- **R-17:** The OLT MUST support forwarding traffic received at the V interface (i.e. downstream direction) to GEM Ports on the PON based on S-Tag, including P-bits if needed, and destination MAC address.
- **R-48:** The ONU MUST support deriving P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID, received P-bit markings, and EtherType.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.

Note: Section 5.1/TR-156 [2] states the following:

“On U interface ingress, traffic is classified into VLANs with various Ethernet priorities based on a number of criteria: physical port, VID, VLAN P-bits, EtherType and/or DSCP. Any combination of these criteria can be used to determine the Ethernet priority. The VID and EtherType can be used to determine the new VID. Once the traffic has been assigned a VLAN and Ethernet precedence, these two Ethernet header components are used to select an upstream GEM Port so that proper QoS can be applied to the flows.”

This indicates a TR-156 [2] compliant ONU should not use other information, such as MAC addresses in the Ethernet frames, as the classification criteria.

In the downstream criteria, this test checks that the S-Tag, including P-bits and destination MAC are used properly to classify the traffic. As GEM ports are not observable within the context of TR-255, Pass/Fail criteria only apply to traffic received at U and V interface.

Test Objective:

- Verify that the ONU/OLT properly use the MAC addresses for traffic classification.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under config number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT/ONU must discard downstream frames with unmatching VID. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The OLT/ONU must be configured:

- To support 2 traffic classes

The Ethernet Traffic Generator will be configured to transmit 8 flows of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes are also indicated.

255i2 Table 6.1.4-7: Test 6.1.4.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)													Traffic class
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type			
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1		
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID1	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID1	Any	1		
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID2	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID2	Any	2		
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID3	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	2		
Eus	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1		
Fus	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID3	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	2		
Gus	1	1	MAC7	MAC8	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID1	Any	1		
Hus	1	1	MAC7	MAC8	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID2	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID2	Any	2		

255i2 Table 6.1.4-8: Test 6.1.4.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													Traffic class
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	1
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID1	Any	1
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID2	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID2	Any	2
Dds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID3	Any	2
Eds	MAC4	MAC3	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	1
Fds	MAC6	MAC5	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	1	1	MAC6	MAC5	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID3	Any	2
Gds	MAC8	MAC7	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID1	Any	1	1	MAC8	MAC7	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID1	Any	1
Hds	MAC8	MAC7	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID2	Any	1	1	MAC8	MAC7	N/A	N/A	N/A	N/A	0x8100	CPbit3	N/A	CVID2	Any	2

Test Procedure:

1. Select distinct random values for CVID1 to CVID3 and SVID1 to SVID3 between 1 and 4094.

2. Select distinct random unicast values for MAC1 through MAC8, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 through CPbit 3 and SPbit1 through SPbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration corresponding to Traffic class 1 and 2 as described above.
5. Start injecting traffic at the U-interface as defined in 255i2 Table 6.1.4-7 for all flows, at a rate below the throughput limits defined for the configured service.
6. Stop injecting traffic at the U-interface.
7. Start injecting traffic at the V-interface as defined in 255i2 Table 6.1.4-8 for all flows at a rate below the throughput limits defined for the configured service.
8. Stop injecting traffic at the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6, all upstream flows have been received without packet loss from the V-interface as defined in 255i2 Table 6.1.4-7.
2. At step 8, all downstream flows have been received without packet loss from the V-interface as defined in 255i2 Table 6.1.4-8.

Remarks:

- None

6.1.5 Extended VLAN Tagging Operation Downstream Modes

6.1.5.1 Downstream Translation for Code Point 0

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU/OLT combination can perform downstream translation for the code point 0 (The operation performed in the downstream direction is the inverse of that performed in the upstream direction. Which treatment and filter fields are used for downstream filtering and the handling of unmatched frames are left to the implementation of the ONU).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 0 (The operation performed in the downstream direction is the inverse of that performed in the upstream direction. Which treatment and filter fields are used for downstream filtering and the handling of unmatched frames are left to the implementation of the ONU).

255i2 Table 6.1.5-1: Test 6.1.5.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-2: Test 6.1.5.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-1.
2. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.5-2.

Remarks:

- None

6.1.5.2 Downstream Translation for Code Point 1

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for the code point 1 (Regardless of the filter rules, no operation is performed in the downstream direction. All downstream frames are forwarded unmodified).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to silently drop all upstream frames except those described in 255i2 Table 6.1.5-3. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 1 (Regardless of the filter rules, no operation is performed in the downstream direction. All downstream frames are forwarded unmodified).

255i2 Table 6.1.5-3: Test 6.1.5.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-4: Test 6.1.5.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above, except traffic stream Cds, to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-3.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.5-3.

Remarks:

- None

6.1.5.3 Downstream Translation for Code Point 2

Test Status: Mandatory

Reference Documents:

- BBF TR-280 Issue 2 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 2 (Filter on VID and p-bit value. On a match, perform the inverse operation on both the VID and p-bit value. If no match is found, forward the frame unmodified).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to silently drop all upstream frames except those described in 255i2 Table 6.1.5-5. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 2 (Filter on VID and p-bit value. On a match, perform the inverse operation on both the VID and p-bit value. If no match is found, forward the frame unmodified).

255i2 Table 6.1.5-5: Test 6.1.5.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-6: Test 6.1.5.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above, except traffic stream Cds, to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-5.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.5-6.

Remarks:

- None

6.1.5.4 Downstream Translation for Code Point 3

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 3 (Filter on VID only. On a match, perform the inverse VID operation only. Pass the p bits through unmodified. If no match is found, forward the frame unmodified).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to silently drop all upstream frames except those described in 255i2 Table 6.1.5-7. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 3 (Filter on VID only. On a match, perform the inverse VID operation only. Pass the p bits through unmodified. If no match is found, forward the frame unmodified).

255i2 Table 6.1.5-7: Test 6.1.5.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-8: Test 6.1.5.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID2	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above, except traffic stream Cds, to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-7.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.5-8.

Remarks:

- None

6.1.5.5 Downstream Translation for Code Point 4

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 4 (Filter on p-bit only. On a match, perform the inverse p-bit operation only. Pass the VID through unmodified. If no match is found, forward the frame unmodified).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to silently drop all upstream frames except those described in 255i2 Table 6.1.5-9. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 4 (Filter on p-bit only. On a match, perform the inverse p-bit operation only. Pass the VID through unmodified. If no match is found, forward the frame unmodified).

255i2 Table 6.1.5-9: Test 6.1.5.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-10: Test 6.1.5.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID4	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above, except traffic stream Cds, to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-9.
2. Downstream frames from Traffic Streams Ads through Cds must be received from the U-interface as defined in 255i2 Table 6.1.5-10.

Remarks:

- None

6.1.5.6 Downstream Translation for Code Point 5

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 5 (Filter on VID and p-bit value. On a match, perform the inverse operation on both the VID and p-bit value. If no match is found, discard the frame).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 5 (Filter on VID and p-bit value. On a match, perform the inverse operation on both the VID and p-bit value. If no match is found, discard the frame).

255i2 Table 6.1.5-11: Test 6.1.5.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-12: Test 6.1.5.6 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-11.
2. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.5-12.
3. Downstream frames from Traffic Stream Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.5.7 Downstream Translation for Code Point 6

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 6 (Filter on VID. On a match, perform the inverse operation on the VID only. Pass the p bits through unmodified. If no match is found, discard the frame).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 6 (Filter on VID. On a match, perform the inverse operation on the VID only. Pass the p bits through unmodified. If no match is found, discard the frame).

255i2 Table 6.1.5-13: Test 6.1.5.7 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-14: Test 6.1.5.7 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID2	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-13.
2. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.5-14.
3. Downstream frames from Traffic Stream Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.5.8 Downstream Translation for Code Point 7

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 7 (Filter on p-bit only. On a match, perform the inverse p-bit operation only. Pass the VID through unmodified. If no match is found, discard the frame).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 7 (Filter on p-bit only. On a match, perform the inverse p-bit operation only. Pass the VID through unmodified. If no match is found, discard the frame).

255i2 Table 6.1.5-15: Test 6.1.5.8 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-16: Test 6.1.5.8 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID3	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID4	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800													

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-15.
2. Downstream frames from Traffic Streams Ads and Bds must be received from the U-interface as defined in 255i2 Table 6.1.5-16.
3. Downstream frames from Traffic Stream Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.1.5.9 Downstream Translation for Code Point 8

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

- **R-61:** The ONU MUST support all actual code points (0 to 8) for the downstream mode attribute of the Extended VLAN tagging operation configuration data ME as defined in ITU-T G.988.

Test Objective:

- Verify that the ONU can perform downstream translation for code point 8 (Regardless of the filter rules, discard all downstream traffic).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to silently drop all upstream frames except those described in 255i2 Table 6.1.5-17. The ONU must be configured to translate a received S-tag for upstream frames. In the downstream direction, the ONU must perform the operation as described in code point 8 (Regardless of the filter rules, discard all downstream traffic).

255i2 Table 6.1.5-17: Test 6.1.5.9 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbitts	DEI	VID	TPID	Pbitts	DEI	VID				TPID	Pbitts	DEI	VID	TPID	Pbitts	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800

255i2 Table 6.1.5-18: Test 6.1.5.9 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	0x0800														
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID4	0x0800														
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID5	0x0800														

Test Procedure:

1. Select distinct random values for VID1 through VID5 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit5 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the VLAN configuration described above, except traffic stream Cds, to be activated on the ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the upstream and downstream frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus must be received from the V-interface as defined in 255i2 Table 6.1.5-17.
2. Downstream frames from Traffic Streams Ads through Cds must be silently discarded (e.g., not received from the U-interface).

Remarks:

- None

6.2 Quality of Service Functions

6.2.1 Frame Classification (Derivation and Manipulation of P-bits)

6.2.1.1 Setting of P-bit Value Based on Received VID

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-48:** The ONU MUST support deriving P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID, received P-bit markings, and EtherType.

Test Objective:

- Verify the OLT and ONU can support setting a fixed P-bit value based on the received VLAN VID values. The behavior is expected to be symmetric in the upstream/downstream directions.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. ONU/OLT MUST pass test case 6.1.1.3.
2. The ONU is powered and connected to the ODN as shown in Figure 4-1.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

The OLT should configure the ONU to support the VLAN architecture defined as configuration number 3 in Table 6-1, “Tagged UNI for N:1 architecture.” The OLT should configure the ONU to overwrite the received P-bits, as indicated in Table 6-32 below. Table 6-33 defines the symmetric downstream operations. The VLAN VID values should remain the same across the U/V interfaces, with only the “type” being changes from a Q-tag to S-tag.

Table 6-32: Test 6.2.1.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID2	0x0800

Table 6-33: Test 6.2.1.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800	

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus MUST be received from the V-interface as defined in Table 6-32.
2. Downstream frames from Traffic Streams Ads and Bds MUST be received from the U-interface as defined in Table 6-33.

Remarks:

- None

6.2.1.2 Setting of P-bit Value Based on Received P-bit

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-48:** The ONU MUST support deriving P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID, received P-bit markings, and EtherType.

Test Objective:

- Verify the OLT and ONU can support setting a fixed P-bit value based on the received p-bit values. The behavior is expected to be symmetric in the upstream/downstream directions.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. ONU/OLT MUST pass test case 6.1.1.3.
2. The ONU is powered and connected to the ODN as shown in Figure 4-1.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

The OLT should configure the ONU to support the VLAN architecture defined as configuration number 3 in Table 6-1, “Tagged UNI for N:1 architecture.” The OLT should configure the ONU to overwrite the received P-bits, as indicated in Table 6-34 below. Table 6-35 defines the symmetric downstream operations. The VLAN VID values should remain the same across the U/V interfaces, with only the “type” being changes from a Q-tag to S-tag.

Table 6-34: Test 6.2.1.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID1	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit6	Any	VID2	0x0800

Table 6-35: Test 6.2.1.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	Any	VID1	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit6	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit3	Any	VID2	0x0800

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit6 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus MUST be received from the V-interface as defined in Table 6-34.
2. Downstream frames from Traffic Streams Ads through Cds MUST be received from the U-interface as defined in Table 6-35.

Remarks:

- None

6.2.1.3 Setting of P-bit Value Based on Received EtherType

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-48:** The ONU MUST support deriving P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID, received P-bit markings, and EtherType.

Test Objective:

- Verify the OLT and ONU can support setting a fixed P-bit value based on the received Ethertype. The behavior is expected to be symmetric in the upstream/downstream directions.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. ONU/OLT MUST pass test case 6.1.1.3.
2. The ONU is powered and connected to the ODN as shown in Figure 4-1.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

The OLT should configure the ONU to support the VLAN architecture defined as configuration number 3 in Table 6-1, “Tagged UNI for N:1 architecture.” The OLT should configure the ONU to overwrite the received P-bits, as indicated in Table 6-36 below. Table 6-37 defines the symmetric downstream operations. The VLAN VID values should remain the same across the U/V interfaces, with only the “type” being changes from a Q-tag to S-tag.

Table 6-36: Test 6.2.1.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0806	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0806
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x86dd	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID1	0x86dd

Table 6-37: Test 6.2.1.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0806	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0806
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID1	0x86dd	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x86dd

Test Procedure:

1. Select a random value for VID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus MUST be received from the V-interface as defined in Table 6-36.
2. Downstream frames from Traffic Streams Ads through Cds MUST be received from the U-interface as defined in Table 6-37.

Remarks:

- None

6.2.1.4 Setting of P-bit Value Based on UNI Port

Test Status: Conditionally Mandatory, for ONUs with multiple UNI ports

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-48:** The ONU MUST support deriving P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID, received P-bit markings, and EtherType.

Test Objective:

- Verify the OLT and ONU can support setting a fixed P-bit value based on the UNI port where the frame was received. The behavior is expected to be symmetric in the upstream/downstream directions.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. ONU/OLT MUST pass test case 6.1.1.3.
2. The ONU is powered and connected to the ODN as shown in Figure 4-3.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

The OLT should configure the ONU to support the VLAN architecture defined as configuration number 3 in Table 6-1, “Tagged UNI for N:1 architecture.” The OLT should configure the ONU to overwrite the received P-bits, as indicated in Table 6-38 below. Table 6-39 defines the symmetric downstream operations. The VLAN VID values should remain the same across the U/V interfaces, with only the “type” being changes from a Q-tag to S-tag.

Table 6-38: Test 6.2.1.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800
Bus	1	2	MAC1	MAC3	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	MAC1	MAC3	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800

Table 6-39: Test 6.2.1.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	PbBits	DEI	VID	TPID	PbBits	DEI	VID						TPID	PbBits	DEI	VID	TPID	PbBits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bds	MAC3	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800	1	2	MAC3	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800

Test Procedure:

1. Select a random value for VID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC3, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on ONU.
5. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
6. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
7. Cause the Ethernet Traffic Generator to transmit the frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus and Bus MUST be received from the V-interface as defined in Table 6-38.
2. Downstream frames from Traffic Streams Ads and Bds MUST be received from the U-interface as defined in Table 6-39.

Remarks:

- None

6.2.1.5 Setting of P-bit Value Based on Received DSCP Value

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-49:** The ONU SHOULD support deriving the P-bit markings in the upstream direction based on an arbitrary combination of: user port, VID and received IPv4 DSCP or IPv6 traffic class value.

Test Objective:

- Verify the OLT and ONU can support setting a fixed P-bit value based on the received DSCP value. The behavior is expected to be symmetric in the upstream/downstream directions.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. ONU/OLT MUST pass test case 6.1.1.3.
2. The ONU is powered and connected to the ODN as shown in Figure 4-1.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

The OLT should configure the ONU to support the VLAN architecture defined as configuration number 3 in Table 6-1, “Tagged UNI for N:1 architecture.” The OLT should configure the ONU to overwrite the received P-bits, as indicated in Table 6-40 below. Table 6-41 defines the symmetric downstream operations. The VLAN VID values should remain the same across the U/V interfaces, with only the “type” being changes from a Q-tag to S-tag.

Table 6-40: Test 6.2.1.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)														V Interface (as received from)													
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	DSCP	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type			
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	DSCP1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800			
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID1	0x0800	DSCP2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800			
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	Any	VID2	0x0800	DSCP3	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID2	0x0800			

Table 6-41: Test 6.2.1.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)												U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	DSCP	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID							TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	0x0800	DSCP1	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID1	0x0800	DSCP2	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	Any	VID2	0x0800	DSCP3	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID2	0x0800	

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit4 between 0 and 7.
4. Select distinct random values for DSCP1 through DSCP3 between 0 and 63.
5. Enter the configuration commands on the OLT to cause the N:1 VLAN configuration described above to be activated on ONU.
6. Configure the Ethernet Traffic Generator to transmit the upstream and downstream frames defined above.
7. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
8. Cause the Ethernet Traffic Generator to transmit the frames.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Streams Aus through Cus MUST be received from the V-interface as defined in Table 6-40.
2. Downstream frames from Traffic Streams Ads through Cds MUST be received from the U-interface as defined in Table 6-41.

Remarks:

- None

6.2.2 Frame Mapping

6.2.2.1 Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on P-bit Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-44:** The OLT MUST support the basic traffic descriptor parameters as specified in G.984.3 (7.4.4.3 Fixed, Assured, Max BW and type NA or BE). These parameters MUST be configurable.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.
- **R-52:** The ONU MUST NOT prevent multiple P-bit values being used in the same VLAN.
- **R-53:** The ONU MUST NOT prevent multiple VLANs from using the same P-bits.
- **R-57:** In the upstream direction, the ONU MUST support at least 4 queues, one per traffic class.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.
- **R-71:** The OLT MUST support assigning a TC to an upstream queue.

Also Recommended:

- **R-67:** In the upstream direction, the ONU MUST support at least 4 T-CONTs, one per traffic class.

Test Objective:

- To verify that the OLT and ONU can support four queues in the upstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) p-bit value(s).
- With 4 upstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four upstream queues.
- With an upstream bandwidth among all traffic classes serviced at a fixed rate which is much less than the U- interface capacity.

The sum of the flow rates applied simultaneously onto the U-interface should be much less than the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Tags will not be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-42: Test 6.2.2.1 Upstream Frame Definitions

Traffic Stream (Traffic Class)	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits3	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits3	Any	CVID1	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits4	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits4	Any	CVID1	0x0800
E (3)	1	1	MAC1	MAC2					0x8100	CPbits5	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits5	Any	CVID1	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits6	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits6	Any	CVID1	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits7	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits7	Any	CVID1	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits8	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits8	Any	CVID1	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.

- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 between 1 and 4094.
2. Select a random value for SPbits1 between 0 and 7.
3. Select distinct random values for CPbits1 through CPbits8 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
4. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
5. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
6. Enable any frame capture mechanism on the Ethernet traffic generator.
7. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.
10. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 7 of the test procedure, all the sent upstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 10 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- None

6.2.2.2 Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-44:** The OLT MUST support the basic traffic descriptor parameters as specified in G.984.3 (7.4.4.3 Fixed, Assured, Max BW and type NA or BE). These parameters MUST be configurable.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.
- **R-52:** The ONU MUST NOT prevent multiple P-bit values being used in the same VLAN.
- **R-53:** The ONU MUST NOT prevent multiple VLANs from using the same P-bits.
- **R-57:** In the upstream direction, the ONU MUST support at least 4 queues, one per traffic class.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.
- **R-71:** The OLT MUST support assigning a TC to an upstream queue.

Also Recommended:

- **R-67:** In the upstream direction, the ONU MUST support at least 4 T-CONTs, one per traffic class.

Test Objective:

- To verify that the OLT and ONU can support four queues in the upstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) VID value(s).
- With 4 upstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four upstream queues.
- With an upstream bandwidth among all traffic classes serviced at a fixed rate which is much less than the U- interface capacity.

The sum of the flow rates applied simultaneously onto the U-interface should be much less than the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-43: Test 6.2.2.2 Upstream Frame Definitions

Traffic Stream (Traffic Class)	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID4	0x0800
E (3)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID5	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID5	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID6	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID6	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID7	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID7	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID8	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID8	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 through CVID8 between 1 and 4094.

2. Select distinct random values for SPbits1 and CPbits1 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.
9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent upstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- None

6.2.2.3 Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID and P-bit Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-44:** The OLT MUST support the basic traffic descriptor parameters as specified in G.984.3 (7.4.4.3 Fixed, Assured, Max BW and type NA or BE). These parameters MUST be configurable.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.
- **R-52:** The ONU MUST NOT prevent multiple P-bit values being used in the same VLAN.
- **R-53:** The ONU MUST NOT prevent multiple VLANs from using the same P-bits.
- **R-57:** In the upstream direction, the ONU MUST support at least 4 queues, one per traffic class.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.
- **R-71:** The OLT MUST support assigning a TC to an upstream queue.

Also Recommended:

- **R-67:** In the upstream direction, the ONU MUST support at least 4 T-CONTs, one per traffic class.

Test Objective:

- To verify that the OLT and ONU can support four queues in the upstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of p-bits & VID values.
- With 4 upstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four upstream queues.
- With an upstream bandwidth among all traffic classes serviced at a fixed rate which is much less than the U- interface capacity.

The sum of the flow rates applied simultaneously onto the U-interface should be much less than the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-44: Test 6.2.2.3 Upstream Frame Definitions

Traffic Stream (Traffic Class)	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID2	0x0800
E (3)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID3	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID4	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID4	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 through CVID4 between 1 and 4094.

2. Select distinct random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.
9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent upstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- None

6.2.2.4 Strict Priority Upstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit, and U-interface Values (1:1 VLAN, Multiple User Port)

Test Status: Conditionally mandatory if Multiple U Interfaces are supported by the ONU

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-33:** The Access Node MUST configure 1:1 VLANs so that the C-Tags are assigned to be unique across the U interfaces and across the entries in the 1:1 VLAN membership list.
- **R-44:** The OLT MUST support the basic traffic descriptor parameters as specified in G.984.3 (7.4.4.3 Fixed, Assured, Max BW and type NA or BE). These parameters MUST be configurable.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.
- **R-52:** The ONU MUST NOT prevent multiple P-bit values being used in the same VLAN.
- **R-53:** The ONU MUST NOT prevent multiple VLANs from using the same P-bits.
- **R-57:** In the upstream direction, the ONU MUST support at least 4 queues, one per traffic class.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.
- **R-71:** The OLT MUST support assigning a TC to an upstream queue.

Also Recommended:

- **R-67:** In the upstream direction, the ONU MUST support at least 4 T-CONTs, one per traffic class.

Test Objective:

- To verify that the OLT and ONU can support four queues in the upstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-3.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of p-bits, VID & user port values.
- With 4 upstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four upstream queues.
- With an upstream bandwidth among all traffic classes serviced at a fixed rate which is much less than the U- interface capacity.

The sum of the flow rates applied simultaneously onto the U-interface should be much less than the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-45: Test 6.2.2.4 Upstream Frame Definitions

Traffic Stream (Traffic Class)	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID2	0x0800
E (3)	1	2	MAC1	MAC3					0x8100	CPbits1	Any	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800
F (3)	1	2	MAC1	MAC3					0x8100	CPbits2	Any	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID3	0x0800
G (4)	1	2	MAC1	MAC3					0x8100	CPbits3	Any	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits3	Any	CVID3	0x0800
H (4)	1	2	MAC1	MAC3					0x8100	CPbits4	Any	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits4	Any	CVID3	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 through CVID3 between 1 and 4094.
2. Select distinct random values for SPbits1 and CPbits1 through CPbits4 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC3.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.
9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent upstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- None

6.2.2.5 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on P-bit Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-29:** The OLT MUST support forwarding traffic received at the V interface (i.e., downstream direction) to GEM Ports on the PON based on S-VID or (S-VID & C-VID), including P-bits, where needed, in the S-Tag.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) p-bit value(s).
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-46: Test 6.2.2.5 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits3	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits3	Any	CVID1	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits4	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits4	Any	CVID1	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits5	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits5	Any	CVID1	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits6	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits6	Any	CVID1	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits7	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits7	Any	CVID1	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits8	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits8	Any	CVID1	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 between 1 and 4094.
2. Select a random value for SPbits1 between 0 and 7.
3. Select distinct random values for CPbits1 through CPbits8 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
4. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
5. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
6. Enable any frame capture mechanism on the Ethernet traffic generator.
7. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.

10. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 7 of the test procedure, all the sent downstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 10 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.6 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-29:** The OLT MUST support forwarding traffic received at the V interface (i.e. downstream direction) to GEM Ports on the PON based on S-VID or (S-VID & C-VID), including P-bits, where needed, in the S-Tag.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) VID value(s).
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-47: Test 6.2.2.6 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID3	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID4	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID5	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID5	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID6	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID6	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID7	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID7	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID8	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID8	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 through CVID8 between 1 and 4094.
2. Select distinct random values for SPbits1 and CPbits1 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.

9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.7 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID and P-bit Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-29:** The OLT MUST support forwarding traffic received at the V interface (i.e. downstream direction) to GEM Ports on the PON based on S-VID or (S-VID & C-VID), including P-bits, where needed, in the S-Tag.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of p-bits & VID values.
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-48: Test 6.2.2.7 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID2	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID3	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID3	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID4	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID4	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and CVID1 through CVID4 between 1 and 4094.
2. Select distinct random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.

9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.8 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on SVID, CVID, and P-bit Values (1:1 VLAN, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-29:** The OLT MUST support forwarding traffic received at the **V** interface (i.e. downstream direction) to GEM Ports on the PON based on S-VID or (S-VID & C-VID), including P-bits, where needed, in the S-Tag.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of SVID, CVID & p-bit.
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-49: Test 6.2.2.8 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID2	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID1	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits2	Any	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID1	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits1	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	Any	CVID2	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits2	Any	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	Any	CVID2	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 through SVID2 and CVID1 through CVID2 between 1 and 4094.
2. Select distinct random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC2.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.

9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.9 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit Values, and MAC DA (VBES, Single User Port)

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-39:** The OLT MUST support forwarding traffic in the downstream direction to GEM Ports based on the S-Tag, including P-bits, when needed, and destination MAC address.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of p-bits, VID and MAC DA values.
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-50: Test 6.2.2.9 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800	1	1	MAC1	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800
B (2)	MAC2	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800
C (2)	MAC2	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800
D (3)	MAC3	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800	1	1	MAC3	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800
E (3)	MAC4	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800	1	1	MAC4	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800
F (3)	MAC5	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800	1	1	MAC5	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800
G (4)	MAC6	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800	1	1	MAC6	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800
H (4)	MAC7	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800	1	1	MAC7	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1.
- Traffic Streams B & C must be assigned to Traffic Class 2.
- Traffic Streams D, E & F must be assigned to Traffic Class 3.
- Traffic Streams G & H must be assigned to Traffic Class 4.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and SVID2 between 1 and 4094.
2. Select distinct random values for SPbits1 and SPbits2 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC8.
4. Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU. Applying traffic in upstream as a first step might be necessary to enable MAC Learning functions.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream A until no frame from traffic streams D, E & F (i.e., Traffic Class 3) is received on the Ethernet traffic generator.

9. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to H are received at the Ethernet traffic generator, error free.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic streams A, B & C are received error free.
 - b. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received.
 - c. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. All frames from traffic stream A are received error free.
 - b. At least some of the frames from traffic streams B & C (i.e., Traffic Class 2) are received.
 - c. No frame from traffic streams D, E & F (i.e., Traffic Class 3) is received.
4. At step 9 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A are received.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2), D, E & F (i.e., Traffic Class 3) and G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.10 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on SVID, CVID, and P-bit Values (1:1 VLAN, Multiple User Port)

Test Status: Conditionally mandatory if Multiple U Interfaces are supported by the ONU

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-29:** The OLT MUST support forwarding traffic received at the **V** interface (i.e. downstream direction) to GEM Ports on the PON based on S-VID or (S-VID & C-VID), including P-bits, where needed, in the S-Tag.
- **R-31:** The ONU MUST support mapping traffic from one or more GEM Ports to a **U** interface in the downstream direction.
- **R-33:** The Access Node MUST configure 1:1 VLANs so that the C-Tags are assigned to be unique across the U interfaces and across the entries in the 1:1 VLAN membership list.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.
- To verify that a traffic class can be mapped to a specific U-interface.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-3.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 7. The ONU must be configured to support passing a received C-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 VLAN configuration, supporting adding of the S-tag in the upstream direction. In the downstream direction, the OLT must perform the reverse operation.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of SVID, CVID, p-bit.
- With 4 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the four downstream queues.
- With mapping to U-interface depending on the traffic class.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-51: Test 6.2.2.10 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits1	Any	CVID1	0x0800
B (2)	MAC1	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits2	Any	CVID1	0x0800
C (2)	MAC1	MAC3	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits1	Any	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits1	Any	CVID1	0x0800
D (3)	MAC2	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits3	Any	CVID2	0x0800	1	2	MAC2	MAC3					0x8100	CPbits3	Any	CVID2	0x0800
E (3)	MAC2	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits4	Any	CVID2	0x0800	1	2	MAC2	MAC3					0x8100	CPbits4	Any	CVID2	0x0800
F (3)	MAC2	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits1	Any	CVID3	0x0800	1	2	MAC2	MAC3					0x8100	CPbits1	Any	CVID3	0x0800
G (4)	MAC2	MAC3	0x88A8	SPbits1	Any	SVID1	0x8100	CPbits2	Any	CVID3	0x0800	1	2	MAC2	MAC3					0x8100	CPbits2	Any	CVID3	0x0800
H (4)	MAC2	MAC3	0x88A8	SPbits1	Any	SVID2	0x8100	CPbits3	Any	CVID4	0x0800	1	2	MAC2	MAC3					0x8100	CPbits3	Any	CVID4	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1 AND mapped to U-interface 1.
- Traffic Streams B & C must be assigned to Traffic Class 2 AND mapped to U-interface 1.
- Traffic Streams D, E & F must be assigned to Traffic Class 3 AND mapped to U-interface 2.
- Traffic Streams G & H must be assigned to Traffic Class 4 AND mapped to U-interface 2.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 through SVID2 and CVID1 through CVID4 between 1 and 4094.
2. Select distinct random values for SPbits1 and CPbits1 through CPbits4 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC3.
4. Enter the configuration commands on the OLT to cause the 1:1 VLAN configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU.

7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.
8. Gradually increase the bit rate of traffic stream D until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to C are received at the Ethernet traffic generator, error free at U-interface 1, only U-interface 1 and traffic streams from D to H are received at the Ethernet traffic generator, error free at U-interface 2, only U-interface 2.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A (i.e., Traffic Class 1) are received at U-interface 1, only U-interface 1.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received at U-interface 2, only U-interface 2.
 - b. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.2.11 Strict Priority Downstream Scheduling Among 4 Queues on ONU and OLT Based on VID, P-bit Values, and MAC DA (VBES, Multiple User Port)

Test Status: Conditionally mandatory if Multiple U Interfaces are supported by the ONU

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-39:** The OLT MUST support forwarding traffic in the downstream direction to GEM Ports based on the S-Tag, including P-bits, when needed, and destination MAC address.
- **R-41:** The ONU MUST support mapping traffic from one or more GEM Ports to a U interface in the downstream direction.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-56:** In the downstream direction, the ONU MUST support at least 4 queues per user port, one per traffic class.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-64:** The OLT and ONU MUST support assigning an individual TC to a downstream queue.

Test Objective:

- To verify that the OLT and ONU can support four queues in the downstream direction, that each queue can be assigned to one specific traffic class and that they support strict priority scheduling among those four traffic classes.
- To verify that multiple traffic streams can be mapped into a specific traffic class.
- To verify that a traffic class can be mapped to a specific U-interface.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-3.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

The OLT/ONU will be configured:

- To support 4 traffic classes, each one associated to specific(s) combination(s) of p-bits, VID and MAC DA values.
- With 4 downstream queues, each one assigned to one traffic class.

- With strict priority scheduling between the four downstream queues.
- With mapping to U-interface depending on the traffic class.

Tags won't be modified on the ONU; expected frame format at the U-interface is also shown in the table.

Table 6-52: Test 6.2.2.11 Downstream Frame Definitions

Traffic Stream (Traffic Class)	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A (1)	MAC1	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800	1	1	MAC1	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800
B (2)	MAC2	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800
C (2)	MAC2	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800
D (3)	MAC3	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800	1	2	MAC3	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800
E (3)	MAC4	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800	1	2	MAC4	MAC8					0x88A8	SPbits1	Any	SVID1	0x0800
F (3)	MAC5	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800	1	2	MAC5	MAC8					0x88A8	SPbits2	Any	SVID1	0x0800
G (4)	MAC6	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800	1	2	MAC6	MAC8					0x88A8	SPbits1	Any	SVID2	0x0800
H (4)	MAC7	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800	1	2	MAC7	MAC8					0x88A8	SPbits2	Any	SVID2	0x0800

Note:

- Traffic Stream A must be assigned to Traffic Class 1 AND mapped to U-interface 1.
- Traffic Streams B & C must be assigned to Traffic Class 2 AND mapped to U-interface 1.
- Traffic Streams D, E & F must be assigned to Traffic Class 3 AND mapped to U-interface 2.
- Traffic Streams G & H must be assigned to Traffic Class 4 AND mapped to U-interface 2.

Note:

- Traffic class 1 will have the highest priority and traffic class 4 the lowest.
- Traffic class 2 will have a higher priority than traffic class 3.

Test Procedure:

1. Select distinct random values for SVID1 and SVID2 between 1 and 4094.
2. Select distinct random values for SPbits1 and SPbits2 between 0 and 7.
 - a. Note: Traffic class 1 will have the highest priority and traffic class 4 the lowest. Traffic class 2 will have a higher priority than traffic class 3.
3. Select distinct random values for unicast MAC addresses MAC1 through MAC8.
4. Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
5. Enable any frame capture mechanism on the Ethernet traffic generator.
6. Cause the traffic generator to send the configured traffic flows. Initially, the eight streams will be sent at the same bit rate and the total bit rate will be below the maximum bandwidth available for the ONU. Applying traffic in upstream as a first step might be necessary to enable MAC Learning functions.
7. Gradually increase the bit rate of traffic stream A until no frame from traffic streams B & C (i.e., Traffic Class 2) is received on the Ethernet traffic generator.

8. Gradually increase the bit rate of traffic stream D until no frame from traffic streams G & H (i.e., Traffic Class 4) is received on the Ethernet traffic generator.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6 of the test procedure, all the sent downstream frames of traffic streams from A to C are received at the Ethernet traffic generator, error free at U-interface 1, only at U-interface 1 and traffic streams from D to H are received at the Ethernet traffic generator, error free at U-interface 2, only at U-interface 2.
2. At step 7 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic stream A (i.e., Traffic Class 1) are received at U-interface 1, only at U-interface 1.
 - b. No frame from traffic streams B & C (i.e., Traffic Class 2) is received.
3. At step 8 of the test procedure, at the Ethernet traffic generator:
 - a. At least some of the frames from traffic streams D, E & F (i.e., Traffic Class 3) are received at U-interface 2, only at U-interface 2.
 - b. No frame from traffic streams G & H (i.e., Traffic Class 4) is received.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.3 Drop Precedence

6.2.3.1 Indicating Drop Precedence Using P-bit Upstream

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-54:** The OLT and ONU MUST support drop precedence within at least 2 traffic classes and MUST support configurable mapping to these classes and drop precedence from the 8 possible values of the Ethernet P-bits.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.

Test Objective:

- To verify that the OLT and ONU can implement drop precedence using p-bits upstream.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

ONU must be set up with the standard L2 OCM (single user) with two upstream queues and two associated traffic classes. ONU queues are set up with the following: drop precedence indication = PCP 6P2D; yellow thresholds set to half the queue size; green thresholds set to the queue size. The intent of the test is to define four flows, two per traffic class. For each traffic class, one of the flows is marked with drop precedence.

Each traffic class (through T-CONT rate) should be serviced at a fixed rate, E.

Each flow rate is set to $R=0.7E$.

The sum of the flow rates applied simultaneously onto the U-interface should be below the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Table 6-53: Test 6.2.3.1 Upstream Frame Definitions

Traffic Stream	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A*	1	1	MAC1	MAC2					0x88A8	2		SVID1	0x0800	MAC1	MAC2					0x88A8	2		SVID1	0x0800
B	1	1	MAC1	MAC2					0x88A8	3		SVID1	0x0800	MAC1	MAC2					0x88A8	3		SVID1	0x0800
C*	1	1	MAC1	MAC2					0x88A8	4		SVID1	0x0800	MAC1	MAC2					0x88A8	4		SVID1	0x0800
D	1	1	MAC1	MAC2					0x88A8	5		SVID1	0x0800	MAC1	MAC2					0x88A8	5		SVID1	0x0800

*=Drop Precedence Flow

Note:

- Streams A&B are in Traffic Class 1.
- Streams C&D are in Traffic Class 2.

Test Procedure:

- Select a random value for SVID1 between 1 and 4094.
- Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
- Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
- Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R.
- Enable any frame captured mechanisms on the Ethernet Traffic Generator.
- Verify at the V-interface that the only packets dropped are from stream marked with drop precedence.
- Stop traffic streams A & B.
- Repeat steps 4 to 7 using traffic streams C & D.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

- Verify at the V-interface, that the only packets dropped are from streams marked with drop precedence.

Remarks:

- None

6.2.3.2 Indicating Drop Precedence Using DEI Bit Upstream

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-55:** The OLT and ONU MUST support drop precedence within all supported traffic classes based on the DEI bit value of the 802.1ad header.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.

Test Objective:

- To verify that the OLT and ONU can implement drop precedence using DEI bit upstream.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

ONU must be set up with the standard L2 OCM (single user) with four upstream queues and four associated traffic classes. ONU queues are set up with the following: drop precedence indication = DEI; yellow thresholds set to half the queue size; green thresholds set to the queue size. The intent of the test is to define eight flows, two per traffic class. For each traffic class, one of the flows is marked with drop precedence.

Each traffic class (through T-CONT rate) should be serviced at a fixed rate, E.

Each flow rate is set to $R=0.7E$.

The sum of the flow rates applied simultaneously onto the U-interface should be below the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

Table 6-54: Test 6.2.3.2 Upstream Frame Definitions

Traffic Stream	U INTERFACE												V INTERFACE											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A*	1	1	MAC1	MAC2					0x88A8	SPbits1	1	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits1	1	SVID1	0x0800
B	1	1	MAC1	MAC2					0x88A8	SPbits1	0	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits1	0	SVID1	0x0800
C*	1	1	MAC1	MAC2					0x88A8	SPbits2	1	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits2	1	SVID1	0x0800
D	1	1	MAC1	MAC2					0x88A8	SPbits2	0	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits2	0	SVID1	0x0800
E*	1	1	MAC1	MAC2					0x88A8	SPbits3	1	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits3	1	SVID1	0x0800
F	1	1	MAC1	MAC2					0x88A8	SPbits3	0	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits3	0	SVID1	0x0800
G*	1	1	MAC1	MAC2					0x88A8	SPbits4	1	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits4	1	SVID1	0x0800
H	1	1	MAC1	MAC2					0x88A8	SPbits4	0	SVID1	0x0800	MAC1	MAC2					0x88A8	SPbits4	0	SVID1	0x0800

*=Drop Precedence Flow

Note:

- Streams A&B are in Traffic Class 1.
- Streams C&D are in Traffic Class 2.
- Streams E&F are in Traffic Class 3.
- Streams G&H are in Traffic Class 4.

Test Procedure:

- Select a random value for SVID1 between 1 and 4094.
- Select distinct random values for SPbits1 through SPbits4 between 0 and 7.
- Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
- Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
- Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R.
- Enable any frame captured mechanisms on the Ethernet Traffic Generator.
- Verify at the V-interface that the only packets dropped are from stream marked with drop precedence.
- Stop traffic streams A & B.
- Repeat steps 5 to 8 using traffic streams C&D.
- Stop traffic streams C&D.
- Repeat steps 5 to 8 using traffic streams E&F.
- Stop traffic streams E&F.
- Repeat steps 5 to 8 using traffic streams G&H.
- Stop traffic streams G&H.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

- Verify at the V-interface that the only packets dropped are from streams marked with drop precedence.

Remarks:

- None

6.2.3.3 Indicating Drop Precedence Using P-bits Downstream

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-54:** The OLT and ONU MUST support drop precedence within at least 2 traffic classes and MUST support configurable mapping to these classes and drop precedence from the 8 possible values of the Ethernet P-bits.

Test Objective:

- To verify that the OLT and ONU can implement drop precedence using p-bits downstream.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

ONU must be set up with the standard L2 OCM (single user) with two downstream queues. ONU queues are set up with the following: drop precedence indication = PCP 6P2D; yellow thresholds set to half the queue size; green thresholds set to the queue size. The intent of the test is to define four flows, two per traffic class. For each traffic class, one of the flows is marked with drop precedence. For a user port egress rate of E, each flow rate is set to $R=0.7E$.

Table 6-55: Test 6.2.3.3 Downstream Frame Definitions

Traffic Stream	V INTERFACE										U INTERFACE													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	PbIts	DEI	VID	TPID	PbIts	DEI	VID						TPID	PbIts	DEI	VID	TPID	PbIts	DEI	VID	
A*	MAC1	MAC2					0x88A8	2		SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	2		SVID1	0x0800
B	MAC1	MAC2					0x88A8	3		SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	3		SVID1	0x0800
C*	MAC1	MAC2					0x88A8	4		SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	4		SVID1	0x0800
D	MAC1	MAC2					0x88A8	5		SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	5		SVID1	0x0800

*=Drop Precedence Flow

Note:

- Streams A&B are in Traffic Class 1.
- Streams C&D are in Traffic Class 2.

Test Procedure:

- Select a random value for SVID1 between 1 and 4094.
- Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
- Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
- Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R.
- Enable any frame captured mechanisms on the Ethernet Traffic Generator.
- Verify at the U-interface that the only packets dropped are from stream marked with drop precedence.
- Stop traffic streams A&B.
- Repeat steps 4 to 7 using traffic streams C&D.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

- Verify at the-U-interface, that the only packets dropped are from streams marked with drop precedence.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.2.3.4 Indicating Drop Precedence Using DEI Bits Downstream

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-55:** The OLT and ONU MUST support drop precedence within all supported traffic classes based on the DEI bit value of the 802.1ad header.

Test Objective:

- To verify that the OLT and ONU can implement drop precedence using DEI bit downstream.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to support passing a received S-tag for upstream frames. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

ONU must be set up with the standard L2 OCM (single user) with four downstream queues. ONU queues are set up with the following: drop precedence indication = DEI; yellow thresholds set to half the queue size; green thresholds set to the queue size. The intent of the test is to define eight flows, two per traffic class. For each traffic class, one of the flows is marked with drop precedence. For a user port egress rate of E, each flow rate is set to $R=0.7E$.

Table 6-56: Test 6.2.3.4 Downstream Frame Definitions

Traffic Stream	V INTERFACE											U INTERFACE												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A*	MAC1	MAC2					0x88A8	SPbits1	1	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits1	1	SVID1	0x0800
B	MAC1	MAC2					0x88A8	SPbits1	0	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits1	0	SVID1	0x0800
C*	MAC1	MAC2					0x88A8	SPbits2	1	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits2	1	SVID1	0x0800
D	MAC1	MAC2					0x88A8	SPbits2	0	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits2	0	SVID1	0x0800
E*	MAC1	MAC2					0x88A8	SPbits3	1	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits3	1	SVID1	0x0800
F	MAC1	MAC2					0x88A8	SPbits3	0	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits3	0	SVID1	0x0800
G*	MAC1	MAC2					0x88A8	SPbits4	1	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits4	1	SVID1	0x0800
H	MAC1	MAC2					0x88A8	SPbits4	0	SVID1	0x0800	1	1	MAC1	MAC2					0x88A8	SPbits4	0	SVID1	0x0800

*=Drop Precedence Flow

Note:

- Streams A&B are in Traffic Class 1.
- Streams C&D are in Traffic Class 2.
- Streams E&F are in Traffic Class 3.
- Streams G&H are in Traffic Class 4.

Test Procedure:

- Select a random value for SVID1 between 1 and 4094.
- Select distinct random values for SPbits1 through SPbits4 between 0 and 7.
- Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
- Enter the configuration commands on the OLT to cause the VBES configuration described above to be activated on the ONU.
- Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R.
- Enable any frame captured mechanisms on the Ethernet Traffic Generator.
- Verify at the U-interface that the only packets dropped are from stream marked with drop precedence.
- Stop traffic streams A & B.
- Repeat steps 5 to 8 using traffic streams C&D.
- Stop traffic streams C&D.
- Repeat steps 5 to 8 using traffic streams E&F.
- Stop traffic streams E&F.
- Repeat steps 5 to 8 using traffic streams G&H.
- Stop traffic streams G&H.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

- Verify at the-U-interface, that the only packets dropped are from streams marked with drop precedence.

Remarks:

- This test case is designed to overload the UNI in the downstream resulting in frame discard. The frame loss for the lower priority frames should be observed at the UNI. Therefore, the tester should ensure that the sum of the flow rates applied simultaneously is below the overall throughput capacity of the ONU/OLT under test.

6.3 IGMP Controlled Multicast

The following configurations shall apply to all IGMP controlled multicast test cases.

Table 6-57 defines the configuration of LAN side hosts responsible for generating upstream IGMP messages, such as membership reports or leave group requests. The destination MAC and IP addresses are set depending on the message being generated, such as an IGMP Membership Report message being sent to the MAC and IP address of the “all routers group.”

Table 6-57: LAN Host Configurations

Host	Source MAC Address	Source IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
LAN_Host_1	00:01:02:03:04:01	132.177.121.64	121	0x8100	None	None
LAN_Host_2	00:01:02:03:04:02	132.177.121.65	121	0x8100	None	None
LAN_Host_3	00:01:02:03:04:03	132.177.122.100	122	0x8100	None	None
LAN_Host_4	00:01:02:03:04:04	132.177.122.101	122	0x8100	None	None

Table 6-58 defines the configuration of hosts responsible for generating downstream IGMP messages, such as Global Query Messages. In a real-world deployment, these hosts would typically be multicast capable routers. The destination MAC and IP addresses are set depending on the message being generated.

Table 6-58: Downstream IGMP Generator Configurations

Host	Source MAC Address	Source IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
IGMP_Router_1	00:02:02:03:04:01	132.177.121.1	2121	0x88a8	None	None
IGMP_Router_2	00:02:02:03:04:02	132.177.122.1	2122	0x88a8	None	None

Table 6-59 defines the configuration of hosts responsible for generating downstream-multicast traffic, such as a downstream video stream.

Table 6-59: Multicast Source Configurations

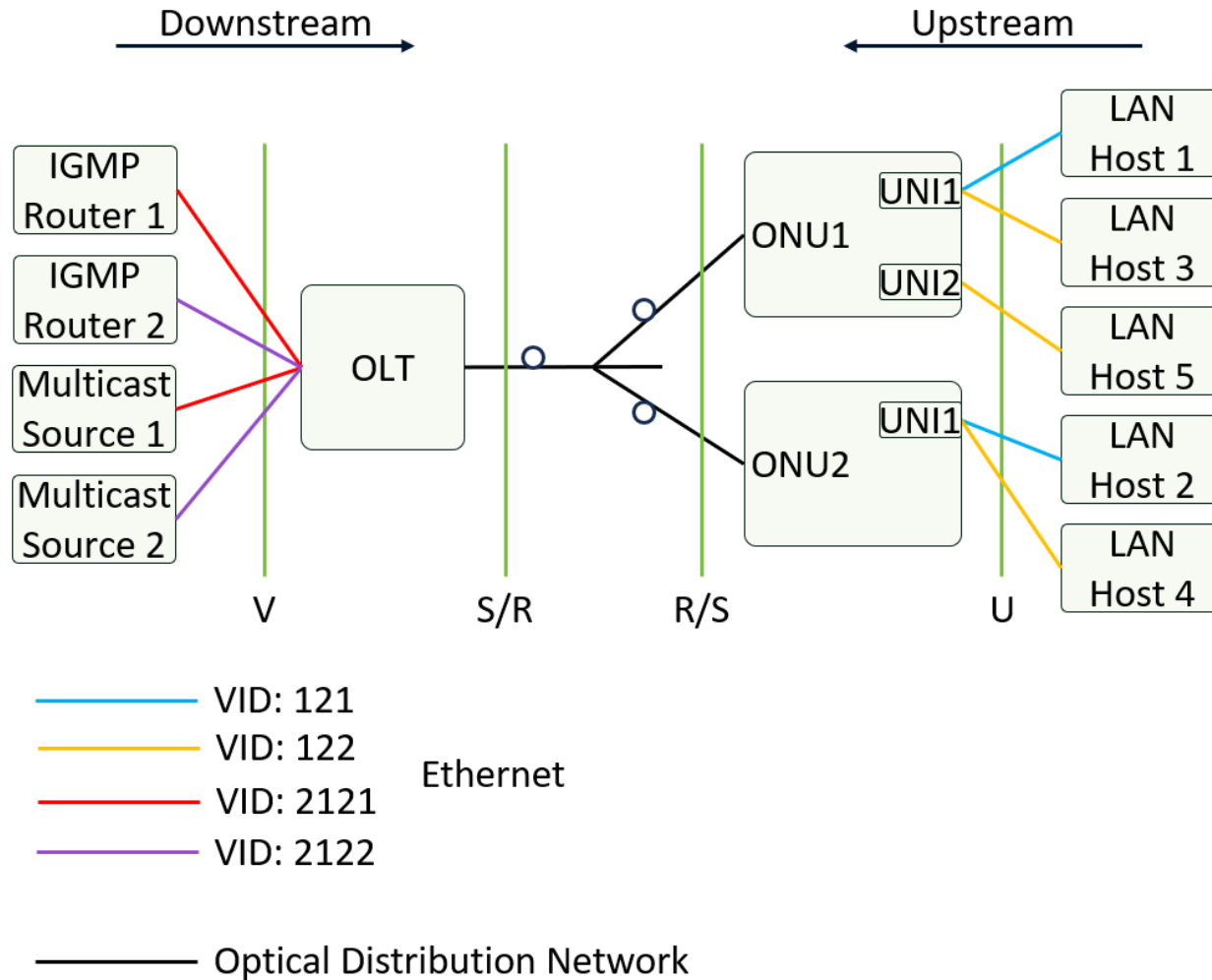
Host	Source MAC Address	Source IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
Multicast_Source_1	00:03:02:03:04:01	132.177.123.2	2121	0x88a8	None	None
Multicast_Source_2	00:03:02:03:04:02	132.177.123.3	2122	0x88a8	None	None

Table 6-60 defines the configuration for various multicast groups, including the group address, traffic bitrate. One or more of the multicast sources defined in Table 6-59 sources the multicast traffic for each of these groups. All multicast traffic streams are generated using Ethernet frames 1514 bytes in length, excluding the 4-byte FCS.

Table 6-60: Multicast Group Configurations

Group Name	Group IP Address	Group MAC Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID	Bitrate (Mbps)
A	234.0.4.1	01:00:5E:00:04:01	2121	0x88a8	None	None	12
B	234.0.4.2	01:00:5E:00:04:02	2121	0x88a8	None	None	12
C	234.0.4.3	01:00:5E:00:04:03	2121	0x88a8	None	None	12
D	234.0.4.4	01:00:5E:00:04:04	2121	0x88a8	None	None	18
E	234.0.4.5	01:00:5E:00:04:05	2122	0x88a8	None	None	12
F	234.0.4.6	01:00:5E:00:04:06	2122	0x88a8	None	None	12
G	234.0.4.7	01:00:5E:00:04:07	2122	0x88a8	None	None	12
H	234.0.4.8	01:00:5E:00:04:08	2122	0x88a8	None	None	18

Figure 6-1: Multicast Test Setup



Note: The Multicast Source, IGMP Router, and LAN Host functions are logical and may be implemented inside an Ethernet Traffic Generator, as depicted in Figure 4-2: Setup for Interoperability Tests Requiring Multiple ONUs. The VLAN tag manipulations described in the figure and table above are also described in the N:1 configuration 3 defined in Table 6-1.

6.3.1 Downstream Transport of IGMP Messages

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-80:** The OLT SHOULD send downstream multicast IGMP messages (e.g. global query messages) using the same GEM port that is used to carry the multicast content.
- **R-81:** The ONU MUST support receiving downstream multicast IGMP messages (e.g. global query messages) on a unicast GEM port and on the multicast GEM port that is used to carry the multicast content.
- **R-82:** The ONU and OLT MUST support the identification and processing of upstream IGMP messages. When this function is disabled on a UNI (on the ONU) and/or VLAN (on the ONU or OLT), these messages MUST be forwarded through.
Note: the details of the kind of processing are covered in subsequent requirements, including amongst others R-83 (IGMP discarding), R-84 (IGMP snooping) and R-87 (IGMP rate limiting).

Test Objective:

- To verify the OLT and ONT combination can deliver and receive downstream IGMP messages.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as IGMP_Router_1.
2. Ethernet Traffic Generator connected to the U-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the U-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream IGMPv2 global query message.
3. Verify the global query message was received from the U-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The downstream global query message must be received from the U-interface, tagged with VLAN VID 121 and TPID 0x8100.

Remarks:

- None

6.3.2 Upstream Transport of IGMP Messages

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-79:** The GPON network MUST use a bidirectional GEM port for upstream IGMP messages. This GEM port can be shared by other VLANs from the same U interface that share the same TC.
- **R-82:** The ONU and OLT MUST support the identification and processing of upstream IGMP messages. When this function is disabled on a UNI (on the ONU) and/or VLAN (on the ONU or OLT), all messages MUST be forwarded through.

Test Objective:

- To verify the OLT and ONT combination can deliver and receive upstream IGMP messages.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. The ONU has been provisioned to allow the UNI to join Multicast Group A.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an upstream IGMPv2 membership report message indicating membership in Multicast Group A.
3. Verify the membership report message was received from the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The upstream membership report message must be received from the V-interface, tagged with VLAN VID 2121 and TPID 0x88a8.

Remarks:

- None

6.3.3 Configurable Discard of Upstream IGMP Messages

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-83:** The OLT MUST be configurable to silently discard of all IGMP messages associated with an ONU user port and/or VLAN. This requirement takes precedence over R-82.

Test Objective:

- To verify the OLT and ONT combination can configure the silent discard of upstream IGMP messages received by the ONU.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT and ONU are configured to silently discard all upstream IGMP messages received by the ONU on VLAN VID 121.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an upstream IGMPv2 membership report message.
3. Verify the membership report message was not received from the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The upstream membership report message must not be received from the V-interface.

Remarks:

- None

6.3.4 White and Black Listing of Multicast Channels

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN. Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups 'matching' a multicast VLAN as well as on groups 'not matching' a multicast VLAN.

Test Objective:

- To verify the OLT and ONT combination can configure both allowed and not-allowed multicast groups.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT has configured the ONU to only allow the UNI port to join Multicast Channel A, no other multicast channels are allowed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.

2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an upstream IGMPv2 membership report message, joining Channel A.
3. Verify the membership report message was received from the V-interface.
4. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an upstream IGMPv2 membership report message, joining Channel B.
5. Verify the membership report message was not received from the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The upstream membership report message including Multicast Channel A must be received from the V-interface, tagged with VLAN VID 2121 and TPID 0x88a8.
2. The upstream membership report message including Multicast Channel B must not be received from the V-interface.

Remarks:

- None

6.3.5 Blocking of User Generated Multicast Traffic

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-85:** The OLT MUST support mechanisms to stop user ports injecting multicast traffic to the aggregation network. This behavior MUST be configurable per ONU user port and/or VLAN.

Test Objective:

- To verify the OLT and ONT combination can block user generated (received by the UNI port) multicast traffic.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT and ONU are configured to not allow users to generate multicast traffic on VLAN VID 121.
5. ONU2 has joined Multicast Channel A by sending an upstream IGMP membership report.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface and Ethernet Traffic Generator connected to U-interface of ONU2 to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit upstream multicast frames belonging to Multicast Channel A, with the VID replaced with 121 and the TPID replaced with 0x8100.
3. Verify the multicast frames were not received from the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The upstream multicast frames must not be received from the V-interface.
2. The upstream Multicast frames are not received from the U-interface of ONU2.

Remarks:

- None

6.3.6 Rate-limiting of User Generated IGMP Messages

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-87:** The ONU and OLT MUST be able to rate-limit IGMP messages received from user-facing ports.

Test Objective:

- To verify the OLT and ONT combination can rate-limit IGMP messages received from user-facing ports.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT has configured the ONU to allow the UNI port to join Multicast Channel A.
5. OLT has been configured to rate-limit user generated IGMP messages to 10 messages per second, or less.
6. OLT has been configured to enable IGMP Snooping, IGMP Proxy MUST NOT be enabled.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an upstream IGMPv2 membership report message, joining Channel A, at a rate of 20 messages per second.
3. Verify the upstream IGMP messages were not received from the V-interface at a rate higher than 10 messages per second.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The upstream IGMP messages must be received from the V-interface and must not be received at a rate higher than 10 messages per second.

Remarks:

- Some combinations of OLT/ONU equipment may apply rate limits based on bitrate and may require the applied transmitted message rates may need to be adjusted to exceed the configured bitrate limit.

6.3.7 IGMPv3 Transparent Snooping Functions

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-88:** The ONU and OLT MUST support an IGMPv3 transparent snooping function (i.e. the IGMP message processing would not result in the ONU or OLT discarding the IGMP message). This MUST be configurable on a per VLAN basis.
Note that in case the ONU or OLT is configured to apply the R-88 behavior, then R-84 does not apply.
Note: IGMPv3 includes support of earlier versions of IGMP. Specifically, this function is responsible for configuring multicast filters such that frame replication is restricted to those user ports that requested receipt.
- **R-90:** The ONU and OLT IGMP v3 transparent snooping function MUST be able to dynamically create and delete MAC-level group filter entries, enabling in turn, selective multicast forwarding from network-facing VLANs to user-facing ports.

Test Objective:

- To verify the OLT and ONT combination implement the IGMPv3 transparent snooping and multicast filtering functions.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the U-interface of ONU2 configured to act as LAN_Host_2 and capture Ethernet frames.
3. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1.
4. ONU1 and ONU2 are configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
5. OLT has configured the ONUs to allow the UNI ports to join Multicast Channels A, B, and C.
6. No limits on total multicast channels joined or multicast bandwidth have been provisioned.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channels A, B, and C.
2. Verify no downstream multicast frames are received from the U-interface of either ONU.

3. Cause the Ethernet Traffic Generator connected to the U-interface of ONU1 to transmit an upstream IGMPv2 membership report message, joining Channel A.
4. Verify the Ethernet Traffic Generator connected to the U-interface of ONU1 begins receiving downstream multicast frames from Multicast Channel A.
5. Verify the Ethernet Traffic Generator connected to the U-interface of ONU2 does not begin receiving downstream multicast frames from Multicast Channel A.
6. Cause the Ethernet Traffic Generator connected to the U-interface of ONU2 to transmit an upstream IGMPv2 membership report message, joining Channel B.
7. Verify the Ethernet Traffic Generator connected to the U-interface of ONU2 begins receiving downstream multicast frames from Multicast Channel B.
8. Verify the Ethernet Traffic Generator connected to the U-interface of ONU1 does not begin receiving downstream multicast frames from Multicast Channel B.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator connected to the U-interface of ONU1 must receive downstream multicast frames from Multicast Channel A.
2. At step 5, the Ethernet Traffic Generator connected to the U-interface of ONU2 must not receive downstream multicast frames from Multicast Channel A.
3. At step 7, the Ethernet Traffic Generator connected to the U-interface of ONU2 must receive downstream multicast frames from Multicast Channel B.
4. At step 8, the Ethernet Traffic Generator connected to the U-interface of ONU1 must not receive downstream multicast frames from Multicast Channel B.
5. Downstream multicast frames from Multicast Channel C must not be received from the U-interface of either ONU.

Remarks:

- None

6.3.8 IGMP Immediate Leave

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-91:** The ONU MUST support IGMP immediate leave as part of the IGMP transparent snooping function.

Test Objective:

- To verify the OLT and ONT combination implement the IGMP immediate leave functionality.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1.
3. ONU1 is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT has configured the ONUs to allow the UNI ports to join Multicast Channel A.
5. The ONU is configured with IGMP Immediate Leave enabled.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A.
2. Verify no downstream multicast frames are received from the U-interface of the ONU.
3. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Channel A.
4. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel A.
5. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Channel A.
6. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU immediately stops receiving downstream multicast frames from Multicast Channel A.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator connected to the U-interface of the ONU must receive downstream multicast frames from Multicast Channel A.
2. At step 6, the Ethernet Traffic Generator connected to the U-interface of the ONU stops receiving downstream multicast frames from Multicast Channel A within 5 seconds of sending the IGMP leave message.

Remarks:

- None

6.3.9 Discard of User Generated Proxy Query Solicitations

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-93:** For security purposes, the ONU SHOULD and OLT MUST silently discard any user-initiated IGMP Leave messages for group '0.0.0.0'.

Test Objective:

- To verify the OLT and ONT combination silently discard user generated IGMPv2 proxy query solicitations.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU1 is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Verify no downstream multicast frames are received from the U-interface of the ONU.
3. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 proxy query solicitation message (IGMPv2 Group Leave with group address '0.0.0.0').
4. Verify the Ethernet Traffic Generator connected to the V-interface of OLT does not receive the IGMPv2 proxy query solicitation message.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the V-interface of the OLT must not receive the IGMPv2 proxy query solicitation message.

Remarks:

- None

6.3.10 Marking of Upstream IGMP Messages with Ethernet P-bits

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-94:** The ONU MUST support marking, in the upstream direction, user-initiated IGMP messages with Ethernet P-bits.

Test Objective:

- To verify the OLT and ONT combination can mark upstream IGMP messages with specific P-bit values.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. ONU is configured to set the P-bit value for all upstream IGMP messages to 0x5.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP membership report message, joining Multicast Channel A.
3. Verify the Ethernet Traffic Generator connected to the V-interface of OLT receives the IGMP membership report, and the Ethernet frame contains an outer VLAN P-bit value of 0x5.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the V-interface of the OLT must receive the IGMP membership report and the Ethernet frame must contain an outer VLAN P-bit value of 0x5.

Remarks:

- None

6.3.11 Configurable Maximum Number of Simultaneous Multicast Groups

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-97:** The ONU and OLT MUST be able to configure per U interface the maximum number of simultaneous multicast groups allowed.

Test Objective:

- To verify the OLT and ONT combination can limit the maximum number of multicast groups a U-interface may join at one time.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. OLT has configured the ONUs to allow the UNI ports to join Multicast Channels A, B, and C.
5. ONU is configured to only allow the U-interface to join 2 multicast groups at a time.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channels A, B, and C.
2. Verify no downstream multicast frames are received from the U-interface of the ONU.
3. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP membership report message, joining Multicast Channel A.
4. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel A.
5. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP membership report message, joining Multicast Channel B.
6. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel B.

7. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP membership report message, joining Multicast Channel C.
8. Verify the Ethernet Traffic Generator connected to the U-interface of ONU does not begin receiving downstream multicast frames from Multicast Channel C.
9. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP leave group message for Multicast Channel A.
10. Verify the Ethernet Traffic Generator connected to the U-interface of ONU stops receiving downstream multicast frames from Multicast Channel A.
11. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP membership report message, joining Multicast Channel C.
12. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel C.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator connected to the U-interface begins receiving downstream multicast frames belonging to Multicast Channel A.
2. At step 6, the Ethernet Traffic Generator connected to the U-interface begins receiving downstream multicast frames belonging to Multicast Channel B.
3. At step 8, the Ethernet Traffic Generator connected to the U-interface does not begin receiving downstream multicast frames belonging to Multicast Channel C.
4. At step 10, the Ethernet Traffic Generator connected to the U-interface stops receiving downstream multicast frames belonging to Multicast Channel A.
5. At step 12, the Ethernet Traffic Generator connected to the U-interface begins receiving downstream multicast frames belonging to Multicast Channel C.

Remarks:

- None

6.3.12 Silent Discard of Upstream IGMPv1 Messages

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-98:** The ONU MUST silently discard IGMP v1 messages.

Test Objective:

- To verify the OLT and ONT combination silently discard upstream IGMPv1 messages.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv1 message.
3. Verify the Ethernet Traffic Generator connected to the V-interface of OLT does not receive the IGMPv1 message.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the V-interface of the OLT must not receive the IGMPv1 message.

Remarks:

- None

6.3.13 Maximum Multicast Bandwidth

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups 'matching' a multicast VLAN as well as on groups 'not matching' a multicast VLAN.

BBF TR-280 [10]

- **R-19:** The OLT and the ONU MUST be capable of supporting a maximum multicast bandwidth per U interface
- **R-20:** The ONU MUST support the configuration of the maximum multicast bandwidth as defined in clause 9.3.28/ITU-T G.988.
- **R-55:** ONU MUST support the following attributes of the Multicast subscriber monitor ME defined in clause 9.3.29/ITU-T G.988:
 - Current multicast bandwidth
 - Join messages counter
 - Bandwidth exceeded counter

Test Objective:

- Verify that the OLT/ONU can configure per U-interface the maximum Multicast bandwidth.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A, B and C
2. Enter the configuration commands at the OLT to configure the ONU to only allow the UNI port to join Multicast Channel A, B, and C, with an imputed Group bandwidth of respectively 512 000, 512 000 and 768 000 bytes/s.
3. Enter the configuration commands at the OLT to configure the enforcement of a maximum multicast bandwidth of 1 024 000 bytes/s for the ONU U-interface.
4. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel A.
5. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel B.
6. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel C.
7. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel B.
8. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel C.
9. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel A
10. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel C.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator receives the Multicast Channel A Join message from the V-interface.
2. At step 4, the Ethernet Traffic Generator receives only the Multicast Channel A flow from the U-interface.
3. At step 5, the Ethernet Traffic Generator receives the Multicast Channel B Join message from the V-interface.
4. At step 5, the Ethernet Traffic Generator receives only the Multicast Channel A and B flows from the U-interface.
5. At step 7, the Ethernet Traffic Generator receives the Multicast Channel B Leave message from the V-interface.
6. At step 7, the Ethernet Traffic Generator receives only the Multicast Channel A flow from the U-interface.
7. At step 8, the Ethernet Traffic Generator receives only the Multicast Channel A flow from the U-interface.

8. At step 9, the Ethernet Traffic Generator receives the Multicast Channel A Leave message from the V-interface.
9. At step 10, the Ethernet Traffic Generator receives the Multicast Channel C Join message from the V-interface.
10. At step 10, the Ethernet Traffic Generator receives only the Multicast Channel C flow from the U-interface.

Remarks:

- None

6.3.14 VID and P-bit Translation in Upstream and Downstream for IGMP/MLD and Multicast Packets

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups ‘matching’ a multicast VLAN as well as on groups ‘not matching’ a multicast VLAN.

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- **R-16:** The ONU MUST support all combinations of VID and P-bit translation in the upstream direction for IGMP/MLD packets, and IGMP/MLD and multicast frames in the downstream direction.
- **R-17:** The ONU MUST support the following attributes of the Multicast Operations Profile ME:
 - Upstream IGMP TCI
 - Upstream IGMP tag control
 - All code points defined in this attribute
 - Downstream IGMP and multicast TCI
 - All code points defined in this attribute
- **R-18:** The OLT MUST support and send configuration to the ONU of the following attributes of the Multicast Operations Profile ME:
 - Upstream IGMP TCI
 - Upstream IGMP tag control
 - All code points defined in this attribute
 - Downstream IGMP and multicast TCI
 - All code points defined in this attribute

- **R-21:** The ONU MUST support to forward or discard IGMP/MLD packets based on the permissions of multicast group in the upstream.
- **R-22:** The OLT MUST support to send permissions of a multicast group to the ONU.

Test Objective:

- Verify that the OLT/ONU can configure and perform VID and P-bit translation in the upstream and downstream for IGMP/MLD and Multicast packets.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-4.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and LAN_Host_2 and capture Ethernet frames.
3. The Ethernet Traffic Generator is configured to transmit 1 flow of single-tagged unicast Ethernet frames in both directions with the parameters defined in 255i2 Table 6.3.14-1 and 255i2 Table 6.3.14-2.
4. The Traffic Generator connected to the U-interface configured to transmit the upstream IGMPv2 messages defined in 255i2 Table 6.3.14-3.
5. The Traffic generator connected to the U-interface configured to transmit the upstream IGMPv3 messages defined in 255i2 Table 6.3.14-4.
6. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the OLT/ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.3.14-1: Test 6.3.14 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	N/A	121	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	2121	Any	

255i2 Table 6.3.14-2: Test 6.3.14 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	2121	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	N/A	121	Any

255i2 Table 6.3.14-3: Test 6.3.14 Upstream IGMPv2 Message Definitions

Host	Source IP Address	Group IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
LAN_Host_1	0.0.0.0	A	CVID1	0x8100	None	None

255i2 Table 6.3.14-4: Test 6.3.14 Upstream IGMPv3 Message Definitions

Host	Source IP Address	Group IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
LAN_Host_2	0.0.0.0	B	CVID1	0x8100	None	None

Test Procedure:

1. Select a random value for CVID1, different from 121 and 2121, between 0 and 4094.
2. Enter the configuration commands at the OLT to configure the ONU to replace the tag in the upstream direction for IGMP/MLD flows with a VID of 2121
3. Enter the configuration commands at the OLT to configure the ONU to replace the tag in the downstream direction for IGMP/MLD flows with a VID of CVID1.
4. Enter the configuration commands at the OLT to configure the ONU to allow the UNI port to join Multicast Channels A and B.
5. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A and B
6. Enable the Ethernet Traffic Generator to start injecting upstream and downstream unicast traffic as defined in the configuration traffic tables.
7. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP message to join Multicast Channel A as defined in test configuration step 4.
8. Cause the Ethernet Traffic Generator connected to the V-interface of OLT to send one IGMP global/general query message as Multicast_Source_1.
9. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP message to leave Multicast Channel A as defined in test configuration step 4.
10. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP message to join Multicast Channel B as defined in test configuration step 5.
11. Cause the Ethernet Traffic Generator connected to the V-interface of OLT to send one IGMP global/general query message as Multicast_Source_1.
12. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMP message to leave Multicast Channel B as defined in test configuration step 4.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, no multicast flow is received from the Ethernet Traffic Generator from the U-interfaces.
2. At step 6, unicast flows are received from the Ethernet Traffic Generator as defined in the Traffic Table.
3. At step 7, the Ethernet Traffic Generator receives the Multicast Channel A Join message with a VID of 2121 from the V-interface.
4. At step 7, the Ethernet Traffic Generator receives the Multicast Channel A flow with a VID of CVID1 from the U-interface.
5. At step 8, the Ethernet Traffic Generator receives the IGMP (General Query) message with a VID of CVID1 from the U-interface.

6. At step 9, the Ethernet Traffic Generator receives the Multicast Channel A Leave message with a VID of 2121 from the V-interface.
7. At step 9, the Ethernet Traffic Generator stops receiving the Multicast Channel A flow from the U-interface.
8. At step 10, the Ethernet Traffic Generator receives the Multicast Channel B Join message with a VID of 2121 from the V-interface.
9. At step 10, the Ethernet Traffic Generator receives the Multicast Channel B flow with a VID of CVID1 from the U-interface.
10. At step 11, the Ethernet Traffic Generator receives the IGMP (General Query) message with a VID of CVID1 from the U-interface.
11. At step 12, the Ethernet Traffic Generator receives the Multicast Channel B Leave message with a VID of 2121 from the V-interface.
12. At step 12, the Ethernet Traffic Generator stops receiving the Multicast Channel B flow from the U-interface.

Remarks:

- None

6.3.15 Create and Remove Multicast Groups in the Dynamic Access Control List Table

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups ‘matching’ a multicast VLAN as well as on groups ‘not matching’ a multicast VLAN.

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- **R-21:** The ONU MUST support to forward or discard IGMP/MLD packets based on the permissions of multicast group in the upstream.
- **R-22:** The OLT MUST support to send permissions of a multicast group to the ONU.
- **R-23:** The ONU MUST support the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table
- **R-24:** The OLT MUST support and send configuration to the ONU of the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table
- **R-75:** The ONU MUST support the deletion of an entry into the Dynamic Access Control List table in the Multicast Operation Profile ME without causing any reboot, or MIB reset.
- **R-76:** The ONU MUST support the deletion of entries into the Dynamic Access Control List table in the Multicast Operation Profile ME without causing any packet loss on existing traffic flows from all the traffic classes and existing active Multicast Groups (as defined in TR-156, R-76).
- **R-77:** The ONU MUST support the addition of an entry into the Dynamic Access Control List table in the Multicast Operation Profile ME without causing any reboot, or MIB reset.

- **R-78:** The ONU MUST support the addition of entries into the Dynamic Access Control list table in the Multicast Operation Profile ME without causing any packet loss on existing traffic flows from all the traffic classes and existing active Multicast Groups (as defined in TR-156, R-76).

Test Objective:

- Verify that the OLT/ONU can create and remove a multicast group.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A and B.
2. Enter the configuration commands at the OLT to configure the ONU to only allow the UNI port to join Multicast Channel A, no other multicast channels being allowed.
3. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel A.
4. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel A only.
5. Enter the configuration commands at the OLT to configure the ONU to allow the UNI port to join Multicast Channel B, in addition to Multicast Channel A, no other multicast channels being allowed.
6. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel B.
7. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel A and B.
8. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group messages, leaving Multicast Channel A and Multicast Channel B.
9. Verify the Ethernet Traffic Generator connected to the U-interface of ONU has stopped receiving downstream multicast frames from either Multicast Channel A or Multicast Channel B.
10. Enter the configuration commands at the OLT to configure the ONU to disallow the UNI port to join Multicast Channel A.

11. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report messages, joining Multicast Channel A and Multicast Channel B.
12. Verify the Ethernet Traffic Generator connected to the U-interface of ONU begins receiving downstream multicast frames from Multicast Channel B only.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator receives the Multicast Channel A Join message from the V-interface.
2. At step 5, the Ethernet Traffic Generator receives only the Multicast Channel A flow from the U-interface.
3. At step 6, the Ethernet Traffic Generator receives the Multicast Channel B Join message from the V-interface.
4. At step 7, the Ethernet Traffic Generator receives flows from Multicast Channel A and Multicast Channel B from the U-interface.
5. At step 9, the Ethernet Traffic Generator stops receiving multicast flows from the U-interface.
6. At step 11, the Ethernet Traffic Generator receives the Multicast Channel B Join message from the V-interface.
7. At step 11, the Ethernet Traffic Generator does not receive the Multicast Channel A Join message from the V-interface.
8. At step 12, the Ethernet Traffic Generator receives only the flow from Multicast Channel B from the U-interface.

Remarks:

- None

6.3.16 Maximum Multicast Bandwidth Modification

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups ‘matching’ a multicast VLAN as well as on groups ‘not matching’ a multicast VLAN.

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- **R-19:** The OLT and the ONU MUST be capable of supporting a maximum multicast bandwidth per U interface.
- **R-20:** The ONU MUST support the configuration of the maximum multicast bandwidth as defined in clause 9.3.28/ITU-T G.988.
- **R-55:** ONU MUST support the following attributes of the Multicast subscriber monitor ME defined in clause 9.3.29/ITU-T G.988:
 - Current multicast bandwidth
 - Join messages counter
 - Bandwidth exceeded counter
- **R-81:** The ONU MUST support the modification of the Maximum Multicast Bandwidth in the Multicast Subscriber Config Info ME without causing any reboot, or MIB reset.
- **R-82:** The ONU MUST support the modification of the Maximum Multicast Bandwidth in the Multicast Subscriber Config Info ME without causing any packet loss on existing traffic flows from all the traffic classes and existing active Multicast Groups (as defined in TR-156, R-76).
Note: If the Maximum Multicast Bandwidth value is decreased, no packet loss is expected on the existing active Multicast Groups until the Multicast Channel Subscriber leaves the channel. For example at the beginning 50Mbit/s for multicast traffic is allowed and the Multicast Channel Subscriber reaches the 50Mbit/s, then the Maximum Multicast Bandwidth is set to 45Mbit/s. If the

Multicast Channel Subscriber leaves a channel of 5Mbit/s then the associated Multicast Channel is stopped. If the Multicast Channel Subscriber wants to join another channel, the ONU MUST deny the joining as the Maximum Multicast Bandwidth is already reached.

Test Objective:

- Verify that the OLT/ONU can configure per U-interface the maximum Multicast bandwidth.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-4.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A, B, both with a bandwidth of 256 000 bytes/s.
2. Enter the configuration commands at the OLT to configure the ONU to only allow the UNI port to join Multicast Channel A and B, both with an imputed Group bandwidth of respectively 512 000 bytes/s.
3. Enter the configuration commands at the OLT to configure the enforcement of a maximum multicast bandwidth of 1 024 000 bytes/s for the ONU U-interface.
4. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv2 membership report messages, joining Multicast Channel A and B.
5. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel A and B.
6. Enter the configuration commands at the OLT to configure the enforcement of a maximum multicast bandwidth of 512 000 bytes/s for the ONU U-interface.
7. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel A.
8. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel B.
9. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel A and B.

10. Enter the configuration commands at the OLT to configure the enforcement of a maximum multicast bandwidth of 1 024 000 bytes/s for the ONU U-interface.
11. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv2 membership report messages, joining Multicast Channel A and B.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.
2. At step 4, the Ethernet Traffic Generator receives both Multicast Channel A and B Join messages from the V-interface.
3. At step 4, the Ethernet Traffic Generator receives only the Multicast Channel A and B flows from the U-interface.
4. At step 5, the Ethernet Traffic Generator receives both Multicast Channel A and B Leave messages from the V-interface.
5. At step 5, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.
6. At step 7, the Ethernet Traffic Generator receives Multicast Channel A Join message from the V-interface.
7. At step 7 and 8, the Ethernet Traffic Generator receives only the Multicast Channel flow A from the U-interface.
8. At step 9, the Ethernet Traffic Generator receives Multicast Channel A Leave message from the V-interface.
9. At step 9, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.
10. At step 11, the Ethernet Traffic Generator receives both Multicast Channel A and B Join messages from the V-interface.
11. At step 11, the Ethernet Traffic Generator receives only the Multicast Channel A and B flows from the U-interface.

Remarks:

- None

6.3.17 Individual Multicast Groups in Dynamic Access Control List Table

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups 'matching' a multicast VLAN as well as on groups 'not matching' a multicast VLAN.

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- **R-21:** The ONU MUST support to forward or discard IGMP/MLD packets based on the permissions of multicast group in the upstream.
- **R-22:** The OLT MUST support to send permissions of a multicast group to the ONU.
- **R-23:** The ONU MUST support the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table
- **R-24:** The OLT MUST support and send configuration to the ONU of the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table
- **R-83:** The ONU MUST support 1024 entries in the Dynamic Access Control list table in the Multicast Operation Profile ME when the Multicast Access Control table is used for admission control.

Test Objective:

- Verify that the OLT/ONU support individual multicast groups in Dynamic Access Control List table.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-4.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. The Ethernet Traffic Generator must be configured to transmit the downstream multicast Ethernet frames as defined in 255i2 Table 6.3.17-1.
4. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

255i2 Table 6.3.17-1: Test 6.3.17 Downstream Multicast Ethernet Frame Definitions

Group Name	Group IP Address	Group MAC Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
Ch1	IP-G1	<u>MAC-G1</u>	2121	0x88a8	None	None
Ch2	IP-G2	<u>MAC-G2</u>	2121	0x88a8	None	None
Ch3	IP-G3	<u>MAC-G3</u>	2121	0x88a8	None	None
Ch4	IP-G4	<u>MAC-G4</u>	2121	0x88a8	None	None
Ch5	IP-G5	<u>MAC-G5</u>	2121	0x88a8	None	None

Test Procedure:

1. Select value for multicast IP group address IP-G1: first multicast group of a multicast range containing at least 1000 channels.
2. Select value for multicast IP group address IP-G5: last multicast group of a multicast range starting at IP-G1 and containing at least 1000 channels.
3. Select distinct random values for multicast IP group addresses IP-G2, IP-G3 and IP-G4 within the multicast range bounded by IP-G1 and IP-G5.
4. Use associated random multicast MAC addresses: MAC-G1, MAC-G2, MAC-G3, MAC-G4 and MAC-G5.
5. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
6. Enter the configuration commands on the OLT to configure OLT & ONU Multicast Operation Profile Dynamic access control list table range defined in 255i2 Table 6.3.17-2.

7. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channels 1 to 5.
8. At the U-interface send IGMP message to join channel Ch1.
9. At the U-interface send IGMP message to leave channel Ch1.
10. At the U-interface send IGMP message to join channel Ch2.
11. At the U-interface send IGMP message to leave channel Ch2.
12. At the U-interface send IGMP message to join channel Ch3.
13. At the U-interface send IGMP message to leave channel Ch3.
14. At the U-interface send IGMP message to join channel Ch4.
15. At the U-interface send IGMP message to leave channel Ch4.
16. At the U-interface send IGMP message to join channel Ch5.
17. At the U-interface send IGMP message to leave channel Ch5.

255i2 Table 6.3.17-2: Test 6.3.17 Multicast Operation Profile Dynamic Access Control List Table Range Definition

VLAN ID	Multicast source IP address	Multicast IP group addresses
2121	0.0.0.0	1000 channel entries included in the range defined by IP-G1 – IP-G5 and including channels IP-G1 to IP-G5.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 7, the Ethernet Traffic Generator connected to the U-interface does not receive the multicast flows Ch1, Ch2, Ch3, Ch4 and Ch5.
2. At step 8, the Ethernet Traffic Generator receives the Ch1 Join message from the V-interface.
3. At step 8, the Ethernet Traffic Generator receives only the multicast flow Ch1 from the U-interface.
4. At step 9, the Ethernet Traffic Generator receives the Ch1 Leave message from the V-interface.
5. At step 10, the Ethernet Traffic Generator receives the Ch2 Join message from the V-interface.
6. At step 10, the Ethernet Traffic Generator receives only the multicast flow Ch2 from the U-interface.
7. At step 11, the Ethernet Traffic Generator receives the Ch2 Leave message from the V-interface.
8. At step 12, the Ethernet Traffic Generator receives the Ch3 Join message from the V-interface.
9. At step 12, the Ethernet Traffic Generator receives only the multicast flow Ch3 from the U-interface.
10. At step 13, the Ethernet Traffic Generator receives the Ch3 Leave message from the V-interface.
11. At step 14, the Ethernet Traffic Generator receives the Ch4 Join message from the V-interface.
12. At step 14, the Ethernet Traffic Generator receives only the multicast flow Ch4 from the U-interface.
13. At step 15, the Ethernet Traffic Generator receives the Ch4 Leave message from the V-interface.
14. At step 16, the Ethernet Traffic Generator receives the Ch5 Join message from the V-interface.
15. At step 16, the Ethernet Traffic Generator receives only the multicast flow Ch5 from the U-interface.
16. At step 17, the Ethernet Traffic Generator receives the Ch5 Leave message from the V-interface.

Remarks:

- None

6.3.18 Whole Multicast Range in Dynamic Access Control List Table

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST allow the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups ‘matching’ a multicast VLAN as well as on groups ‘not matching’ a multicast VLAN.

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- **R-21:** The ONU MUST support to forward or discard IGMP/MLD packets based on the permissions of multicast group in the upstream.
- **R-22:** The OLT MUST support to send permissions of a multicast group to the ONU.
- **R-23:** The ONU MUST support the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table
- **R-24:** The OLT MUST support and send configuration to the ONU of the following attributes of the Multicast Operations Profile ME:
 - Dynamic access control list table

Test Objective:

- Verify that the OLT/ONU support the whole multicast range in Dynamic Access Control List table as defined per ITU-T G988 [7] standard (224.0.0.0 to 239.255.255.255)
 - The following two addresses cannot be used in the whole multicast range:
 - 224.0.0.2 is reserved for leaves.
 - 224.0.0.1 is reserved for General Query.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

- The ONU is powered and connected to the ODN as shown in Figure 6-4.
- The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

- Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
- Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
- The Ethernet Traffic Generator must be configured to transmit the downstream multicast Ethernet frames as defined in 255i2 Table 6.3.18-1.
- ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

255i2 Table 6.3.18-1: Test 6.3.18 Downstream Multicast Frame Definitions

Group Name	Group IP Address	Group MAC Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
Ch1	IP-G1	<u>MAC-G1</u>	2121	0x88a8	None	None
Ch2	IP-G2	<u>MAC-G2</u>	2121	0x88a8	None	None
Ch3	IP-G3	<u>MAC-G3</u>	2121	0x88a8	None	None
Ch4	IP-G4	<u>MAC-G4</u>	2121	0x88a8	None	None
Ch5	IP-G5	<u>MAC-G5</u>	2121	0x88a8	None	None

Test Procedure:

- Set value for multicast IP group address IP-G1 to 224.0.1.0.
- Set value for multicast IP group address IP-G5 to 239.255.255.255.
- Select distinct random values for multicast IP group addresses: IP-G2, IP-G3 and IP-G4 from the whole multicast range as defined per ITU-T G988 [7] standard (224.0.0.0 to 239.255.255.255), excluding any reserved multicast addresses.
- Use associated random multicast MAC addresses: MAC-G1, MAC-G2, MAC-G3, MAC-G4 and MAC-G5
- Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
- Enter the configuration commands on the OLT to configure OLT & ONU Multicast Operation Profile Dynamic access control list table range to the whole multicast range as defined per ITU-T G988 [7] standard (224.0.0.0 to 239.255.255.255), for any source IP address (Multicast source IP address set to 0.0.0.0), on VLAN 2121.
- Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channels 1 to 5.
- At the U-interface send IGMP message to join channel Ch1.
- At the U-interface send IGMP message to leave channel Ch1.

10. At the U-interface send IGMP message to join channel Ch2.
11. At the U-interface send IGMP message to leave channel Ch2.
12. At the U-interface send IGMP message to join channel Ch3.
13. At the U-interface send IGMP message to leave channel Ch3.
14. At the U-interface send IGMP message to join channel Ch4.
15. At the U-interface send IGMP message to leave channel Ch4.
16. At the U-interface send IGMP message to join channel Ch5.
17. At the U-interface send IGMP message to leave channel Ch5.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 7, the Ethernet Traffic Generator connected to the U-interface does not receive the multicast flows Ch1, Ch2, Ch3, Ch4 and Ch5.
2. At step 8, the Ethernet Traffic Generator receives the Ch1 Join message from the V-interface.
3. At step 8, the Ethernet Traffic Generator receives only the multicast flow Ch1 from the U-interface.
4. At step 9, the Ethernet Traffic Generator receives the Ch1 Leave message from the V-interface.
5. At step 10, the Ethernet Traffic Generator receives the Ch2 Join message from the V-interface.
6. At step 10, the Ethernet Traffic Generator receives only the multicast flow Ch2 from the U-interface.
7. At step 11, the Ethernet Traffic Generator receives the Ch2 Leave message from the V-interface.
8. At step 12, the Ethernet Traffic Generator receives the Ch3 Join message from the V-interface.
9. At step 12, the Ethernet Traffic Generator receives only the multicast flow Ch3 from the U-interface.
10. At step 13, the Ethernet Traffic Generator receives the Ch3 Leave message from the V-interface.
11. At step 14, the Ethernet Traffic Generator receives the Ch4 Join message from the V-interface.
12. At step 14, the Ethernet Traffic Generator receives only the multicast flow Ch4 from the U-interface.
13. At step 15, the Ethernet Traffic Generator receives the Ch4 Leave message from the V-interface.
14. At step 16, the Ethernet Traffic Generator receives the Ch5 Join message from the V-interface.
15. At step 16, the Ethernet Traffic Generator receives only the multicast flow Ch5 from the U-interface.
16. At step 17, the Ethernet Traffic Generator receives the Ch5 Leave message from the V-interface.

Remarks:

- None

6.3.19 Maximum Number of Dynamic Multicast Groups Modification

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-76:** The ONU MUST support the configuration of the IPv4 multicast groups that are acceptable per user port based on:
 - Source address matching
 - Group address matching
 - VLAN membership
- **R-84:** The OLT and ONU MUST support matching groups conveyed by IGMP messages on a user port to the list of groups (R-76) associated with this port. When there is no match, the copy of the IGMP message directed toward the multicast-VLAN MUST be silently discarded. When there is a match, the upstream IGMP message SHOULD be forwarded by the OLT within a multicast-VLAN.
Note that in case R-84 is applied, then the behavior specified in R-88 does not apply.
Note: IGMP v3 report messages may carry membership information for multiple multicast groups. Therefore, a single IGMP report message may carry membership information on groups ‘matching’ a multicast VLAN as well as on groups ‘not matching’ a multicast VLAN.

BBF TR-280 [10]

- **R-79:** The ONU MUST support the modification of the Maximum Simultaneous Groups in the Multicast Subscriber Config Info ME without causing any reboot, or MIB reset.
- **R-80:** The ONU MUST support the modification of the Maximum Simultaneous Groups in the Multicast Subscriber Config Info ME without causing any packet loss on existing traffic flows from all the traffic classes and existing active Multicast Groups (as defined in TR-156, R-76).
Note: If the Maximum Simultaneous Groups value is decreased, no packet loss is expected on the existing active Multicast Groups until the Multicast Channel Subscriber leaves the channel. For example, at the beginning 4 channels are allowed and the Multicast Channel Subscriber receives 4 channels, then the Maximum Simultaneous Groups is reconfigured to 3. If the Multicast Channel Subscriber leaves a channel, then the associated Multicast Channel is stopped. If the Multicast Channel Subscriber wants to subsequently join a 4th channel, the ONU MUST deny joining the 4th channel because the Maximum Simultaneous Groups is already reached.

Test Objective:

- Verify that the OLT/ONU can configure the maximum number of dynamic multicast groups.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-4.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet frames belonging to Multicast Channel A, and B.
2. Enter the configuration commands at the OLT to configure the ONU to only allow the UNI port to join Multicast Channel A and B.
3. Enter the configuration commands at the OLT to configure the enforcement of a maximum of 2 dynamic multicast groups that may be joined at the ONU.
4. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv2 membership report messages, joining Multicast Channel A and B.
5. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel A and B.
6. Enter the configuration commands at the OLT to configure the enforcement of a maximum of 1 dynamic multicast group that may be joined at the ONU.
7. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel A.
8. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit an upstream IGMPv2 membership report message, joining Multicast Channel B.
9. Cause the Ethernet Traffic Generator connected to the U-interface of the ONU to transmit an upstream IGMPv2 leave group message, leaving Multicast Channel A and B.
10. Enter the configuration commands at the OLT to configure the enforcement of a maximum of 2 dynamic multicast groups that may be joined at the ONU.
11. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv2 membership report messages, joining Multicast Channel A and B.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.

2. At step 4, the Ethernet Traffic Generator receives both Multicast Channel A and B Join messages from the V-interface.
3. At step 4, the Ethernet Traffic Generator receives only the Multicast Channel A and B flows from the U-interface.
4. At step 5, the Ethernet Traffic Generator receives both Multicast Channel A and B Leave messages from the V-interface.
5. At step 5, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.
6. At step 7, the Ethernet Traffic Generator receives Multicast Channel A Join message from the V-interface.
7. At step 7 and 8, the Ethernet Traffic Generator receives only the Multicast Channel flow A from the U-interface.
8. At step 9, the Ethernet Traffic Generator receives Multicast Channel A Leave message from the V-interface.
9. At step 9, the Ethernet Traffic Generator does not receive any Multicast flow from the U-interface.
10. At step 11, the Ethernet Traffic Generator receives both Multicast Channel A and B Join messages from the V-interface.
11. At step 11, the Ethernet Traffic Generator receives only the Multicast Channel A and B flows from the U-interface.

Remarks:

- None

6.3.20 IGMP Transparent Forwarding

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-82:** The ONU and OLT MUST support the identification and processing of upstream IGMP messages. When this function is disabled on a UNI (on the ONU) and/or VLAN (on the ONU or OLT), all messages MUST be forwarded through.

Note: Only the second sentence in R-82 is verified by this test.

Test Objective:

- Verify that the OLT/ONU can support IGMP transparent forwarding function.

Test Setup:

- Figure 6-4: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-4.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the V-interface configured to act as Multicast_Source_1 and capture Ethernet Frames.
2. Ethernet Traffic Generator connected to the U-interface configured to act as LAN_Host_1 and capture Ethernet frames.
3. Ethernet Traffic Generator connected to the U-interface is configured to send a single flow of unicast Ethernet frames as defined in 255i2 Table 6.3.20-1.
4. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.

255i2 Table 6.3.20-1: Test 6.3.20 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)										
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	0	N/A	121	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	0	Any	2121	Any

Test Procedure:

1. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
2. Enter the configuration at the OLT to enable IGMP transparent forwarding on both OLT and ONU.
3. Cause the Ethernet Traffic Generator connected to the U-interface to start transmitting flow Aus.
4. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv2 membership report messages, joining Multicast Channel A.
5. Cause the Ethernet Traffic Generator connected to the U-interface of ONU to transmit upstream IGMPv3 membership report messages, joining Multicast Channel B.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, the Ethernet Traffic Generator receives all unicast flow Aus frames from the V-interface with a TPID of 0x88a8 and a S-VID of 2121.
2. At step 4, the Ethernet Traffic Generator receives all Multicast Channel A Join messages from the V-interface with a TPID of 0x88a8 and an S-VID of 2121.
3. At step 5, the Ethernet Traffic Generator receives all Multicast Channel B Join messages from the V-interface with a TPID of 0x88a8 and a S-VID of 2121.

Remarks:

- None

6.3.21 Multicast VLAN Membership Based on User Ports (Multiple User Ports)

Test Status: Conditionally Mandatory (if ONT has multiple user ports)

Reference Documents:

- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-96:** The ONU MUST support configuring which user ports are members of a given multicast VLAN.

Test Objective:

- Verify that the ONU/OLT can configure which user ports are members of a given multicast VLAN.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. The Ethernet Traffic Generator connected to the V-interface is configured to act as Multicast_Source_1 and Multicast_Source_2 and to capture Ethernet Frames.
2. The Ethernet Traffic Generator connected to ONU UNI port 1 is configured to act as LAN_Host_1 and to capture Ethernet Frames.
3. The Ethernet Traffic Generator connected to ONU UNI port 2 is configured to act as LAN_Host_5 and to capture Ethernet Frames.

Test Procedure:

1. Cause the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet Frames belonging to Multicast Group A and E.
2. Enter the configuration commands at the OLT to configure ONU to allow UNI port 1 to join Multicast Group A.
3. Enter the configuration commands at the OLT to configure ONU to allow UNI port 2 to join Multicast Group E.
4. Cause the Ethernet Traffic Generator connected to ONU UNI port 1 to transmit an upstream IGMPv2 membership report message, joining Multicast Group A.
5. Verify that the Ethernet Traffic Generator connected to ONU UNI port 1 begins receiving downstream multicast frames from Multicast Group A.
6. Cause the Ethernet Traffic Generator connected to ONU UNI port 1 to transmit an upstream IGMPv2 membership report message, joining Multicast Group E.
7. Verify that the Ethernet Traffic Generator connected to ONU UNI port 1 does not begin receiving downstream multicast frames from Multicast Group E.

8. Cause the Ethernet Traffic Generator connected to ONU UNI port 2 to transmit an upstream IGMPv2 membership report message, joining Multicast Group A.
9. Verify that the Ethernet Traffic Generator connected to ONU UNI port 2 does not begin receiving downstream multicast frames from Multicast Group A.
10. Cause the Ethernet Traffic Generator connected to ONU UNI port 2 to transmit an upstream IGMPv2 membership report message, joining Multicast Group E.
11. Verify that the Ethernet Traffic Generator connected to ONU UNI port 2 begins receiving downstream multicast frames from Multicast Group E.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator receives the Multicast Group A Join message from the V-interface.
2. At step 5, the Ethernet Traffic Generator receives the Multicast Group A flow from ONU UNI port 1.
3. At step 6, the Ethernet Traffic Generator does not receive the Multicast Group E Join message from the V-interface.
4. At step 7, the Ethernet Traffic Generator does not receive the Multicast Group E flow from ONU UNI port 1.
5. At step 8, the Ethernet Traffic Generator does not receive the Multicast Group A Join message from the V-interface.
6. At step 9, the Ethernet Traffic Generator does not receive the Multicast Group A flow from ONU UNI port 2.
7. At step 10, the Ethernet Traffic Generator receives the Multicast Group E Join message from the V-interface.
8. At step 11, the Ethernet Traffic Generator receives the Multicast Group E flow from ONU UNI port 2.

Remarks:

- None

6.3.22 IGMPv3 Transparent Snooping Functions (Multiple User Ports)

Test Status: Conditionally Mandatory (if ONT has multiple user ports)

Reference Documents:

- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-88:** The ONU and OLT MUST support an IGMPv3 transparent snooping function (i.e. the IGMP message processing would not result in the ONU or OLT discarding the IGMP message). This MUST be configurable on a per VLAN basis.
Note that in case the ONU or OLT is configured to apply the R-88 behavior, then R-84 does not apply.
Note: IGMPv3 includes support of earlier versions of IGMP. Specifically, this function is responsible for configuring multicast filters such that frame replication is restricted to those user ports that requested receipt.
- **R-89:** The ONU and OLT IGMP v3 transparent snooping function MUST support the capability to snoop the multicast source IPv4 address and destination IPv4 group address in IGMP messages and to set the corresponding MAC group address filters as specified in R-90.
- **R-90:** The ONU and OLT IGMP v3 transparent snooping function MUST be able to dynamically create and delete MAC-level group filter entries, enabling in turn, selective multicast forwarding from network-facing VLANs to user-facing ports.

Test Objective:

- Verify that the ONU/OLT can support the IGMP transparent snooping function and this functionality can be enabled for a multicast VLAN for an ONU with multiple user ports. Note, this test case does not cover the second MUST within R-88 which has been intentionally removed from the above requirements.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. The Ethernet Traffic Generator connected to the V-interface is configured to act as Multicast_Source_1 and to capture Ethernet Frames.
2. The Ethernet Traffic Generator connected to ONU UNI port 1 is configured to act as LAN_Host_1 and to capture Ethernet Frames.
3. The Ethernet Traffic Generator connected to ONU UNI port 2 is configured to act as LAN_Host_2 and to capture Ethernet Frames.

Test Procedure:

1. Cause the Ethernet Traffic Generator connected to the V-interface to begin generating Ethernet Frames belonging to Multicast Group A through D.

2. Enter the configuration commands at the OLT to configure ONU to allow UNI port 1 to join only Multicast Group A and C.
3. Enter the configuration commands at the OLT to configure ONU to allow UNI port 2 to join only Multicast Group B.
4. Cause the Ethernet Traffic Generator connected to ONU UNI port 1 to transmit an upstream IGMPv2 membership report message, joining Multicast Group A.
5. Verify that the Ethernet Traffic Generator connected to ONU UNI port 1 begins receiving downstream multicast frames from Multicast Group A.
6. Cause the Ethernet Traffic Generator connected to ONU UNI port 2 to transmit an upstream IGMPv2 membership report message, joining Multicast Group B.
7. Verify that the Ethernet Traffic Generator connected to ONU UNI port 2 begins receiving downstream multicast frames from Multicast Group B.
8. Cause the Ethernet Traffic Generator connected to ONU UNI port 1 to transmit an upstream IGMPv2 membership report message, joining Multicast Group C.
9. Verify that the Ethernet Traffic Generator connected to ONU UNI port 1 begins receiving downstream multicast frames from Multicast Group C.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4, the Ethernet Traffic Generator receives the Multicast Group A Join message from the V-interface.
2. At step 5, the Ethernet Traffic Generator receives only the Multicast Group A flow from ONU UNI port 1 and no Multicast Group flows from ONU UNI port 2.
3. At step 6, the Ethernet Traffic Generator receives the Multicast Group B Join message from the V-interface.
4. At step 7, the Ethernet Traffic Generator receives only the Multicast Group A flow from ONU UNI port 1 and only the Multicast Group B flow from ONU UNI port 2.
5. At step 8, the Ethernet Traffic Generator receives the Multicast Group C Join message from the V-interface.
6. At step 9, the Ethernet Traffic Generator receives only the Multicast Group A and C flows from ONU UNI port 1 and only the Multicast Group B flow from ONU UNI port 2.

Remarks:

- None

6.4 Non-IGMP Controlled Multicast and Broadcast

The tests within this section refer to the LAN IGMP Host, Downstream IGMP Host, and Multicast Source definitions defined within Section 6.3.

6.4.1 Silent Discard of Frames with Unknown MAC Addresses

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-109:** It MUST be possible to configure each N:1 VLAN so that the OLT either silently discards or floods frames with MAC addresses that are not in the AN forwarding table.

Test Objective:

- To verify the OLT and ONT combination silently discard downstream frames with destination MAC addresses not currently present in the AN forwarding table, when configured to do so.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as the IGMP_Router_1.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. Configure the OLT/ONU to silently discard downstream frames with unknown destination MAC addresses.
5. Configure the OLT/ONU so that the LAN_Host_1's MAC address is present in the AN forwarding table.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the U-interface of the ONU to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream Ethernet frame, with a unicast MAC address matching the configured LAN_Host_1.
3. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU does receive the downstream frame.

4. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream Ethernet frame, with a unicast MAC address not matching the configured LAN_Host_1.
5. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU does not receive the downstream frame.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, the Ethernet Traffic Generator connected to the U-interface of the ONU must receive the downstream frame directed to LAN_Host_1.
2. At step 5, the Ethernet Traffic Generator connected to the U-interface of the ONU must not receive the downstream frame.

Remarks:

- None

6.4.2 Flooding of Frames with Unknown MAC Addresses

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-110:** For N:1 VLANs where flooding is enabled, when the OLT receives a tagged frame with an unknown unicast MAC address then it MUST be forwarded to the incidental broadcast GEM port.

Test Objective:

- To verify the OLT and ONT combination flood downstream frames with destination MAC addresses not currently present in the AN forwarding table to all ONUs, when configured to do so.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as the IGMP_Router_1.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. Configure the OLT/ONU to flood frames with unknown destination MAC addresses.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the U-interface of the ONU to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream Ethernet frame, with an unknown MAC address not matching the configured LAN_Host_1.
3. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU receives the downstream frame.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the U-interface of the ONU must receive the downstream frame.

Remarks:

- None

6.4.3 Silent Discard of Downstream Broadcast Frames

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-111:** It MUST be possible to configure each VLAN so that it silently discards broadcast frames.

Test Objective:

- To verify the OLT and ONT combination silently discard downstream broadcast frames, when configured to do so.

Test Setup:

1. Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as the IGMP_Router_1.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. Configure the OLT/ONU to silently discard downstream broadcast frames.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the U-interface of the ONU to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream broadcast Ethernet frame.
3. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU does not receive the downstream frame.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the U-interface of the ONU must not receive the downstream broadcast frame.

Remarks:

- None

6.4.4 Flooding of Downstream Broadcast Frames

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-112:** For N:1 VLANs, when the OLT receives a broadcast frame, and if it is not otherwise filtered, then it MUST be forwarded to the incidental broadcast GEM port.

Test Objective:

- To verify the OLT and ONT combination flood downstream broadcast frames to all ONUs, when configured to do so.

Test Setup:

- Figure 6-1: Multicast Test Setup

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 6-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Ethernet Traffic Generator connected to the U-interface of ONU1 configured to act as LAN_Host_1 and capture Ethernet frames.
2. Ethernet Traffic Generator connected to the V-interface configured to act as the IGMP_Router_1.
3. ONU is configured for N:1 VLAN; translating VLAN VID 121 on the UNI to VLAN VID 2121 on the ANI interface, no p-bit operations are performed.
4. Configure the OLT/ONU to flood downstream broadcast frames.

Test Procedure:

1. Enable the Ethernet Traffic Generator connected to the U-interface of the ONU to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the V-interface to transmit a downstream broadcast Ethernet frame.
3. Verify the Ethernet Traffic Generator connected to the U-interface of the ONU receives the downstream broadcast frame.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Ethernet Traffic Generator connected to the U-interface of the ONU must receive the downstream broadcast frame.

Remarks:

- None

6.4.5 Downstream Broadcast Handling, Single U-interface

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-112:** For N:1 VLANs, when the OLT receives a broadcast frame, and if it is not otherwise filtered, then it MUST be forwarded to the incidental broadcast GEM port.
- **R-113:** If the ONU receives a tagged frame on a downstream GEM Port, it MUST forward it to all U interfaces that are members of that VLAN.

Test Objective:

- Verify that the OLT/ONU pass frames with broadcast destination MAC addresses in the downstream direction to all U-interfaces that are members of the VLAN contained in the frame's headers. This test is performed on ONU devices with 1 U-interface.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT/ONU must discard frames with unmatching VID in the downstream direction. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 1 flow of single-tagged Unicast Ethernet frames in the upstream direction with the parameters provided in the next tables:

255i2 Table 6.4.5-1: Test 6.4.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any

The Ethernet Traffic Generator will be configured to transmit 2 flows of single-tagged Broadcast Ethernet frames in the downstream direction with the parameters provided in the next tables:

255i2 Table 6.4.5-2: Test 6.4.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any
Bds	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x88a8	0	Any	SVID2	Any													

Test Procedure:

1. Select distinct random value for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random values for CPbit1 and SPbit1 between 0 and 7.
3. Select random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
5. Start injecting traffic at the V-interface and the U-interfaces as defined in the traffic tables.
6. Stop injecting traffic at the V-interface and the U-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, upstream frames from stream Aus are received from the V-interface as defined in the Traffic table.
2. At step 5, downstream frames from stream Ads are received from the U-interface as defined in the Traffic table.
3. At step 5, no downstream frames from stream Bds are received from the U-interface.

Remarks:

- None

6.4.6 Downstream Broadcast Handling, Multiple U-interfaces

Test Status: Conditionally Mandatory (if ONT has multiple user ports)

Reference Documents:

- ITU-T G.988 [7]

For Reference:

BBF TR-156 [2]

- **R-112:** For N:1 VLANs, when the OLT receives a broadcast frame, and if it is not otherwise filtered, then it MUST be forwarded to the incidental broadcast GEM port.
- **R-113:** If the ONU receives a tagged frame on a downstream GEM Port, it MUST forward it to all U interfaces that are members of that VLAN.

Test Objective:

- Verify that the OLT/ONU pass frames with broadcast destination MAC addresses in the downstream direction to all U-interfaces that are members of the VLAN contained in the frame's headers. This test is performed on ONU devices with multiple U-interfaces.

Test Setup:

- Figure 6-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-3.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction, with the same SVID for both UNIs. In the downstream direction, the ONU must perform the reverse operation.

The OLT/ONU must discard frames with unmatching VID in the downstream direction. The OLT must be configured for N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 1 flow of single-tagged Unicast Ethernet frames in the upstream direction with the parameters provided in the next tables:

255i2 Table 6.4.6-1: Test 6.4.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	N/A	SVID1	Any

The Ethernet Traffic Generator will be configured to transmit 2 flows of single-tagged Broadcast Ethernet frames into the downstream direction with the parameters provided in the next table. The User interface is also provided:

255i2 Table 6.4.6-2: Test 6.4.6 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	UNI
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	1 & 2
Bds	MAC-BRD	MAC1	N/A	N/A	N/A	N/A	0x88a8	0	Any	SVID2	Any														

Test Procedure:

1. Select distinct random values for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random values for CPbit1 and SPbit1 between 0 and 7.
3. Select random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
5. Start injecting traffic at the V-interface and the U-interfaces as defined in the traffic tables.
6. Stop injecting traffic at the V-interface and the U-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, upstream frames from stream Aus are received from the V-interface as defined in the Traffic table.
2. At step 5, downstream frames from stream Ads are received as untagged Ethernet frames from both U-interfaces.
3. At step 5, no downstream frames from stream Bds must be received from either U-interfaces.

Remarks:

- None

6.5 Security

6.5.1 Test for Providing Service to Users with Duplicate MAC Addresses

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-114:** The OLT SHOULD be able to provide service to users with duplicate MAC addresses.

Test Objective:

- To verify in IOP context that the OLT can provide service to users with duplicate MAC addresses.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. Two users have been provisioned with the same N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit Ethernet frames upstream with the following parameters at two distinct U interfaces, and marking the payload in such a way that the frames can be identified regardless of layer 2 addressing information.

Table 6-61: Test 6.5.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800												
B	1	2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800												

Table 6-62: Test 6.5.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads											1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	
Bds											1	2	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	

Note: frames Aus and Bus are expected to be received at the V-interface, fields in the tables above have not been defined to allow for different implementations of the supporting users with duplicate MAC addresses.

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2.
3. Cause the Ethernet Traffic Generator to transmit upstream frame(s) as specified in the test configuration.
4. Capture frames at the V interface.
5. The Ethernet Traffic Generator should be configured to transmit Ethernet frames downstream by copying the upstream frames received at the V interface, and swapping their respective MAC source and destination addresses.
6. Capture frames at the U interfaces and note the destination MAC.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 4 the upstream frames are received at the V interface.
2. At step 6 the downstream frames are received at the proper U interfaces (as verified by checking the payload marking), with destination MAC addresses equals to MAC2.

Remarks:

- The use of Virtual-MAC addresses presents one possible solution to provide services to users with duplicate MAC addresses. Other solutions may also be available to implement similar functionality.

6.5.2 Test for Denying Service to Users with Duplicate MAC Addresses

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-115:** The OLT SHOULD be able to deny service to users with duplicate MAC addresses.

Test Objective:

- To verify in IOP context that the OLT can deny service to users with duplicate MAC addresses.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. Two users have been provisioned with the same N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit Ethernet frames upstream with the following parameters at two distinct U interfaces.

Table 6-63: Test 6.5.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Bus	1	2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800

Table 6-64: Test 6.5.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbbits	DEI	VID	TPID	Pbbits	DEI	VID						TPID	Pbbits	DEI	VID	TPID	Pbbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2.
3. Configure the OLT to disallow duplicate MAC addresses.
4. Cause the Ethernet Traffic Generator to transmit upstream frame(s) for the user 1.
5. Cause the Ethernet Traffic Generator to transmit upstream frame(s) for the user 2.
6. Capture frames at the V interface.
7. The Ethernet Traffic Generator should be configured to transmit Ethernet frames downstream with the following parameters at the V interface.
8. Capture frames at the U interfaces.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5 the upstream frames are received from one user at the V interface, but are not received from the other user.
2. At step 7 the downstream frames are received at the user's U interface, whose upstream frames were received at the V interface and not at the other user's U interface.

Remarks:

- None

6.5.3 Test for Mechanism to Prevent Broadband Network Gateway MAC Address Spoofing

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-116:** The OLT SHOULD provide a mechanism to prevent Broadband Network Gateway MAC address spoofing.

Test Objective:

- To verify in IOP context that the OLT can provide a Mechanism to prevent Broadband Network Gateway MAC address spoofing.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. Two users have been provisioned with the same N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit Ethernet frames upstream with the following parameters at two distinct U interfaces.

Table 6-65: Test 6.5.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC3	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC3	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800
Cus	1	2	MAC3	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800											

Table 6-66: Test 6.5.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800
Bds	MAC2	MAC3	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID2	0x0800	1	1	MAC2	MAC3	N/A	N/A	N/A	N/A	0x8100	Any	Any	VID1	0x0800

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC3.
3. Cause the Ethernet Traffic Generator to transmit frame(s) for the V and U1 interfaces.
4. Cause the Ethernet Traffic Generator to transmit upstream frame(s) for the U2 interface.
5. Capture frames at the V interface and U1.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, all upstream frames are received at the V interface from U1 interface but not from U2 interface.
2. At step 5, all downstream frames are received at the U1 interface from V interface.

Remarks:

- None

6.5.4 Test for Mechanism to Handle ARP Broadcasts

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-117:** The OLT MUST be able to inspect upstream and downstream DHCP packets in order to discover the mapping of IPv4 address to MAC address and populate an ARP table associating these addresses with their respective U interface and VLAN.
- **R-118:** The OLT MUST be able to ensure that downstream broadcast ARP requests are not sent on U interfaces that do not have the requested IPv4 address.

Test Objective:

- To verify in IOP context that the OLT can discover IP address mappings and ensure that downstream broadcast ARP requests are not sent on U-interfaces that do not have the requested IP address.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. Two users have been provisioned with the same N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit DHCP DISCOVER and REQUEST upstream at two distinct U interfaces U1 and U2.
3. The Ethernet Traffic Generator should be configured to respond with DHCP OFFER and ACK downstream at V interface.
4. The Ethernet Traffic Generator should be configured to transmit broadcast ARP requests downstream at V interface.
5. The Ethernet Traffic Generator should be configured to respond with upstream ARP message at U interfaces.

Test Procedure:

1. Select unicast IP addresses IP1 and IP2.
2. Cause the Ethernet Traffic Generator to generate complete DHCP sequences (DISCOVER, OFFER, REQUEST, ACK) so that DHCP leases for IP1 and IP2 are allocated to U1 and U2 interfaces respectively.
3. Cause the Ethernet Traffic Generator to generate a downstream ARP broadcast targeting IP1.
4. In case downstream ARP broadcasts are received at the U1 interface, the Ethernet Traffic Generator should respond with an upstream ARP unicast message.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, no downstream ARP message targeting IP1 is received at interface U2.
2. Following step 3, and step 4 if applicable, an upstream ARP response related to IP1 is received from the V interface.

Remarks:

- None

6.5.5 Test for Mechanism to Prevent IP Address Spoofing

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-117:** The OLT MUST be able to inspect upstream and downstream DHCP packets in order to discover the mapping of IPv4 address to MAC address and populate an ARP table associating these addresses with their respective U interface and VLAN.
- **R-119:** The OLT MUST provide mechanisms to prevent user IPv4 address spoofing, by discarding upstream IPv4 packets received from U interfaces that do not match the configured or DHCP-discovered source IPv4 address.

Test Objective:

- To verify in IOP context that the OLT can discover IP address mappings and ensure that upstream IP packets received from U-interfaces that do not match the configured or DHCP-discovered source IP address are discarded.

Test Setup:

- Figure 4-3: Setup for Interoperability Tests with ONU Supporting Multiple U-interfaces

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. Two users have been provisioned with the same N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit DHCP DISCOVER and REQUEST upstream at two distinct U interfaces U1 and U2.
3. The Ethernet Traffic Generator should be configured to respond with DHCP OFFER and ACK downstream at V interface.
4. The Ethernet Traffic Generator should be configured to transmit upstream IPoE packets at U1 interface using source IP addresses IP1, IP2 and IP3 sequentially.

Test Procedure:

1. Select unicast IP addresses IP1, IP2 and IP3.
2. Cause the Ethernet Traffic Generator to generate complete DHCP sequences (DISCOVER, OFFER, REQUEST, ACK) so that a DHCP lease is allocated to both U1 and U2 interfaces. IP1 and IP2 are the IP addresses allocated via DHCP at interfaces U1 and U2 respectively.
3. Cause the Ethernet Traffic Generator to generate upstream IPoE packets at U1 interface using source IP addresses IP1.
4. Cause the Ethernet Traffic Generator to generate upstream IPoE packets at U1 interface using source IP addresses IP2 and IP3 sequentially.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, packets with source IP address IP1 are received at the V interface.
2. At step 4, no packet with source IP address IP2 or IP3 is received at the V interface.

Remarks:

- None

6.5.6 Test for Mechanism to Prevent MAC Flooding Attacks

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]

For Reference:

- **R-121:** In order to prevent source MAC flooding attacks, the OLT MUST be able to limit the number of source MAC addresses learned and forwarded from each user port. This limit MUST be configurable per user port.

Test Objective:

- To verify in IOP context that the OLT can limit the number of source MAC addresses learned and forwarded from each user port and that this limit is configurable.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. OLT and ONU(s) are connected to the same ODN and powered on.
2. ONU activation and OMCC establishment processes have been successfully completed.

Test Configuration:

1. A user interface U has been provisioned with a N:1 VLAN service.
2. The Ethernet Traffic Generator should be configured to transmit Ethernet upstream traffic at the U interface using source MAC addresses MAC 1 to MAC N+1 sequentially.

Test Procedure:

1. Configure the maximum number of MAC addresses that can be learned at interface U with value N.
2. Cause the Ethernet Traffic Generator to generate Ethernet upstream traffic at the U interface using source MAC addresses MAC 1 to MAC N+1 sequentially.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Ethernet traffic with source MAC addresses 1 to N is received at the V interface.
2. No Ethernet traffic with source MAC address N+1 is received at the V interface.

Remarks:

- None

6.5.7 Unicast GEM Port Encryption Downstream

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

BBF TR-280 [10]

- **R-66:** The ONU MUST support GEM port encryption for all unicast GEM ports

Test Objective:

- Verify that the ONU/OLT can support downstream encryption activation for unicast GEM ports.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to add an S-tag in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.5.7-1: Test 6.5.7 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)												
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type		
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID			
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	SVID1	Any		

255i2 Table 6.5.7-2: Test 6.5.7 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Any

Test Procedure:

1. Select a random value for SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select a random value for Pbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described above, with a data rate of 100Mbps in both directions.
5. Start injecting traffic at the U-interface as defined in the upstream traffic tables at a data rate of 50Mbps.
6. Start Injecting traffic at the V-interface as defined in the downstream traffic tables at data rate of 50Mbps.
7. Wait 20 seconds.
8. Enter the configuration commands at the OLT to activate downstream encryption for the configured service.
9. Wait 20 seconds.
10. Enter the configuration commands at the OLT to deactivate downstream encryption for the configured service.
11. Wait 20 seconds.
12. Stop injecting traffic at the U and V interfaces.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 11, no packet loss has been observed since Step 5.
2. At step 7, if the optional PON Analyzer is being used, it MUST report the traffic on the GEM port is not encrypted.
3. At step 9, if the optional PON Analyzer is being used, it MUST report the OLT has activated encryption downstream on the GEM port and that the traffic is encrypted after activation.
4. At step 11, if the optional PON Analyzer is being used, it MUST report the OLT has deactivated encryption downstream on the GEM port and that the traffic is not encrypted after deactivation.

Remarks:

- None

6.5.8 Unicast GEM Port Encryption Upstream

Test Status: Conditionally Mandatory (applies to all OLT/ONUs except G-PON OLT/ONUs)

Reference Documents:

- BBF TR-280 [10]

For Reference:

BBF TR-280 [10]

- **R-66:** The ONU MUST support GEM port encryption for all unicast GEM ports

Test Objective:

- Verify that the ONU/OLT can support upstream encryption activation for unicast GEM ports.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 1. The ONU must be configured to add an S-tag in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

255i2 Table 6.5.8-1: Test 6.5.8 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)													V Interface (as received from)												
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type		
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID			
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	SVID1	Any		

255i2 Table 6.5.8-2: Test 6.5.8 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	Any

Test Procedure:

1. Select a random value for SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select a random value for Pbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described above, with a data rate of 100Mbps in both directions.
5. Start injecting traffic at the U-interface as defined in the upstream traffic tables at a data rate of 50Mbps.
6. Start Injecting traffic at the V-interface as defined in the downstream traffic tables at a data rate of 50Mbps.
7. Wait for 20 seconds.
8. Enter the configuration commands at the OLT to activate upstream encryption for the configured service.
9. Wait 20 seconds.
10. Enter the configuration commands at the OLT to deactivate upstream encryption for the configured service.
11. Wait 20 seconds.
12. Stop injecting traffic at the U and V interfaces.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 11, no packet loss has been observed since Step 5.
2. At step 7, if the optional PON Analyzer is being used, it MUST report the traffic on the GEM port is not encrypted.
3. At step 9, if the optional PON Analyzer is being used, it MUST report the OLT has activated encryption upstream on the GEM port and that the traffic is encrypted after activation.
4. At step 11, if the optional PON Analyzer is being used, it MUST report the OLT has deactivated encryption upstream on the GEM port and that the traffic is not encrypted after deactivation.

Remarks:

- None

6.6 Filtering

6.6.1 MAC Source Address Allowing Filter

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-122:** The OLT and ONU SHOULD allow configuring and applying the following filters. The OLT MUST apply any configured filters in the downstream direction, and the ONU MUST apply any configured filters in the upstream direction.
 1. Source MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access from a specific MAC address.
 - ii. Denying access from a specific MAC address.
 2. Destination MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access to specific destinations.
 - ii. Denying access to specific destinations.

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure ONU to allow access of Ethernet frames with a specified MAC source address, by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-67: Test 6.6.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
B	1	1	MAC1	MAC3	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC3, which are not already in use by any ONU or other connected devices. To support configuration of MAC filtering as defined in next step, select the following MAC addresses for each ONU: MAC2 for the ONU.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable MAC filtering, allowing access from the MAC address selected in step 1.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from Traffic Streams A & B simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be received at V-Interface by the Ethernet Traffic Generator.
2. Upstream frames from Traffic Stream B shall be silently discarded.

Remarks:

- None

6.6.2 MAC Source Address Denying Filter

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-122:** The OLT and ONU SHOULD allow configuring and applying the following filters. The OLT MUST apply any configured filters in the downstream direction, and the ONU MUST apply any configured filters in the upstream direction.
 1. Source MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access from a specific MAC address.
 - ii. Denying access from a specific MAC address.
 2. Destination MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access to specific destinations.
 - ii. Denying access to specific destinations.

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure ONU to deny access of Ethernet frames with a specified MAC source address, by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-68: Test 6.6.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
B	1	1	MAC1	MAC3	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC3	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC3, which are not already in use by any ONU or other connected devices. To support configuration of MAC filtering as defined in next step, select the following MAC addresses for each ONU: MAC2 for the ONU.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable MAC filtering, allowing deny from the MAC address selected in step 1.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be silently discarded.
2. Upstream frames from Traffic Stream B shall be received at V-Interface by the Ethernet Traffic Generator.

Remarks:

- None

6.6.3 MAC Destination Address Allowing Filter

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-122:** The OLT and ONU SHOULD allow configuring and applying the following filters. The OLT MUST apply any configured filters in the downstream direction, and the ONU MUST apply any configured filters in the upstream direction.
 1. Source MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access from a specific MAC address.
 - ii. Denying access from a specific MAC address.
 2. Destination MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access to specific destinations.
 - ii. Denying access to specific destinations.

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure ONU to allow access for Ethernet frames with the specified MAC destination address, by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

- The ONU is powered and connected to the ODN as shown in Figure 4-1.
- The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-69: Test 6.6.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
B	1	1	MAC3	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC3, which are not already in use by any ONU or other connected devices. To support configuration of MAC filtering as defined in next step, select the following MAC addresses for each ONU: MAC1 for the ONU.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable MAC filtering, allowing access from the MAC address selected in step 1.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be received at V-Interface by the Ethernet Traffic Generator.
2. Upstream frames from Traffic Stream B shall be silently discarded.

Remarks:

- None

6.6.4 MAC Destination Address Denying Filter

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-122:** The OLT and ONU SHOULD allow configuring and applying the following filters. The OLT MUST apply any configured filters in the downstream direction, and the ONU MUST apply any configured filters in the upstream direction.
 1. Source MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access from a specific MAC address.
 - ii. Denying access from a specific MAC address.
 2. Destination MAC address filter. This filter may be used in one of the following ways:
 - i. Allowing access to specific destinations.
 - ii. Denying access to specific destinations.

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure ONU to deny access for Ethernet frames with the specified MAC destination address, by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-70: Test 6.6.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
B	1	1	MAC3	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC3	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC3, which are not already in use by any ONU or other connected devices. To support configuration of MAC filtering as defined in next step, select the following MAC addresses for each ONU: MAC1 for the ONU.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable MAC filtering, allowing deny from the MAC address selected in step 1.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be silently discarded.
2. Upstream frames from Traffic Stream B shall be received at V-Interface by the Ethernet Traffic Generator.

Remarks:

- None

6.6.5 Group MAC Destination Address Filter

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-124:** The OLT and ONU SHOULD be able to filter reserved group MAC destination addresses (in the 01:80:C2 range – ref. R-118TR-101i2)

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure ONU to filter Ethernet frames with the reserved group MAC destination addresses, by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-71: Test 6.6.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	0x0800
B	1	1	MAC3	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select distinct random values for MAC1 through MAC3, which are not already in use by any ONU or other connected devices. MAC1 and MAC2 MUST NOT begin with the prefix 01:80:C2:00:00, MAC3 MUST begin with the prefix 01:80:C2:00:00.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable MAC filtering, denying access to reserved group MAC destination addresses (in the 01:80:C2 range).
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be received at V-Interface by the Ethernet Traffic Generator.
2. Upstream frames from Traffic Stream B shall be silently discarded.

Remarks:

- None

6.6.6 EtherType Allowing Filter (IPoE)

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-123:** The ONU SHOULD allow configuration of an EtherType filter, and applying it per U interface in the upstream direction. This filter may be used in one of the following ways:
 - i. Allowing a specific EtherType frame access (e.g. IPv4oE, IPv6oE, PPPoE).
 - ii. Denying a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure a single U-interface on an ONU to access a specific EtherType frame (e.g., IPoE), by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-72: Test 6.6.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	IPv4oE 0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	IPv4oE 0x0800
B	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Discovery 0x8863											
C	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Session 0x8864											

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by any ONU or other connected devices.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable Ethertype filtering, allowing access for IPv4oE frames.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be received at V-Interface by the Ethernet Traffic Generator.
2. Upstream frames from Traffic Stream B & C shall be silently discarded.

Remarks:

- None

6.6.7 EtherType Allowing Filter (PPPoE)

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-123:** The ONU SHOULD allow configuration of an EtherType filter, and applying it per U interface in the upstream direction. This filter may be used in one of the following ways:
 - i. Allowing a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).
 - ii. Denying a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure a single U-interface on an ONU to allow access for specific EtherType frames (e.g., PPPoE), by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-73: Test 6.6.7 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	IPv4oE 0x0800											
B	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Discovery 0x8863	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	PPPoE Discovery 0x8863
C	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Session 0x8864	MAC5	MAC6	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	PPPoE Session 0x8864

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by any ONU or other connected devices.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable Ethertype filtering, allowing access for PPPoE Discovery and PPPoE Session frames.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be silently discarded.
2. Upstream frames from Traffic Stream B & C shall be received at V-Interface by the Ethernet Traffic Generator.

Remarks:

- Note

6.6.8 EtherType Denying Filter (IPoE)

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-123:** The ONU SHOULD allow configuration of an EtherType filter, and applying it per U interface in the upstream direction. This filter may be used in one of the following ways:
 - i. Allowing a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).
 - ii. Denying a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure a single U-interface on an ONU to deny a specified EtherType frame access (e.g., IPoE), by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-74: Test 6.6.8 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	IPv4oE 0x0800											
B	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Discovery 0x8863	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	PPPoE Discovery 0x8863
C	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Session 0x8864	MAC5	MAC6	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	PPPoE Session 0x8864

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by any ONU or other connected devices.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable Ethertype filtering, denying access to IPv4oE frames.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Upstream frames from Traffic Stream A shall be silently discarded.
2. Upstream frames from Traffic Stream B & C shall be received at V-Interface by the Ethernet Traffic Generator.

Remarks:

- None

6.6.9 EtherType Denying Filter (PPPoE)

Test Status: Optional

Reference Documents:

- BBF TR-156 [2]
- ITU-T G.988 [7]

For Reference:

- **R-123:** The ONU SHOULD allow configuration of an EtherType filter, and applying it per U interface in the upstream direction. This filter may be used in one of the following ways:
 - i. Allowing a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).
 - ii. Denying a specific EtherType frame access (e.g. IPv4oE+ARP, IPv6oE, PPPoE).

Test Objective:

- Verify the OMCI interoperability between OLT and ONU, that OLT can configure a single U-interface on an ONU to deny a specified EtherType frame access (e.g., PPPoE), by sending Ethernet traffic in upstream direction using Ethernet Traffic Generator, and checking at the Ethernet Traffic Generator that all received Ethernet traffic is filtered.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. The Ethernet traffic generator is configured to generate Ethernet frames upstream as defined in the tables below.

Table 6-75: Test 6.6.9 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	IPv4oE 0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Any	Any	VID1	IPv4oE 0x0800
B	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Discovery 0x8863											
C	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	PPPoE Session 0x8864											

Test Procedure:

1. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by any ONU or other connected devices.
2. Configure the OLT to provision each ONU to support the following:
 - a. A single untagged U-interface.
 - b. Addition/removal of the S-Tag in the upstream/downstream directions, respectively.
3. Enable Ethertype filtering, denying access to PPPoE Discovery and PPPoE Session frames.
4. Cause the Ethernet Traffic Generator to transmit upstream frames from all Traffic Streams simultaneously.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

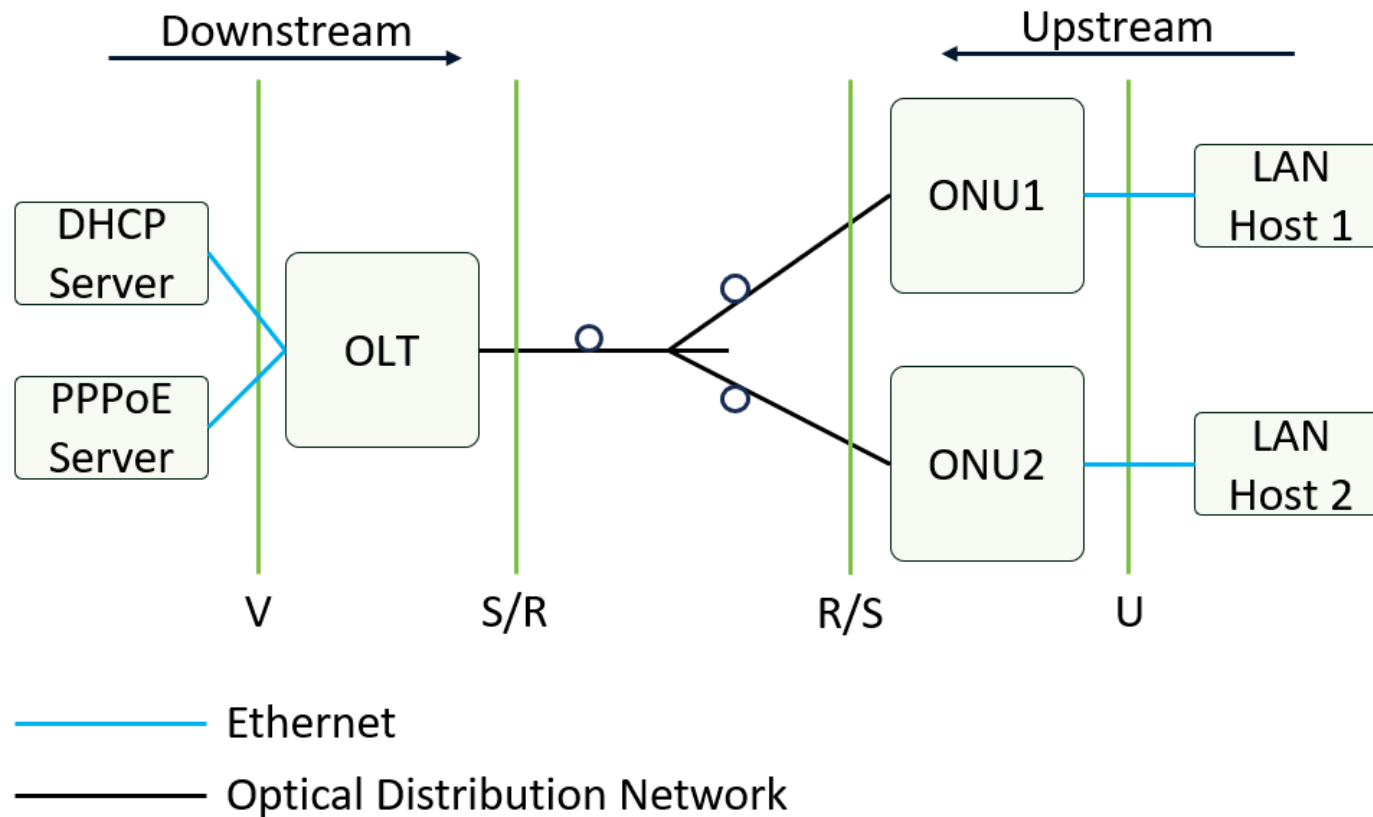
1. Upstream frames from Traffic Stream A shall be received at V-Interface by the Ethernet Traffic Generator.
2. Upstream frames from Traffic Stream B & C shall be silently discarded.

Remarks:

- None

6.7 Port Identification and Characterization

Figure 6-2: Port Identification Test Setup



Note: The DHCP Server, PPPoE Server, and LAN Host functions are logical and may be implemented inside an Ethernet Traffic Generator, as depicted in Figure 4-2: Setup for Interoperability Tests Requiring Multiple ONUs.

6.7.1 Basic PPPoE Intermediate Function

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-119, R-120, R-121
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-129:** The OLT MUST be able to perform the PPPoE Intermediate Agent function as specified in Section 3.9.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for the PPPoE discovery phase.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-1".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN host and PPPoE Server interfaces.

4. Cause LAN Host 1 to send an upstream PPPoE PADI message. The PADI message must not include the Option 82 data, as described in TR-101 [1].
5. Allow the PPPoE Server to respond to the PADI message with a downstream PADO message. The PADO message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The PADI message captured at the PPPoE server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned.
2. The PADO message captured at the LAN Host interface must not include the Option 82 data.

Remarks:

- None

6.7.2 PPPoE Intermediate Function Option 82 Overwriting

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-118, R-119, R-120, R-121, R-124, R-126
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-129:** The OLT MUST be able to perform the PPPoE Intermediate Agent function as specified in Section 3.9.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for the PPPoE discovery phase. If the upstream PPPoE discovery messages already contain the Option 82 data, this data is overwritten with the appropriate value.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-2".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].

3. Enable frame capture mechanisms as the LAN host and PPPoE Server interfaces.
4. Cause LAN Host 1 to send an upstream PPPoE PADI message. The PADI message must include the Option 82 data, as described in TR-101, the value of the Agent Remote ID must not match the value provisioned in step 1.
5. Allow the PPPoE Server to respond to the PADI message with a downstream PADO message. The PADO message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The PADI message captured at the PPPoE server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned.
2. The PADO message captured at the LAN Host interface must not include the Option 82 data.

Remarks:

- None

6.7.3 PPPoE Intermediate Function with Multiple Clients

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-118, R-119, R-120
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-129:** The OLT MUST be able to perform the PPPoE Intermediate Agent function as specified in Section 3.9.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for the PPPoE discovery phase for multiple clients.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "" (no value).
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN hosts and PPPoE Server interfaces.

4. Cause LAN Host 1 to send an upstream PPPoE PADI message. The PADI message must not include the Option 82 data, as described in TR-101 [1].
5. Cause LAN Host 2 to send an upstream PPPoE PADI message. The PADI message must not include the Option 82 data, as described in TR-101 [1].
6. Allow the PPPoE Server to respond to each PADI message with a downstream PADO message. The PADO message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The PADI message captured at the PPPoE server interface must include the Option 82 data, including the correct Circuit ID previously provisioned.
2. The PADI message captured at the PPPoE server interface must include the Option 82 data, including the correct Remote ID as an empty string.
3. The PADO message captured at the LAN Hosts interface must not include the Option 82 data.

Remarks:

- None

6.7.4 PPPoE Intermediate Function with Unicast PADI Message

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-119, R-120, R-121
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-129:** The OLT MUST be able to perform the PPPoE Intermediate Agent function as specified in Section 3.9.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for the PPPoE discovery phase when the PADI message is unicast to the PPPoE Server.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-4".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN hosts and PPPoE Server interfaces.

4. Cause LAN Host 1 to send an upstream PPPoE PADI message as a unicast message. The destination MAC address of the message should be the MAC address of the PPPoE Server. The PADI message must not include the Option 82 data, as described in TR-101 [1].
5. Allow the PPPoE Server to respond to each PADI message with a downstream PADO message. The PADO message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The PADI message captured at the PPPoE server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned.
2. The PADO message captured at the LAN Hosts interface must not include the Option 82 data.

Remarks:

- None

6.7.5 Basic DHCP Relay Agent Functions

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-98, R-112, R-114
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-128:** The OLT MUST be able to perform the Layer 2 DHCP relay agent function as specified in Section 3.8.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for DHCP messages.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-5".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN host and DHCP Server interfaces.

4. Cause LAN Host 1 to send an upstream DHCP Discover message. The Discover message must not include the Option 82 data, as described in TR-101 [1].
5. Allow the DHCP Server to respond to the Discover message with a downstream Offer message. The Offer message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Discover message captured at the DHCP server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned.
2. The Offer message captured at the LAN Host interface must not include the Option 82 data.

Remarks:

- None

6.7.6 DHCP Relay Agent Functions Option 82 Overwriting

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-98, R-112, R-113, R-114, R-124, R-126
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-128:** The OLT MUST be able to perform the Layer 2 DHCP relay agent function as specified in Section 3.8.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for DHCP messages. If the upstream DHCP discovery messages already contain the Option 82 data, this data is overwritten with the appropriate value.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-6".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].

3. Enable frame capture mechanisms as the LAN host and DHCP Server interfaces.
4. Cause LAN Host 1 to send an upstream DHCP Discover message. The Discover message must include the Option 82 data, as described in TR-101 [1]. The included Option 82 Remote ID must not be the same value provisioned in step 1.
5. Allow the DHCP Server to respond to the Discover message with a downstream Offer message. The Offer message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Discover message captured at the DHCP server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned in step 1.
2. The Offer message captured at the LAN Host interface must not include the Option 82 data.

Remarks:

- None

6.7.7 DHCP Relay Agent Functions with Multiple Clients

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-113
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-128:** The OLT MUST be able to perform the Layer 2 DHCP relay agent function as specified in Section 3.8.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for DHCP messages for multiple clients.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "" (no value).
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN host and DHCP Server interfaces.

4. Cause LAN Host 1 to send an upstream DHCP Discover message. The Discover message must not include the Option 82 data, as described in TR-101 [1].
5. Cause LAN Host 2 to send an upstream DHCP Discover message. The Discover message must not include the Option 82 data, as described in TR-101 [1].
6. Allow the DHCP Server to respond to each Discover message with a downstream Offer message. The Offer message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Discover message captured at the DHCP server interface must include the Option 82 data, including the correct Circuit ID previously provisioned in step 1.
2. The Discover message captured at the DHCP server interface must include the Option 82 data, including the correct Remote ID of an empty string (no value).
3. The Offer message captured at the LAN Hosts interface must not include the Option 82 data.

Remarks:

- None

6.7.8 DHCP Relay Agent Functions with Unicast DHCP Discover Message

Test Status: Optional

Reference Documents:

- BBF TR-101 [1]
- BBF TR-156 [2]

For Reference:

- BBF TR-101 [1]:
 - R-100, R-101, R-102, R-103, R-104, R-105
- BBF TR-156 [2]:
 - **R-125:** The OLT MUST create the Agent Circuit ID and Remote ID as described in TR-101.
 - **R-128:** The OLT MUST be able to perform the Layer 2 DHCP relay agent function as specified in Section 3.8.2/TR-101i2.

Test Objective:

- To verify the OLT/ONT combination can support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 [2] and TR-101 [1] for unicast DHCP messages.

Test Setup:

- Figure 6-2: Port Identification Test Setup

Pretest Conditions:

1. The ONU/OLT combination must have already passed test case: 6.1.1.3 Q-tagged U-interface Test Case.
2. The ONU is powered and connected to the ODN as shown in Figure 6-2.
3. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. All the ONU(s) is(are) powered and connected to the ODN.
2. Each ONU has been activated by the OLT, has been ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.
3. Each ONU has been provisioned for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case.
 - a. Note: This configuration implies a required VLAN tagging configuration for each LAN Host, DHCP Server, and PPPoE Server.

Test Procedure:

1. Configure the OLT to use the Agent Remote ID of "TR-255-Test-6-7-6".
2. Configure the OLT to use the Agent Circuit ID in the format of "Access-Node-Identifier eth Slot/Port/ONUID/Slot/Port[:VLAN-ID]".
 - a. Note: This format is the default format listed in BBF TR-156 [2].
3. Enable frame capture mechanisms as the LAN host and DHCP Server interfaces.

4. Cause LAN Host 1 to send an upstream unicast DHCP Discover message. The destination MAC address of the Discover message should be the MAC address of the DHCP Server. The Discover message must not include the Option 82 data, as described in TR-101 [1].
5. Allow the DHCP Server to respond to each Discover message with a downstream Offer message. The Offer message must include the Option 82 data.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. The Discover message captured at the DHCP server interface must include the Option 82 data, including the correct Circuit ID and Remote ID previously provisioned.
2. The Offer message captured at the LAN Hosts interface must not include the Option 82 data.

Remarks:

- None

6.8 Initial Provisioning of ONU

6.8.1 ONU Provisioning According to Serial Number Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2] Section 7.2
- ITU-T G.984.3 [4] Section 10 and Annex A.6
- ITU-T G.984.3 [5] Amd1 Section 2.3

For Reference:

- **R-150:** The OLT MUST support the pre-provisioning of ONU serial numbers and their associated ONUIDs.
- **R-154:** When the OLT receives a serial number from an ONU during Serial number acquisition, the OLT MUST determine whether the serial number is recognized either from a previous registration or from its set of provisioned values.
- **ITU-T G.984.3:** Annex A.6, test of the ONU activation according to the serial number

Test Objective:

- To verify that the ONU can reach the state O5 using the serial number method.
- To verify that the OMCC is established and activated.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should not have already registered this ONU (if it is not the case, the ONU must be de-provisioned at the OLT).
2. The ONU is not connected to the ODN and power on.
3. Deactivate ONU auto-discover mode if this functionality is available at the OLT.

Test Configuration:

1. Remote access (CLI or EMS) to the OLT MUST be available.

Test Procedure:

1. Pre-provision the ONU with the dedicated serial number at the OLT.
2. Connect the ONU to the ODN.
3. After 30s [time reference defined in the ITU-T Series G, Supplement 46] the ONU should be synchronized on the PON tree.
4. To verify that OMCC channel is up, send reboot ONU from the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, the OLT and ONU are synchronized (O5 state) following serial number method.
2. At step 4, the ONU reboots.

Remarks:

- Note: The procedure for this test case is focused on PLOAM.

6.8.2 ONU Provisioning According to the Registration-ID Test Case

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2] Section 7.2
- ITU-T G.984.3 [4] Section 10 and Annex A.6
- ITU-T G.984.3 [5] Amd1 Section 2.3

For Reference:

- **R-151:** The OLT MUST support the pre-provisioning of registration IDs and their associated ONUIDs.
- **R-155:** In the case where a serial number is not recognized, an OLT MUST determine whether the registration ID is recognized from its set of provisioned values.
- **ITU-T G.984.3 Amd1:** Sections 2.2 and 2.3, test of the ONU activation according to the registration-ID R-151: The OLT MUST support the pre-provisioning of registration IDs and their associated ONUIDs.

Test Objective:

- To verify that the ONU can reach the state O5 using the registration-ID mechanism.
- To verify that the OMCC is established and activated.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should not have already registered this ONU (if it is the case, the ONU must be de-provisioned at the OLT via a remote access).
2. The ONU is not connected to the ODN and power on.
3. Deactivate ONU auto-discover mode if this functionality is available at the OLT.

Test Configuration:

1. Remote access (CLI or EMS) to the OLT MUST be available.

Test Procedure:

1. Pre-provision the ONU with the dedicated registration-ID at the OLT.
2. Via a local interface of the ONU, enter the registration-ID.
3. Connect the ONU to the ODN, which shall range after 30s [time reference defined in the ITU-T Serie G, Supplement 46] the ONU should be synchronized on the PON tree.
4. To verify that OMCC channel is up, send reboot ONU from the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 3, the OLT and ONU are synchronized (O5 state) following serial number method.
2. At step 4, the ONU reboots.

Remarks:

- Note: The procedure for this test case is focused on PLOAM.

6.9 ONU Bring-up

6.9.1 ONU Bring-up for New ONU

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- ITU-T G.988 Appendix I [7]

Test Objective:

- To verify that the OLT and ONU correctly complete the ONU Bring-up method as described in ITU-T G.988 [7]. A new ONU is defined as an ONU that has never completed the OLT's MIB synchronization process.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should be configured to automatically discover any ONU devices connected to the ODN, but to not automatically activate them (download MIB, etc.).

Test Configuration:

1. ONU has never been provisioned or if it has, it has been de-provisioned.
2. ONU is powered off and connected to the ODN.
3. The OLT is powered on, active and connected to the ODN.
4. The OLT should be configured to send the sequence of PLOAM and OMCI messages required to accomplish the ONU activation process, the OMCC establishment, MIB synchronization and MIB download processes.

Test Procedure:

1. Power the ONT on.
2. The OLT should range the ONU in about 30 seconds (ranging is finished when ONU moved into state O5, after the ONU-ID and the ranging-time is sent from OLT to the ONU).
3. The OLT reports ONU as discovered ONU and awaits confirmation and configuration for this ONU.
4. Use the OLT management console to activate the discovered ONU, this should cause the OLT to download the ONU's MIB.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Once ONU activation is completed, the ONU's serial number and status MUST be reported as active by the OLT's management interface.
2. After step 4, the OMCC has been established and the ONU MIB upload has been completed, the ONU MIB MUST be available from the OLT management interface.

Remarks:

- None

6.9.2 ONU Bring-up Method for Old ONU

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- ITU-T G.988 [7] Appendix I

Test Objective:

- To verify the OLT and ONU can perform the methods necessary to bring up an ONU that was previously connected to the OLT.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should be configured to automatically discover any ONU devices connected to the ODN, but to not automatically activate them (download MIB, etc.).

Test Configuration:

1. ONU is connected to the ODN and powered on.
2. OLT is powered on, active and connected to the ODN.
3. ONU has been confirmed on the OLT and successfully achieved MIB synchronization (previously activated).

Test Procedure:

1. Disconnect the ONU from the ODN.
2. Reboot the ONU device and wait for it to fully reboot.
3. Re-connect the ONU to the ODN.
4. The OLT should automatically activate and apply the same provisioning that was previously applied to the ONU.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Once ONU activation is completed, the ONU's serial number and status MUST be reported as active by the OLT's management interface.
2. After step 4, the OMCC has been established and the ONU MIB upload has been completed, the ONU MIB MUST be available from the OLT management interface.

Remarks:

- None

6.9.3 ONU Bring-up Method with Encrypted OMCC

Test Status: Mandatory

Reference Documents:

- ITU-T, G.988 [7]
- ITU-T, G.984.3 [4]

For Reference:

- ITU-T G.988 [7], section 7.2.2 Encryption
- ITU-T G.984.3 [4], section 12.2 Encryption system
- ITU-T G.984.3 [4], section 12.3 Key exchange and switch-over

Test Objective:

- To verify that the OLT and ONU correctly complete the ONU Bring-up method as described in ITU-T G.988 [7], when the OLT has been configured to use encrypted OMCC channels. A new ONU is defined as an ONU that has never completed the OLT's MIB synchronization process.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The OLT should be configured to automatically discover any ONU devices connected to the ODN, but to not automatically activate them (download MIB, etc.).

Test Configuration:

1. ONU has never been provisioned or if it has, it has been de-provisioned.
2. ONU successfully completed Test 6.9.1.
3. ONU is powered off and connected to the ODN.
4. The OLT is powered on, active and connected to the ODN.
5. The OLT should be configured to send the sequence of PLOAM and OMCI messages required to accomplish the ONU activation process, the AES key exchange, the OMCC establishment, the OMCC configuration as an encrypted Port-ID, MIB synchronization and MIB download processes.

Test Procedure:

1. Power the OLT on.
2. The OLT should range the ONU in about 30 seconds (ranging is finished when ONU moved into state O5, after the ONU-ID and the ranging-time is sent from OLT to the ONU).
3. The OLT reports ONU as discovered ONU and awaits confirmation and configuration for this ONU.
4. Use the OLT management console to activate the discovered ONU, this should cause the OLT to download the ONU's MIB.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. Once ONU activation is completed, the ONU's serial number and status MUST be reported as active by the OLT's management interface.
2. After step 4, the OMCC has been established and the ONU MIB upload has been completed, the ONU MIB MUST be available from the OLT management interface.
3. If the optional GPON Analyzer is being used, it MUST report the OLT and ONU are using an AES encrypted OMCC channel.

Remarks:

- None

6.9.4 MIB Synchronization

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- ITU-T G.988 Appendix I [7]

Test Objective:

- The purpose of this test is to verify that the ONU and the OLT can synchronize their MIB in case of MIB de-synchronization.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

- OLT and ONU under test are powered and connected to ODN.
- ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

- A bidirectional GEM port between the ONU and the OLT has been created by OMCI with respect to the traffic table below.
- Ethernet traffic generator is connected with the ONU and Ethernet port of the ONU is up.

Table 6-76: Test 6.9.4 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbits1	0	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbits1	0	SVID1	Any

Table 6-77: Test 6.9.4 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbits1	0	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbits1	0	CVID1	Any

Test Procedure:

- Create the bidirectional GEM port between the ONU and the OLT.
 - Select distinct random values for SVID1 and CVID1 between 1 and 4094.

- Select distinct random values for SPbits1 and CPbits1 between 0 and 7.
- Select distinct random unicast MAC addresses for MAC1 and MAC2.
- 2. Enable any frame capture mechanisms on the Ethernet Traffic Generator.
- 3. Verify that frames are transmitted in both directions.
- 4. Disconnect the optical fiber of the ONU.
- 5. Connect the optical fiber of the ONU.
- 6. Verify that frames are transmitted in both directions.
- 7. Disconnect the optical fiber of the ONU.
- 8. To create a difference in the MIB between the ONU and the OLT, delete the bidirectional GEM port between the ONU and the OLT which has been created by OMCI at the OLT.
- 9. Connect the optical fiber of the ONU.
- 10. After the connection the OLT and the ONU should have performed a MIB synchronization then verify that frames are not transmitted in both directions.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

- 1. The frames between V and U interface are passing in both directions at step 3.
- 2. The frames between V and U interface are passing in both directions at step 6.
- 3. The frames between V and U interface are blocked in both directions at step 10.

Remarks:

- None

6.9.5 OMCI MIB Reset

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- ITU-T G.988 Appendix I [7]

Test Objective:

- Verify that the OLT/ONU can perform an OMCI MIB Reset.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the OLT/ONU must perform the reverse operation. The OLT/ONU must discard frames with unmatching VID in the downstream direction. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 2 flows of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes are also indicated.

255i2 Table 6.9.5-1: Test 6.9.5 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												Traffic class
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1
Bus	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID2	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	2

255i2 Table 6.9.5-2: Test 6.9.5 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)													Traffic class
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	1
Bds	MAC4	MAC3	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID2	Any	2

Test Procedure:

1. Select distinct random values for CVID1, CVID2, SVID1 and SVID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC4, which are not already in use by the OLT, ONU, or other connected devices.
3. Select random values for CPbit1, CPbit2, SPbit1 and SPbit2 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration corresponding to Traffic class 1 as described above.
5. Start injecting traffic at the U-interface as defined in the upstream traffic tables for Traffic classes 1 & 2.
6. Stop injecting traffic at the U-interface.
7. Start injecting traffic at the V-interface as defined in the downstream traffic tables for Traffic classes 1 & 2.
8. Stop injecting traffic at the V-interface.
9. Enter the commands on the OLT to perform a OMCI MIB Reset on the ONU.
10. Start injecting traffic at the U-interface as defined in the upstream traffic tables for Traffic classes 1 & 2.
11. Stop injecting traffic at the U-interface.
12. Start injecting traffic at the V-interface as defined in the downstream traffic tables for Traffic classes 1 & 2.
13. Stop injecting traffic at the V-interface.
14. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration corresponding to Traffic class 2 as described above, with a data rate of 100Mbps in both directions.
15. Start injecting traffic at the U-interface as defined in the upstream traffic tables for Traffic classes 1 & 2.
16. Stop injecting traffic at the U-interface.
17. Start injecting traffic at the V-interface as defined in the downstream traffic tables for Traffic classes 1 & 2.
18. Stop injecting traffic at the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, all upstream frames from stream Aus are received from the V-interface as S-tagged frames with TPID equal to 0x88A8, VID equal to SVID1 and P-bit set to SPBit1, and no frames from stream Bus are received.
2. At step 7, all downstream frames from stream Ads are received from the U-interface as C-tagged frames with TPID equal to 0x8100, VID equal to CVID1 and P-bit equal to CPBit1 and no frame from stream Bds are received.
3. At step 10, no frame is received from the V interface.
4. At step 12, no frame is received from the U interface.

5. At step 15, all upstream frames from stream Bus are received from the V-interface as S-tagged frames with TPID equal to 0x88A8, VID equal to SVID2 and P-bit set to SPBit2, and no frames from stream Aus are received.
6. At step 17, all downstream frames from stream Bds are received from the U-interface as C-tagged frames with TPID equal to 0x8100, VID equal to CVID2 and P-bit equal to CPBit2 and no frame from stream Ads are received.

Remarks:

- None

6.9.6 OMCI Reboot

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- ITU-T G.988 Appendix I [7]

Test Objective:

- Verify that the OLT/ONU can perform an OMCI Reboot, and that the services configured on the OLT/ONU resume their function after the reboot.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

- The ONU is powered and connected to the ODN as shown in Figure 4-1.
- The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the OLT/ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 1 flow of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes are also indicated.

255i2 Table 6.9.6-1 Test 6.9.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any

255i2 Table 6.9.6-2 Test 6.9.6 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any

Test Procedure:

1. Select distinct random values for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select random values for CPbit1 and SPbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
5. Start injecting traffic at the U-interface and the V-interface as defined in the traffic tables.
6. Wait for 20 seconds.
7. Enter the commands on the OLT to perform an OMCI Reboot on the ONU.
8. Check on the ONU that it is rebooting if that information is available on the ONU interface.
9. Wait for the OLT to signal that the ONU is operational and for the configured service to resume, or for a maximum of 10 minutes.
10. Wait 20 seconds.
11. Stop injecting traffic at the U-interface and the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6, upstream frames from stream Aus are received from the V-interface.
2. At step 6, downstream frames from stream Ads are received from the U-interface.
3. At step 7, If the optional PON Analyzer is being used, it MUST report that the OLT has sent an OMCI Reboot on the ONU.
4. At step 7, If the optional PON Analyzer is being used, it MUST report that the ONU has not sent a Dying Gasp following the OMCI Reboot command.
5. At step 7, no Dying Gasp from the ONU is reported by the OLT.
6. At step 8, if the information is available, the ONU must report that it is rebooting.
7. Between step 7 and 10, the Ethernet traffic generator must report that traffic has stopped in both directions, then resumed.
8. At step 10, upstream frames from stream Aus are received from the V-interface.
9. At step 10, downstream frames from stream Ads are received from the U-interface.

Remarks:

- None

6.10 Alarms

6.10.1 Alarms Synchronization

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- Appendix 1

Test Objective:

- The purpose of this test is to verify firstly that the ONU can send an alarm to the OLT in case of trouble and that the OLT is detecting it. Then the second part of the test case will verify that after a fiber disconnection and reconnection or an electrical power off of the ONU, alarms synchronization between OLT and ONU is performed.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. OLT and ONU are powered and connected to ODN.
2. ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

1. A bidirectional GEM port between the ONU and the OLT has been created using OMCI flows.
2. Ethernet traffic generator is connected with the ONU and Ethernet port of the ONU is up. No need of Ethernet traffic.

Test Procedure:

1. Cause an ONU OMCI alarm via an external stimulus (for example by disconnecting the Ethernet cable from an ONU's Ethernet UNI).
2. Verify that the OLT detects the relevant alarm.
3. Solve the OMCI alarm via an external stimulus (for example by connecting back the Ethernet cable from the ONU's Ethernet UNI).
4. Verify that the OLT detects the alarm recovery.
5. Disconnect the optical fiber.
6. Cause an ONU OMCI alarm via an external stimulus (for example by disconnecting the Ethernet cable from an ONU's Ethernet UNI).
7. Connect back the optical fiber.
8. When the ONU is up verify that the OLT detects the alarm.

9. Power off the ONU.
10. Solve the OMCI alarm via an external stimulus (for example by connecting back the Ethernet cable from the ONU's Ethernet UNI).
11. Power on the ONU.
12. When the ONU is up, verify that the OLT detects the alarm recovery.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 2, the OLT detects the alarm.
2. At step 4, the OLT detects the alarm recovery.
3. At step 8, the OLT detects the alarm after a fiber re-connection.
4. At step 12, the OLT detects the alarm recovery after an electrical reboot.

Remarks:

- None

6.10.2 ONU Electrical Reboot

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-280 [10]

For Reference:

ITU-T G.988 Appendix I [7]

BBF TR-280 [10]

- **R-44:** The ONU MUST send a Dying Gasp alarm in response to electrical disconnection and OLT MUST report it.

Test Objective:

- Verify that the ONU can send a Dying Gasp in response to electrical disconnection, that the OLT reports it, and that OLT/ONU resume their functions after electrical reconnection of the ONU.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the OLT/ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 1 flow of single-tagged Ethernet frames in both directions with the parameters provided in the next tables.

255i2 Table 6.10.2-1: Test 6.10.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any

255i2 Table 6.10.2-2: Test 6.10.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any

Test Procedure:

1. Select distinct random values for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 and SPbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
5. Start injecting traffic at the U-interface and the V-interface as defined in the traffic tables.
6. Wait for 20 seconds.
7. Cause an electrical disconnection at the ONU power socket.
8. Wait for the OLT to report the Dying Gasp, for a maximum of 5 minutes.
9. Connect back the ONU power socket and wait, for a maximum of 10 minutes, until the ONU is activated again by the OLT and operational.
10. Wait 20 seconds.
11. If a power button is available on the ONU, manually power off the ONU using the power button.
12. If a power button is available on the ONU, wait for the OLT to report the Dying Gasp, for a maximum of 5 minutes.
13. If a power button is available on the ONU, manually power on the ONU using the power button and wait, for a maximum of 10 minutes, until the ONU is activated again by the OLT and operational.
14. Wait 20 seconds.
15. Stop injecting traffic at the U-interface and the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6, upstream frames from stream Aus are received from the V-interface.
2. At step 6, downstream frames from stream Ads are received from the U-interface.
3. At step 7, if the optional PON Analyzer is being used, it MUST report that the ONU has emitted a Dying Gasp.
4. At step 8, the OLT reports the ONU has emitted a Dying Gasp.
5. At step 9, the ONU becomes operational and is reported as such by the OLT.
6. Between Step 7 and 10, the Ethernet traffic generator must report that traffic has stopped in both directions, then resumed.
7. If a power button is available on the ONU, at Step 11, if the optional PON Analyzer is being used, it MUST report that the ONU has emitted a Dying Gasp.
8. If a power button is available on the ONU, at Step 12 the OLT reports the ONU has emitted a Dying Gasp.
9. If a power button is available on the ONU, at Step 13, the ONU becomes operational and is reported as such by the OLT.
10. If a power button is available on the ONU, between Step 11 and 14, the Ethernet traffic generator must report that traffic has stopped in both directions, then resumed.

Remarks:

- None

6.10.3 Lower Optical Thresholds Setting and Alarm Generation

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

BBF TR-280 [10]

- **R-25c:** The OLT MUST support receiving alarm notifications sent by the ONU.
- **R-25e:** The ONU MUST support generating and sending alarms to the OLT.
- **R-43:** The OLT MUST be able to configure optical threshold via OMCI (ANI-G ME in clause 9.2.1/ITU-T G.988) at the ONU. The ONU MUST be able to configure optical threshold and send alarms (via OMCI) when thresholds are reached for:
 - Low received optical power
 - High received optical power
 - Low transmit optical power
 - High transmit optical power

Test Objective:

- Verify that the OLT/ONU can configure optical thresholds and report optical alarms accordingly.

Test Setup:

- Figure 6-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Enter the configuration commands on the OLT to set the ANI-G ME “Lower optical threshold” attribute to 0 dBm.
2. Enter the configuration commands on the OLT to set the ANI-G ME “Lower transmit power threshold” to 63 dBm.
3. Enter the configuration commands on the OLT to set the ANI-G ME “Upper optical threshold” attribute to 0 dBm.
4. Enter the configuration commands on the OLT to set the ANI-G ME “Upper transmit power threshold” to 63 dBm.

Test Procedure:

1. Wait up to 1 minute for alarms “Low received optical power” and “Low transmit optical power” on the ONU to be signaled by the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the alarm “Low received optical power” on the ONU is signaled by the OLT.

2. At step 1, the alarm “Low transmit optical power” on the ONU is signaled by the OLT.
3. At step 1, no “High received optical power” on the ONU is signaled by the OLT.
4. At step 1, no “High transmit optical power” on the ONU is signaled by the OLT.

Remarks:

- None

6.10.4 Upper Optical Thresholds Setting and Alarm Generation

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

BBF TR-280 [10]

- **R-25c:** The OLT MUST support receiving alarm notifications sent by the ONU.
- **R-25e:** The ONU MUST support generating and sending alarms to the OLT.
- **R-43:** The OLT MUST be able to configure optical threshold via OMCI (ANI-G ME in clause 9.2.1/ITU-T G.988) at the ONU. The ONU MUST be able to configure optical threshold and send alarms (via OMCI) when thresholds are reached for:
 - Low received optical power
 - High received optical power
 - Low transmit optical power
 - High transmit optical power

Test Objective:

- Verify that the OLT/ONU can configure optical thresholds and report optical alarms accordingly.

Test Setup:

- Figure 6-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

1. Enter the configuration commands on the OLT to set the ANI-G ME “Upper optical threshold” attribute to -127 dBm.
2. Enter the configuration commands on the OLT to set the ANI-G ME “Upper transmit power threshold” to 0 dBm
3. Enter the configuration commands on the OLT to set the ANI-G ME “Lower optical threshold” attribute to -127 dBm.
4. Enter the configuration commands on the OLT to set the ANI-G ME “Lower transmit power threshold” to 0 dBm.

Test Procedure:

1. Wait up to 1 minute for alarms “High received optical power” and “High transmit optical power” on the ONU to be signaled by the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the alarm “High received optical power” on the ONU is signaled by the OLT.

2. At step 1, the alarm “High transmit optical power” on the ONU is signaled by the OLT.
3. At step 1, no “Low received optical power” on the ONU is signaled by the OLT.
4. At step 1, no “Low transmit optical power” on the ONU is signaled by the OLT.

Remarks:

- None

6.11 Software Download

6.11.1 Software Download, Valid Image

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- Appendix 1

Test Objective:

- The purpose of this test is to verify that the OLT can upgrade ONU software.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. OLT and ONU under test are powered and connected to ODN.
2. ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

1. ONU vendor has provided valid software image to use in testing.

Test Procedure:

1. Initiate a software download process from the OLT.
2. After correct software download, Activate the new software of the ONU.
3. Once the ONU has loaded and executed the new image as per the Activation process, and has reached the Operational state, the new software is active and “up and running”.
4. Commit the now active software instance of the ONU.
5. Reboot the ONU.
6. Once the ONU has booted up and has reached Operational state, verify again that the new software is active and “up and running”.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the OLT reports successful software download.

2. At step 3, the OLT can send active software and the ONU activates software.
3. At step 4, the OLT can send commit software and the ONU commits software.
4. At step 6, the ONU boots in the committed software.

Remarks:

- None

6.11.2 Software Download, Corrupt Image

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- Appendix 1

Test Objective:

- The purpose of this test is to verify an OLT and ONT will continue to operate in the event a corrupt software image is loaded to the ONT (the ONT should fall back to the alternate software image).

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. OLT and ONU under test are powered and connected to ODN.
2. ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

1. ONU vendor has provided valid software image to use in testing.
2. The ONU/OLT have previously passed test, "Software Download, Valid Image."
3. The ONU software image has been modified in such a way to "corrupt" at least 4 bytes, distributed throughout the image.

Test Procedure:

1. Use the OLT to view and record the current software information reported for the ONU. This information may include, but is not limited or required, the software version or name, the software image instance (0 or 1, a or b, etc.), active/inactive, valid/invalid, committed/uncommitted, etc.
2. If the OLT lists the active and/or committed state of each software instance, verify the active instance is listed as committed and valid.
3. Initiate a software download process from the OLT to download the corrupted image file to the ONU.
4. Once the software download has completed, use the OLT to view the active/committed/valid state of each software instance in the ONT.
 - If the newly downloaded software image is listed as valid, request the ONU activate the new software image.
 - If the newly downloaded software image is listed as invalid, skip to step 7.
5. After software download, request the ONU activate the new software image.
6. Allow the ONU several minutes to attempt to boot the new software image and re-range with the OLT.
7. If the OLT lists the active and/or committed state of each software instance, verify the original instance/version is still active and committed.

8. If the OLT lists the valid/invalid state of each software instance, verify the second image is listed as invalid.
9. Reboot the ONU and allow it to re-range with the OLT.
10. Verify the ONU is still able to boot the original image and range with the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 2, if supported by the OLT, at least one software instance must be listed as committed, active, and valid .
2. At step 6, the ONU must be able to re-range with the OLT once requested to activate the corrupted software image, without human interaction. This process may require the ONU to autonomously reboot multiple times to attempt to boot the new software image.
3. At step 8, if supported by the OLT, verify the newly downloaded software image is listed as invalid .
4. At step 10, the ONU must reboot in the original software version automatically.

Remarks:

- Some OLT equipment requires specific ONU software versions to be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-grain control over the active/committed state of each software instance.

6.11.3 Switch Active Software Instance

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- Appendix 1

Test Objective:

- The purpose of this test is to verify an OLT can cause the ONT to switch its active software instance when two valid images are present.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. OLT and ONU under test are powered and connected to ODN.
2. ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

1. ONU vendor has provided valid software image to use in testing.
2. The ONU/OLT have previously passed test, "Software Download, Valid Image."
3. The ONU currently contains two valid software images.

Test Procedure:

1. Use the OLT to view and record the current software information reported for the ONU. This information may include, but is not limited or required, the software version or name, the software image instance (0 or 1, a or b, etc.), active/inactive, valid/invalid, committed/uncommitted, etc.
2. If the OLT lists the active and/or committed state of each software instance, verify the active instance is listed as committed and valid.
3. Use the OLT to request the ONU activate the non-active software instance.
4. Allow the ONU several minutes to attempt to boot the new software image and re-range with the OLT.
5. If the OLT lists the active and/or committed state of each software instance, verify the original instance/version is no longer active but is still listed as committed.
6. Reboot the ONU and allow it to re-range with the OLT.
7. Verify the ONU is still able to boot the original image and ranges with the OLT.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 2, if supported by the OLT, at least one software instance must be listed as committed, active, and valid .
2. At step 4, the ONU must be able to re-range with the OLT once the activate software image has completed, without human interaction. This process may require the ONU to autonomously reboot to attempt to boot the new software image.
3. At step 5, if supported by the OLT, verify the second software image is listed as active and the first software image is listed as committed (first and second do not imply specific instance numbers).
4. At step 7, the ONU must reboot in the original software version automatically.

Remarks:

- Some OLT equipment requires specific ONU software versions to be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-grain control over the active/committed state of each software instance.

6.11.4 Switch Committed Software Instance

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

- Appendix 1

Test Objective:

- The purpose of this test is to verify an OLT can cause the ONU to switch its committed software instance when two valid images are present.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing
 - Note: The Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. OLT and ONU under test are powered and connected to ODN.
2. ONU has been activated by the OLT, ranged, and a GEM port for OMCI has been created as a result of ONU-ID assignment.

Test Configuration:

1. ONU vendor has provided valid software image to use in testing.
2. The ONU/OLT have previously passed test, "Software Download, Valid Image."
3. The ONU currently contains two valid software images.

Test Procedure:

1. Use the OLT to view and record the current software information reported for the ONU. This information may include, but is not limited or required, the software version or name, the software image instance (0 or 1, a or b, etc.), active/inactive, valid/invalid, committed/uncommitted, etc.
2. If the OLT lists the active and/or committed state of each software instance, verify the active instance is listed as committed and valid.
3. Use the OLT to request the ONU activate the non-active software instance.
4. Allow the ONU several minutes to attempt to boot the new software image and re-range with the OLT.
5. If the OLT lists the active and/or committed state of each software instance, verify the original instance/version is no longer active but is still listed as committed.
6. Use the OLT to request the ONU commit the now active software instance.
7. Reboot the ONU and allow it to re-range with the OLT.
8. Verify the ONU now boots the newly committed image and ranges with the OLT.

9. If the OLT lists the active and/or committed state of each software instance, verify the original instance/version is no longer listed as active or committed.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 2, if supported by the OLT, at least one software instance must be listed as committed, active, and valid.
2. At step 4, the ONU must be able to re-range with the OLT once the activate software image has completed, without human interaction. This process may require the ONU to autonomously reboot to attempt to boot the new software image.
3. At step 5, if supported by the OLT, verify the second software image is listed as active and the first software image is listed as committed (first and second do not imply specific instance numbers).
4. At step 8, the ONU must reboot in the newly committed software version automatically.
5. If supported by the OLT, verify the second software image is listed as active and committed.

Remarks:

- Some OLT equipment requires specific ONU software versions to be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-grain control over the active/committed state of each software instance.

6.12 Performance Monitoring and Parameter Reporting

6.12.1 Performance Monitoring on Ethernet Frames

Test Status: Conditionally Mandatory

This test is not applicable for multi-managed ONUs and is Mandatory for all other ONU types.

Reference Documents:

- BBF TR-280 [10]

For Reference:

BBF TR-280 [10]

- **R-25a:** The OLT MUST support the configuration and retrieval of OMCI-based performance monitoring counters on the ONU.
- **R-25b:** The ONU MUST support the configuration and reporting of OMCI-based performance monitoring counters on the request of the OLT.
- **R-27:** The ONU must collect and report the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information:
 - Received frames
 - Sent frames
 - Dropped received upstream frames due to MAC layer CRC errors
 - Received multicast frames
 - Sent multicast frames
- **R-31a:** The OLT and the ONU MUST support Ethernet frame extended PM ME for the following:
 - Physical path termination point Ethernet UNI ME (when it represents an actual physical interface, not a virtual interface as defined in [R-68])
 - GEM interworking termination point ME
 - Multicast GEM interworking termination point MEand based on any arbitrary combination of:
 - All frames received
 - Frames matching on arbitrary combination of VID+P-bit
 - Frames matching VID
 - Frames matching P-bit
- **R-36:** The OLT/ONU MUST be able to configure, collect, and report on the counters specified in [R-37] to [R-40] and [R-54] to [R-56].
- **R-37:** The ONU MUST collect and report in the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information per GEM port for upstream traffic based on:
 - All frames received
 - Frames matching an arbitrary combination of VID+P-bit
 - Frames matching P-bit
 - Frames matching VID

- **R-38:** The ONU MUST have Ethernet counters per U interface for upstream traffic based on:
 - Total traffic
 - VID
 - P-bit
 - VID+P-bit
- **R-39:** The ONU MUST collect and report in the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information per GEM port for downstream traffic based on:
 - All frames received
 - Frames matching an arbitrary combination of VID+P-bit
 - Frames matching P-bit
 - Frames matching VID
- **R-40:** The ONU MUST have Ethernet counters per U interface for downstream based on:
 - Total traffic
 - VID
 - P-bit
 - VID+P-bit
- **R-84:** The ONU MUST support that counters belonging to Ethernet Frame Extended PM ME instances with a matching criterion be incremented for one of the following scenarios: (all frames and VID) or (all frames and VID+P-bit) or (all frames and P-bit).
Note: An OLT may create two or more Extended PM ME instances on a monitoring point: one Extended PM ME instance to count all received frames without regard to VID or P-bit, other Extended PM ME instances to filter the collected PM data based on the matching VID, or P-bit, or VID + P-bit. If a received Ethernet frame matches the specific filtering criteria defined in one of the other Extended PM ME instances, the ONU needs to increment the corresponding counters in the Extended PM ME instance with the matching filtering criteria, and in the Extended PM ME instance that counts all received frames.
- **R-85:** The OLT MUST support the instantiation of at least 16 Ethernet Frame Extended PM Managed Entity instances when the ONU is provisioned.
Note: The use case that explains the 16 Extended PM ME instances is the following. Consider an ONU that has 4 bidirectional traffic flows and 4 GEM ports, each traffic flow corresponds to a traffic class (as per [R-46] in TR-156 [17]), and one GEM port per traffic class (as per [R-7] in TR-156 [17]). Such ONU is required to support:
 - 8 Extended PM ME instances on the U-interface (i.e., 1 ME instance per traffic class per upstream/downstream direction).
 - 8 Extended PM ME instances on the R/S interface (i.e., 1 ME instance per GEM port per upstream/downstream direction).
- **R-86:** The ONU MUST support the instantiation of at least 16 Ethernet Frame Extended PM Managed Entity instances.

Test Objective:

- To verify the ONU/OLT combination is able to monitor Ethernet traffic on the U interface and GEM ports for both directions.
- To verify that counters can be assigned per VLAN ID and/or P-bit.
- To verify that counters per frame are provided.
- To verify that the ONU/OLT supports the instantiation of 16 Ethernet Frame Extended PM MEs

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to let S-tagged frame through. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

The OLT/ONU must be provisioned with:

- 3 traffic classes (i.e., P-bit mapping)
- 1 bidirectional GEM Port per traffic class.

The Ethernet Traffic Generator will be configured to transmit 4 flows of single-tagged unicast Ethernet frames in both directions with the parameters provided in the next tables:

255i2 Table 6.12.1-1: Test 6.12.1 Upstream Unicast Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit1	Any	VID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	Any
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit2	Any	VID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	Any
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit1	Any	VID2	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID2	Any
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit3	Any	VID3	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID3	Any

255i2 Table 6.12.1-2: Test 6.12.1 Downstream Unicast Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit1	Any	VID1	Any
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit2	Any	VID1	Any
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit2	Any	VID2	Any
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	Any	VID4	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit3	Any	VID4	Any

Test Procedure:

1. Select distinct random values for VID1 through VID4 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 through Pbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to cause the configuration described above to be activated on the ONU.

5. Enter the configuration commands on the OLT to cause the creation of Ethernet Frame Extended PM MEs for:
 - PPTP ME for upstream traffic
 - PPTP ME for upstream traffic VID1+Pbit1
 - PPTP ME for upstream traffic VID1+Pbit2
 - PPTP ME for upstream traffic VID2
 - PPTP ME for upstream traffic Pbit3
 - PPTP ME for downstream traffic
 - PPTP ME for downstream traffic VID1+Pbit1
 - PPTP ME for downstream traffic VID1+Pbit2
 - PPTP ME for downstream traffic VID2
 - PPTP ME for downstream traffic Pbit3
 - GEM interworking termination point ME for upstream traffic (one for each GEM port)
 - GEM interworking termination point ME for downstream traffic (one for each GEM port)
6. Enter the commands at the OLT to retrieve all the counters listed in requirement TR-280 [10] R-27.
7. Enter the commands at the OLT to cause the ONU to clear all the counters listed in requirement TR-280 [10] R-27.
8. Enter the commands at the OLT to retrieve all the ONU counters listed in requirement TR-280 [10] R-27.
9. Enable any frame capture mechanisms on the Ethernet Traffic Generator.
10. Cause the Traffic Generator to send 10 000 packets for each flow, upstream and downstream, as defined in Test Configuration.
11. Enter the commands at the OLT to retrieve all the counters listed in requirement TR-280 [10] R-27.
12. Enter the commands at the OLT to cause the ONU to clear all the counters listed in requirement TR-280 [10] R-27.
13. Enter the commands at the OLT to retrieve all the counters listed in requirement TR-280 [10] R-27.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 9, the OLT is able to retrieve all counters.
2. At step 8, the OLT is able to retrieve all counters and all counters values are zeroed.
3. At step 10, all flows are correctly received from the U and V interface.
4. At step 11, the OLT is able to retrieve all counters.
5. At step 11, all Frame counters are incremented correctly based on their matching criteria.
6. At step 11, no Multicast frame counter is incremented.
7. At step 13, the OLT is able to retrieve all counters and all counters values are zeroed.

Remarks:

- None

6.12.2 Performance Monitoring on Multicast Ethernet Frames

Test Status: Conditionally Mandatory

This test is not applicable for multi-managed ONUs and is Mandatory for all other ONU types.

Reference Documents:

- BBF TR-280 [10]

For Reference:

BBF TR-280 [10]

- **R-25a:** The OLT MUST support the configuration and retrieval of OMCI-based performance monitoring counters on the ONU.
- **R-25b:** The ONU MUST support the configuration and reporting of OMCI-based performance monitoring counters on the request of the OLT.
- **R-27:** The ONU MUST collect and report the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information:
 - Received frames
 - Sent frames
 - Dropped received upstream frames due to MAC layer CRC errors
 - Received multicast frames
 - Sent multicast frames
- **R-31a:** The OLT and the ONU MUST support Ethernet frame extended PM ME for the following:
 - Physical path termination point Ethernet UNI ME (when it represents an actual physical interface, not a virtual interface as defined in [R-68])
 - GEM interworking termination point ME
 - Multicast GEM interworking termination point MEand in upstream and downstream direction for the monitored point:
 - All frames received
 - Frames matching on an arbitrary combination of VID+P-bit
 - Frames matching VID
 - Frames matching P-bit
- **R-36:** The OLT/ONU MUST be able to configure, collect, and report on the counters specified in [R-37] to [R-40] and [R-54] to [R-56].
- **R-37:** The ONU MUST collect and report in the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information per GEM port for upstream traffic based on:
 - All frames received
 - Frames matching an arbitrary combination of VID+P-bit
 - Frames matching P-bit
 - Frames matching VID
- **R-38:** The ONU MUST have Ethernet counters per U interface for upstream traffic based on:
 - Total traffic
 - VID

- P-bit
- VID+P-bit
- **R-39:** The ONU MUST collect and report in the following Ethernet frame extended PM ME (32 bit) (clause 9.3.32/ITU-T G.988) information per GEM port for downstream traffic based on:
 - All frames received
 - Frames matching an arbitrary combination of VID+P-bit
 - Frames matching P-bit
 - Frames matching VID
- **R-40:** The ONU MUST have Ethernet counters per U interface for downstream based on:
 - Total traffic
 - VID
 - P-bit
 - VID+P-bit
- **R-84:** The ONU MUST support that counters belonging to Ethernet Frame Extended PM ME instances with a matching criterion be incremented for one of the following scenarios: (all frames and VID) or (all frames and VID+P-bit) or (all frames and P-bit).
Note: An OLT may create two or more Extended PM ME instances on a monitoring point: one Extended PM ME instance to count all received frames without regard to VID or P-bit, other Extended PM ME instances to filter the collected PM data based on the matching VID, or P-bit, or VID + P-bit. If a received Ethernet frame matches the specific filtering criteria defined in one of the other Extended PM ME instances, the ONU needs to increment the corresponding counters in the Extended PM ME instance with the matching filtering criteria, and in the Extended PM ME instance that counts all received frames.
- **R-85:** The OLT MUST support the instantiation of at least 16 Ethernet Frame Extended PM Managed Entity instances when the ONU is provisioned.
Note: The use case that explains the 16 Extended PM ME instances is the following. Consider an ONU that has 4 bidirectional traffic flows and 4 GEM ports, each traffic flow corresponds to a traffic class (as per [R-46] in TR-156 [17]), and one GEM port per traffic class (as per [R-7] in TR-156 [17]). Such ONU is required to support:
 - 8 Extended PM ME instances on the U-interface (i.e., 1 ME instance per traffic class per upstream/downstream direction).
 - 8 Extended PM ME instances on the R/S interface (i.e., 1 ME instance per GEM port per upstream/downstream direction).
- **R-86:** The ONU MUST support the instantiation of at least 16 Ethernet Frame Extended PM Managed Entity instances.

Test Objective:

- To verify the ONU/OLT combination is able to monitor multicast & generic traffic on Ethernet frames on the U interface and on the Multicast GEM port.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 11. The ONU must be configured to let S-tagged frame through. In the downstream direction, the ONU must perform the reverse operation. The OLT must be configured for VBES operation, supporting passing of the S-tag in the upstream/downstream directions.

The ONU must be provisioned with:

- A bidirectional GEM port between the ONU under test U-interface and the OLT for Unicast traffic and IGMP messages.
- A multicast GEM port between the ONU under test and the OLT for multicast Ethernet frames.

The ONU must be provisioned to allow the UNI to join Multicast Group Ch1 and Ch2 defined below.

The Ethernet Traffic Generator will be configured to transmit 2 flows of single-tagged unicast Ethernet frames in both directions with the parameters provided in the next tables:

255i2 Table 6.12.2-1: Test 6.12.2 Upstream Unicast Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit1	Any	VID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	Any
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88A8	Pbit2	Any	VID2	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	Any

255i2 Table 6.12.2-2: Test 6.12.2 Downstream Unicast Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit1	Any	VID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit1	Any	VID1	Any
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit2	Any	VID2	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88A8	Pbit2	Any	VID2	Any

The Ethernet Traffic Generator must be configured to transmit the downstream multicast Ethernet frames as defined below:

255i2 Table 6.12.2-3: Test 6.12.2 Downstream Multicast Frames

Channel	Multicast source IP address	Multicast IP group address	Multicast MAC group address	VID
Ch1	IP-S1	IP-G1	MAC-G1	VID1
Ch2	IP-S2	IP-G2	MAC-G2	VID2

The Ethernet Traffic Generator must be configured to transmit the following upstream IGMPv2 messages:

255i2 Table 6.12.2-4: Test 6.12.2 Upstream IGMPv2 Messages

Source IP Address	Source MAC address	Multicast group address	VID	P-bit
Ads	IP-S1	IP-G1	VID1	Pbit1
Bds	IP-S2	IP-G2	VID2	Pbit2

Test Procedure:

1. Select distinct random values for VID1 and VID2 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for Pbit1 and Pbit2 between 0 and 7.
4. Select distinct random values for IP group addresses: IP-G1, IP-G2.
5. Use associated multicast MAC addresses: MAC-G1, MAC-G2.
6. Select distinct random values for IP addresses: IP-S1, IP-S2.
7. Enter the configuration commands on the OLT to cause the configuration described above to be activated on the ONU.
8. Enter the configuration commands on the OLT to cause the creation of Ethernet Frame Extended PM MEs for:
 - PPTP ME for upstream traffic
 - PPTP ME for upstream traffic SVID1 and Pbit1
 - PPTP ME for upstream traffic SVID2 and Pbit2
 - PPTP ME for downstream traffic
 - PPTP ME for downstream traffic SVID1 and Pbit1
 - PPTP ME for downstream traffic SVID2 and Pbit2
 - GEM interworking termination point ME for upstream traffic
 - GEM interworking termination point ME for downstream traffic
 - Multicast GEM interworking termination point ME for downstream traffic
9. Enter the commands at the OLT to retrieve all the counters.
10. Cause the Ethernet Traffic Generator to send an IGMP Join on Channel Ch1.
11. Enter the commands at the OLT to cause the ONU to clear all the counters.
12. Enter the commands at the OLT to retrieve all the counters.
13. Enable any frame capture mechanisms on the Ethernet Traffic Generator.
14. Cause the Ethernet Traffic Generator to send 10 000 packets for the downstream multicast flows defined in the configuration.
15. Enter the commands at the OLT to retrieve all the counters.
16. Cause the Ethernet Traffic Generator to send an IGMP Join on Channel Ch2.
17. Enter the commands at the OLT to cause the ONU to clear all the counters.
18. Cause the Ethernet Traffic Generator to send 10 000 packets for the downstream multicast flows defined in the configuration.
19. Enter the commands at the OLT to retrieve all the counters.
20. Enter the commands at the OLT to cause the ONU to clear all the counters.
21. Cause the Ethernet Traffic Generator to send 100 upstream IGMPv2 messages for each flow as defined in Test Configuration.
22. Enter the commands at the OLT to retrieve all the counters.
23. Enter the commands at the OLT to cause the ONU to clear all the counters.

24. Cause the Ethernet Traffic Generator to send 10 000 packets for each unicast flow (A and B), upstream and downstream, as defined the configuration.
25. Enter the commands at the OLT to retrieve all the counters.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 9, the OLT is able to retrieve all counters.
2. At step 12, the OLT is able to retrieve all counters and all counters values are zeroed.
3. At step 14, all downstream multicast frames for Channel1 are received from the U-interface.
4. At step 15, the OLT is able to retrieve all counters and only the Frames and Multicast frames counters associated to the following MEs are incremented (all other ONU Frames and Multicast Frames counters must be zero):
 - Multicast GEM interworking termination point ME for downstream traffic, by 20 000.
 - PPTP ME for downstream traffic, by 10 000.
 - PPTP ME for downstream traffic VID1 and Pbit1, by 10 000.
5. At step 17, the OLT is able to retrieve all counters and all counters values are zeroed.
6. At step 18 all downstream multicast frames are received from the U-interface
7. At step 19, the OLT is able to retrieve all counters and only the Frames and Multicast frames counters associated to the following MEs are incremented (all other ONU Frames and Multicast counters must be zero):
 - Multicast GEM interworking termination point ME for downstream traffic, by 20 000.
 - PPTP ME for downstream traffic, by 20 000.
 - PPTP ME for downstream traffic VID1 and Pbit1, by 10 000.
 - PPTP ME for downstream traffic VID2 and Pbit2, by 10 000.
8. At step 20, the OLT is able to retrieve all counters and all counters values are zeroed.
9. At step 22, the OLT is able to retrieve all counters and only the Frames and Multicast frames counters associated to the following MEs are incremented (all other ONU Frame and Multicast Frames counters must be zero):
 - PPTP ME for upstream traffic by 200
 - PPTP ME for upstream traffic VID1 and Pbit1 by 100
 - PPTP ME for upstream traffic VID2 and Pbit2 by 100
 - GEM interworking termination point ME for upstream traffic by 200
10. At step 23, the OLT is able to retrieve all counters and all counters values are zeroed.
11. At step 24, flow A and B are received from interface U (downstream) and V (upstream)
12. At step 25, the OLT is able to retrieve all counters and only the Frames counters associated to the following MEs are incremented (all other ONU Frames and Multicast Frames counters must be zero):
 - PPTP ME for upstream traffic by 20 000
 - PPTP ME for upstream traffic VID1 and Pbit1 by 10 000
 - PPTP ME for upstream traffic VID2 and Pbit2 by 10 000
 - PPTP ME for downstream traffic by 20 000
 - PPTP ME for downstream traffic VID1 and Pbit1 by 10 000
 - PPTP ME for downstream traffic VID2 and Pbit2 by 10 000

- GEM interworking termination point ME for upstream traffic by 20 000
- GEM interworking termination point ME for downstream traffic by 20 000

Remarks:

- None

6.12.3 Optical Parameters Reporting

Test Status: Mandatory

Reference Documents:

- ITU-T G.988 [7]

For Reference:

BBF TR-280 [10]

- **R-41:** The ONU/OLT MUST measure, collect, and report the following information in ANI-G ME in clause 9.2.1/ITU-T G.988:
 - ONU temperature
 - ONU Voltage
 - ONU bias Current
 - ONU transmitted optical power
 - ONU received optical power

Test Objective:

- Verify that the OLT/ONU can report optical levels as defined in requirement TR-280 [10] R-41.

Test Setup:

- Figure 6-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

- None

Test Procedure:

1. Enter the commands on the OLT to retrieve the Optical parameters (Rx power attribute “Optical signal level”, Tx power) defined in the ANI-G ME.
2. Enter the commands on the OLT to test and record the “test result” for the Optical parameters (Rx or “received optical power”, Tx or “Mean optical launch power”, I_{bias} or “Laser Bias Current, V_{bias} or “power feed voltage”, Temperature) defined in the ANI-G ME

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 1, the OLT can retrieve the listed optical parameters.
2. At step 2, the OLT can launch the Optical parameters tests and retrieve the results.

3. At step 2, the values obtained for “received optical power” and “Mean optical launch power” are within +/-6dB of each other, as per the relevant standard, of the corresponding values obtained at step 1.

Remarks:

- None

6.13 Enhanced Functionalities

6.13.1 Create, Delete, and Add New Services

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.

BBF TR-280 [10]

- **R-90:** The ONU MUST support traffic class deletion (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-91:** The ONU MUST support the deletion of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes.
- **R-92:** The ONU MUST support traffic class addition (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-93:** The ONU MUST support the addition of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes when the addition does not cause any congestion in the ONU.

Test Objective:

- Verify that the ONU/OLT is able to create, delete, and add new services.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the Q-tagged frames into S-tagged frames. In the downstream direction, the ONU must perform the reverse operation. The OLT/ONU must discard frames with unmatching VID in the downstream direction. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 3 flows of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes are also provided.

255i2 Table 6.13.1-1: Test 6.13.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												Traffic class
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1
Bus	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	0x8100	CPbit2	Any	CVID2	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	2
Cus	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	0x8100	CPbit3	Any	CVID3	Any	MAC5	MAC6	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	3

255i2 Table 6.13.1-2: Test 6.13.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)														Traffic class
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type		
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID			
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	1	
Bds	MAC4	MAC3	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit2	Any	CVID2	Any	2	
Cds	MAC6	MAC5	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit3	Any	CVID3	Any	3	

Test Procedure:

1. Select distinct random values for CVID1 through CVID3 and SVID1 through SVID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 through CPbit3 and SPbit1 through SPbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support traffic classes 1 & 2 as defined in the traffic tables.
5. Inject and stop tagged traffic at the U-interface as defined in the upstream traffic tables.
6. Inject and stop tagged traffic at the V-interface as defined in the downstream traffic tables.
7. Enter the configuration commands on the OLT to delete support for traffic class 2 on the OLT & ONU.
8. Enter the configuration commands on the OLT to configure OLT & ONU to support traffic class 3 as defined in the traffic tables.
9. Inject and stop tagged traffic at the U-interface as defined in the upstream traffic tables.
10. Inject and stop tagged traffic at the V-interface as defined in the downstream traffic tables.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, all upstream frames from stream Aus and Bus are received from the V interface.
2. At step 5, no frames from stream Cus are received from the V interface.
3. At step 6, all downstream frames from stream Ads and Bds are received from the U interface.
4. At step 6, no frames from stream Cds are received from the U interface.

5. At step 9, all upstream frames from stream Aus and Cus are received from the V interface.
6. At step 9, no frames from stream Bus are received from the V interface.
7. At step 10, all downstream frames from stream Ads and Cds are received from the U interface.
8. At step 10, no frames from stream Bds are received from the U interface.

Remarks:

- None

6.13.2 Create and Modify Configuration

Test Status: Mandatory

Reference Documents:

- BBF TR-280 [10]

For Reference:

BBF TR-280 [10]

- **R-90:** The ONU MUST support traffic class deletion (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-91:** The ONU MUST support the deletion of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes.
- **R-92:** The ONU MUST support traffic class addition (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-93:** The ONU MUST support the addition of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes when the addition does not cause any congestion in the ONU.

Test Objective:

- Verify that the ONU/OLT are able to create then modify a service.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the ONU must perform the reverse operation. The OLT/ONU must discard downstream frames with unmatching VID. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 2 flows of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes are also indicated.

255i2 Table 6.13.2-1: Test 6.13.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												Traffic class
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID		
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1
Bus	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID2	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	2

255i2 Table 6.13.2-2: Test 6.13.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)											Traffic class		
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI			VID
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	1
Bds	MAC4	MAC3	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit2	N/A	CVID2	Any	2

Test Procedure:

1. Select distinct random values for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC4, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 and SPbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration corresponding to Traffic class 1 as described above.
5. Start injecting traffic at the U-interface as defined in the upstream traffic tables for Traffic classes 1 & 2, at a rate below the throughput limits defined for the configured service.
6. Stop injecting traffic at the U-interface.
7. Start injecting traffic at the V-interface as defined in the downstream traffic tables for Traffic classes 1 & 2 at a rate below the throughput limits defined for the configured service.
8. Stop injecting traffic at the V-interface.
9. Enter the configuration commands on the OLT to configure OLT & ONU remove support for Traffic class 1 and to add support for the VLAN configuration corresponding to Traffic class 2 as described above.
10. Start injecting traffic at the U-interface as defined in the upstream traffic tables for Traffic classes 1 & 2, at a rate below the throughput limits defined for the configured service.
11. Stop injecting traffic at the U-interface.
12. Start injecting traffic at the V-interface as defined in the downstream traffic tables for Traffic classes 1 & 2 at a rate below the throughput limits defined for the configured service.
13. Stop injecting traffic at the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 6, all upstream frames from stream Aus are received from the V-interface as defined in 255i2 Table 6.13.2-1, and no frames from stream Bus are received.
2. At step 8, all downstream frames from stream Ads are received from the U-interface as defined in 255i2 Table 6.13.2-2, and no frames from stream Bds are received.
3. At step 11, all upstream frames from stream Bus are received from the V-interface as defined in 255i2 Table 6.13.2-1, and no frames from stream Aus are received.
4. At step 13, all downstream frames from stream Bds are received from the U-interface as defined in 255i2 Table 6.13.2-2, and no frames from stream Ads are received.

Remarks:

- None

6.13.3 Create, Delete, and Add New Services in Strict Priority Scheduling Context

Test Status: Mandatory

Reference Documents:

- BBF TR-156 [2]
- BBF TR-280 [10]

For Reference:

BBF TR-156 [2]

- **R-44:** The OLT MUST support the basic traffic descriptor parameters as specified in G.984.3 (7.4.4.3 Fixed, Assured, Max BW and type NA or BE). These parameters MUST be configurable.
- **R-46:** The OLT and ONU MUST support at least 4 traffic classes for Ethernet frames.
- **R-51:** The ONU MUST support mapping traffic into GEM Ports based on arbitrary combination of user port, VID and P-bit values in the upstream direction.
- **R-52:** The ONU MUST NOT prevent multiple P-bit values being used in the same VLAN.
- **R-53:** The ONU MUST NOT prevent multiple VLANs from using the same P-bits.
- **R-57:** In the upstream direction, the ONU MUST support at least 4 queues, one per traffic class.
- **R-59:** The OLT MUST support T-CONT types 1, 2, 3 and 4. Each T-CONT type MUST be able to use the full bandwidth available on the GPON.
- **R-63:** The OLT and ONU MUST support scheduling of downstream queues according to strict priority among at least 4 TCs.
- **R-67:** In the upstream direction, the ONU MUST support at least 4 T-CONTs, one per traffic class.
- **R-71:** The OLT MUST support assigning a TC to an upstream queue.

BBF TR-280 [10]

- **R-90:** The ONU MUST support traffic class deletion (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-91:** The ONU MUST support the deletion of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes.
- **R-92:** The ONU MUST support traffic class addition (traffic class as described in TR-156 Section 5) without causing any reboot, or MIB reset.
- **R-93:** The ONU MUST support the addition of a traffic class (traffic class as described in TR-156 Section 5) without causing any packet loss on existing traffic flows from other traffic classes when the addition does not cause any congestion in the ONU.

Test Objective:

- Verify that the ONU/OLT can create, delete, and add new services, and verify that strict priority is well applied.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the Q-tagged frames into S-tagged frames. In the downstream direction, the ONU must perform the reverse operation. The OLT/ONU must discard frames with unmatching VID in the downstream direction. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The OLT/ONU will be configured:

- To support 2 traffic classes, each one associated to specific(s) VID and p-bit value(s).
- With 2 upstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the two upstream queues.
- With an upstream bandwidth among all traffic classes serviced to a fixed rate which is much less than the U- interface capacity.
- With 2 downstream queues, each one assigned to one traffic class.
- With strict priority scheduling between the two downstream queues.

The sum of the upstream flow rates applied simultaneously onto the U-interface should be much less than the U-interface capacity and the overall throughput capacity of the ONU/OLT under test.

The Ethernet Traffic Generator will be configured to transmit 3 flows of single-tagged Ethernet frames in both directions with the parameters provided in the next tables. The traffic classes and priority levels, for downstream (the lower number the higher the priority), are also provided.

255i2 Table 6.13.3-1: Test 6.13.3 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)												Traffic class	Priority Level
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type		
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID			
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1
Bus	1	1	MAC3	MAC4	N/A	N/A	N/A	N/A	0x8100	CPbit2	Any	CVID2	Any	MAC3	MAC4	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	2	0
Cus	1	1	MAC5	MAC6	N/A	N/A	N/A	N/A	0x8100	CPbit3	Any	CVID3	Any	MAC5	MAC6	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	3	2

255i2 Table 6.13.3-2: Test 6.13.3 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)														Traffic class	Priority Level
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type			
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	Any	CVID1	Any	1	1	
Bds	MAC4	MAC3	N/A	N/A	N/A	N/A	0x88a8	SPbit2	Any	SVID2	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit2	Any	CVID2	Any	2	0	
Cds	MAC6	MAC5	N/A	N/A	N/A	N/A	0x88a8	SPbit3	Any	SVID3	Any	1	1	MAC4	MAC3	N/A	N/A	N/A	N/A	0x8100	CPbit3	Any	CVID3	Any	3	2	

Test Procedure:

1. Select distinct random values for CVID1 through CVID3 and SVID1 through SVID3 between 1 and 4094.
2. Select distinct random unicast values for MAC1 through MAC6, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 through CPbit3 and SPbit1 through SPbit3 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support traffic classes 1 & 2 as defined in the traffic tables.
5. Inject and stop tagged traffic at the U-interface as defined in the upstream traffic tables.
6. Inject and stop tagged traffic at the V-interface as defined in the downstream traffic tables.
7. Inject streams Ads and Bds at the V-interface at the same bit rate and with the total bit rate being below the maximum bandwidth available at the U-interface.
8. Gradually increase the rate of stream Bds until losses of frames for stream Ads are detected by the Traffic Generator at the U interface.
9. Inject streams Aus and Bus at the U-interface at the same bit rate and with the total bit rate below the maximum bandwidth available for the ONU.
10. Gradually increase the rate of stream Bus until losses of frames for stream Aus are detected by the Traffic Generator at the V interface.
11. Enter the configuration commands on the OLT to delete the service corresponding to traffic class 2.
12. Enter the configuration commands on the OLT to configure OLT & ONU support for traffic class 3 as defined in the traffic tables.
13. Inject and stop tagged traffic at the U-interface as defined in the upstream traffic tables.
14. Inject and stop tagged traffic at the V-interface as defined in the downstream traffic tables.
15. Inject streams Ads and Cds at the V-interface, at the same bit rate and with the total bit rate below the maximum bandwidth available at the U-interface.
16. Gradually increase the rate of stream Ads until losses of frames for stream Cds are detected by the Traffic Generator at the U interface.
17. Inject streams Aus and Cus at the U-interface, at the same bit rate and with the total bit rate below the maximum bandwidth available for the ONU.
18. Gradually increase the rate of stream Aus until losses of frames for stream Cus are detected by the Traffic Generator at the V interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, all upstream frames from stream Aus and Bus are received from the V interface.
2. At step 5, no frames from stream Cus are received from the V interface.

3. At step 6, all downstream frames from stream Ads and Bds are received from the U interface.
4. At step 6, no frames from stream Cds are received from the U interface.
5. At step 8, there is only loss for stream Ads.
6. At step 10, there is only loss for stream Aus.
7. At step 13, all upstream frames from stream Aus and Cus are received from the V interface.
8. At step 13, no frames from stream Bus are received from the V interface.
9. At step 14, all downstream frames from stream Ads and Cds are received from the U interface.
10. At step 14, no frames from stream Bds are received from the U interface.
11. At step 16, there is only loss from stream Cds.
12. At step 18, there is only loss from stream Cus.

Remarks:

- None

6.14 PON to Ethernet Adaptation

6.14.1 2000-Byte Frames Support

Test Status: Conditionally Mandatory.

This test is not applicable for TR-301 Model 2 Gfast DPU ONUs whose System Under Test does not support 2000-byte frames size and is Mandatory for all other ONU types.

Reference Documents:

- ITU-T G.988 [7]
- BBF TR-156 [2]

For Reference:

BBF TR-156 [2]

- **R-4:** The ONT and OLT MUST support frame sizes of 2000 bytes as per IEEE 802.3as.

Test Objective:

- Verify that the OLT/ONU support 2000-Byte Ethernet frames.

Test Setup:

- Figure 4-1: Basic Setup for Interoperability Testing

Pretest Conditions:

1. The ONU is powered and connected to the ODN as shown in Figure 4-1.
2. The ONU has been ranged and activated by the OLT, as a new ONU.

Test Configuration:

This test case implements/requires the operations defined in Table 6-1, under configuration number 3. The ONU must be configured to translate the incoming Q-tag into an S-tag in the upstream direction. In the downstream direction, the OLT/ONU must perform the reverse operation. The OLT must be configured for 1:1 or N:1 operation, supporting passing of the S-tag in the upstream/downstream directions.

The Ethernet Traffic Generator will be configured to transmit 1 flow of single-tagged Ethernet frames with a frame size of 2000 bytes as per IEEE 802.3as, in both directions with the parameters provided in the next tables.

255i2 Table 6.14.1-1: Test 6.14.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmitted to)												V Interface (as received from)											
	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
					TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID				TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any

255i2 Table 6.14.1-2: Test 6.14.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type	ONU	UNI Port	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ether Type
			TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID						TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	SPbit1	Any	SVID1	Any	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	CPbit1	N/A	CVID1	Any

Test Procedure:

1. Select distinct random values for CVID1 and SVID1 between 1 and 4094.
2. Select distinct random unicast values for MAC1 and MAC2, which are not already in use by the OLT, ONU, or other connected devices.
3. Select distinct random values for CPbit1 and SPbit1 between 0 and 7.
4. Enter the configuration commands on the OLT to configure OLT & ONU to support the VLAN configuration described in the Test Configuration.
5. Start injecting traffic at the U-interface as defined in the upstream traffic tables.
6. Stop injecting traffic at the U-interface.
7. Start injecting traffic at the V-interface as defined in the downstream traffic tables.
8. Stop injecting traffic at the V-interface.

Pass/Fail Criteria:

The test passes if the following are true, otherwise the test fails:

1. At step 5, upstream frames from stream Aus are received from the V-interface.
2. At step 7, downstream frames from stream Ads are received from the U-interface.

Remarks:

- None

End of Broadband Forum Test Plan TP-255