TECHNICAL REPORT

TR-255
GPON Interoperability Test Plan

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Comments or questions about this Broadband Forum Technical Report should be directed to info@broadband-forum.org.

Editors	Lincoln Lavoie	UNH-IOL
	Vincent Buchoux	LAN
FAN WG Chairs	Regis Coat	France Telecom
	Alessandro Capurso	Telecom Italia

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Executive Summary

In order to create a process for the ongoing promotion of GPON interoperability the Broadband Forum has produced TR-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.

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.

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-156 [2] 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-156 [2] 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.

XG-PON1 systems compliant with the ITU-T G.987 series of specifications may be testing using the test cases defined within this document to verify their interoperability with respect to the TR-156 [2] and G.988 [7] specification. Test cases that verify extensions found in G.988 [7] unique to XG-PON1 are for further study.

2 References and Terminology

2.1 Conventions

In this Technical Report, several words are used to signify the requirements of the specification. These words are always capitalized. More information can be found be 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 Technical Report. At the time of publication, the editions indicated were valid. All references are subject to revision; users of this Technical Report 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	*Migration to Ethernet-Based Broadband Aggregation*	BBF	2011
[2]	TR-156 Issue 2	*Using GPON Access in the context of TR-101*	BBF	2010
[3]	G.984.1	*Gigabit-capable Passive Optical Networks (GPON): General Characteristics*	ITU-T	2008

[4]	G.984.3	*Gigabit-capable Passive Optical Networks (GPON): Transmission convergence layer specification*	ITU-T	2008
[5]	G.984.3 Amendment 1	*Gigabit-capable Passive Optical Networks (GPON): Transmission convergence layer specification – Amendment 1*	ITU-T	2009
[6]	G.984.2	*Gigabit-capable Passive Optical Networks (GPON): Physical Media Dependent (PMD) layer specification*	ITU-T	2003
[7]	G.988	*ONU Management and Control Interface Specification (OMCI)*	ITU-T	2010
[8]	IR-247 Issue 2	*GPON ONU Conformance Test Plan*	BBF	2013
[9]	RFC 2119	*Key words for use in RFCs to Indicate Requirement Levels*	IETF	1997

2.3 Definitions

The following terminology is used throughout this Technical Report.

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 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.0
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 Flow	A sequence of frames or packets traversing a particular reference point within a network that share 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.
Traffic Classes	(TC) - Traffic Classes are the set of upstream and downstream supported forwarding behaviours in the network element
U-interface	U-interface is a short form of expressing one or more of the interfaces defined in this Technical Report 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 at the V reference point. It is also essentially equivalent to a network-facing interface at the access node
OLT Emulator	A device that terminates the common (root) endpoint of an ODN, implements the G.984/G.987 PMD and TC layers, and supports the transmission of OMCI messages as defined in the messages sequences in this document.
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
Ethernet Traffic Generator	A device that generates and captures well formed Ethernet frames as defined by test personnel.

2.4 Abbreviations

This Technical Report uses the following abbreviations:

ADSL	Asymmetric Digital Subscriber Line
AES	Advanced Encryption Standard
AN	Access Node
ASP	Application Service Provider
ATM	Asynchronous Transfer Mode
BTS	Base Transceiver Station
CB	Cellular Backhaul
CPE	Customer Premises Equipment
CPN	Customer Premises Network
DSCP	DiffServ Code Point
DSL	Digital Subscriber Line
FE	Fast Ethernet (100Mbps)
FITH	Fiber into the Home
FTTC	Fiber to the Curb
FTTH	Fiber to the Home
FTTO	Fiber to the Office
FTTP	Fiber to the Premises, including buildings
GE	Gigabit Ethernet (1000Mbps)
GEM	Generic Encapsulation Method
GPM	GPON Physical Media layer
GPON	Gigabit-capable Passive Optical Network
GTC	GPON Transmission Convergence layer – as defined in G.984.3[4]
L2-OCM	Layer 2 OMCI Common Model
MAC	Media Access Control
MDU	Multi-Dwelling Unit
ME	Managed Entity
MTU	Multi-Tenant Unit – or Maximum Transmission Unit
NSP	Network Service Provider
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]
POTS	Plain Old Telephone Service
RBN	Regional Broadband Network
RG	Residential Gateway
RNC	Radio Network Controller
SFU	Single Family Unit – a type of residence
TDM	Time-Division Multiplexing
TLS	Transparent LAN Service – a common synonym for Business Ethernet Services
TR	Technical Report
VDSL	Very high speed Digital Subscriber Line
xDSL	Any variety of DSL

3 Technical Report Impact

3.1 Energy Efficiency

TR-255 has no impact on energy efficiency.

3.2 IPv6

TR-255 has no impact on IPv6.

3.3 Security

TR-255 has no impact on security.

3.4 Privacy

TR-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 is able to 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 IR-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 is 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 4-1: Basic setup for interoperability testing

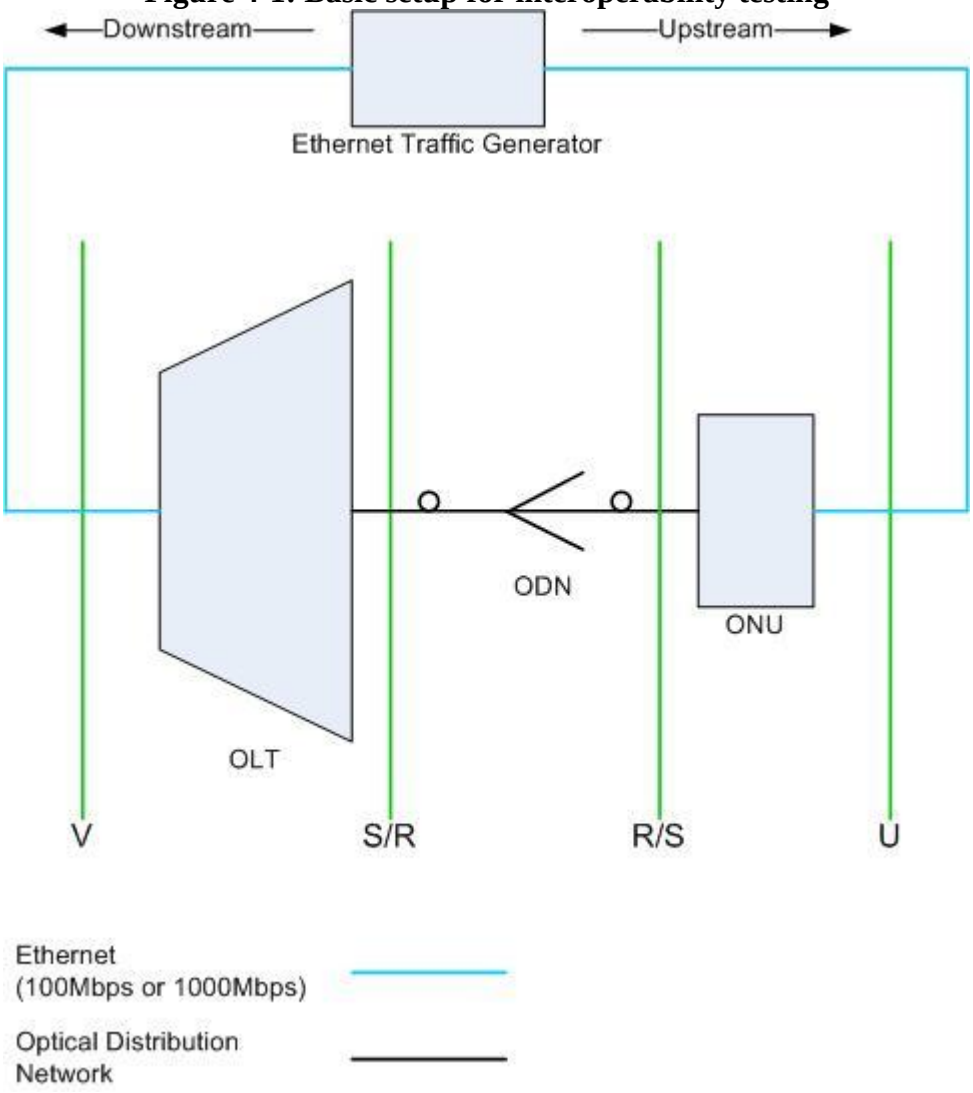


Figure 4-2: Setup for interoperability tests requiring multiple ONUs

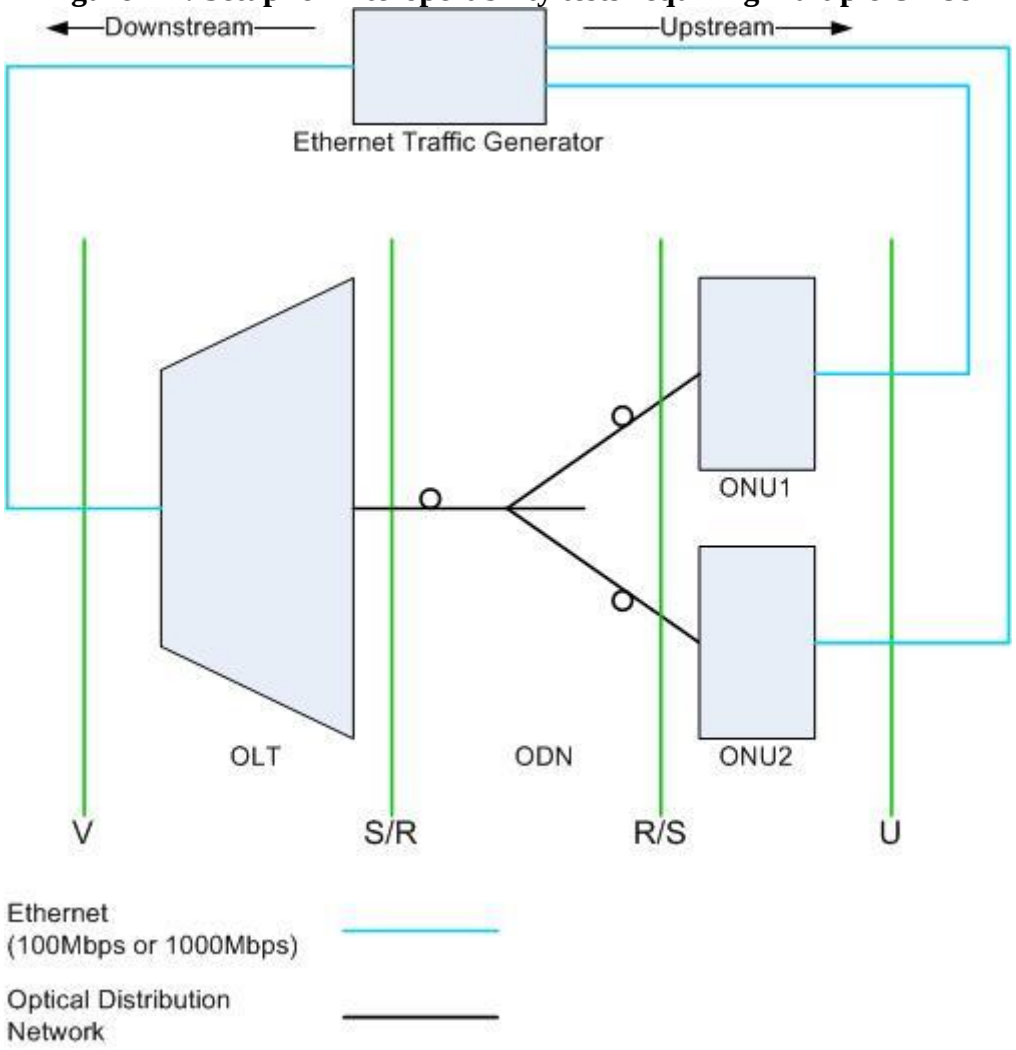
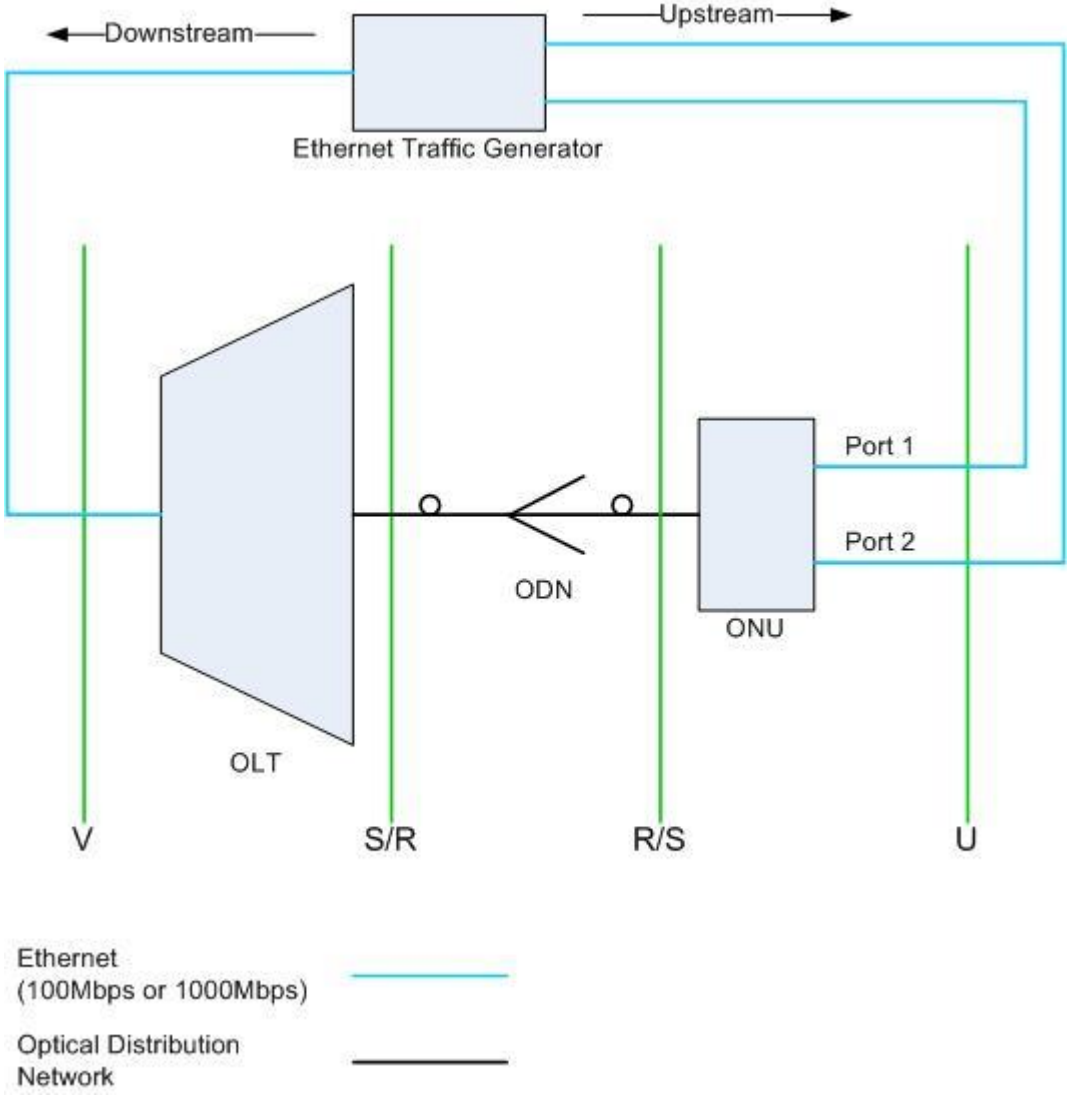


Figure 4-3: Setup for interoperability tests with ONU supporting multiple U interfaces



4.3 Test Case Template

The following text defines the test case template, which should be used by contributors to provide test cases as input the Broadband Forum's FAN Working Group.

Test Name (number is defined by editor during placement into this document)

Test Status: Optional, Mandatory, Conditional (defines requirement of test, bas
Indicate if the test case is Mandatory or Optional. In general, test cases that verify mandatory (MUST) requirements would be defined as mandatory and test cases that verify optional (SHOULD/MAY) requirements would be defined as optional. However, the ultimate decision resides with the developers of this test plan.

Reference Documents:
- Bulleted list of standards referenced within the test case.

For Reference:
- List of requirements from the appropriate specification(s) that are applicable for this test.
- Note: A test case should test as small a set of requirements as is practical.

Test Objective:
Succinct description of the test purpose

Test Setup:
- Reference to test setup (see section 4.2 Test Setup)

Pretest Conditions:
1. Preconditions description if needed

Test Configuration:
1. Succinct description of the test configuration like GEM port/TCONT usage, VIDs, P-bit, etc.
2. A test configuration schematic may also be used to add clarity to the test configuration description.
3. May define frame patters used on Ethernet Traffic Generator, etc.

Test Procedure:
1. Numbered List
2. Detailed description of the test procedure

Pass/Fail Criteria:
1. Numbered List
2. A detailed description of the criteria upon which to base a pass/fail determination.

Remarks:
- Bulleted List
- Description of any particular observations that might affect the test result

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
6.1.3	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, Singled 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, Singled 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
6.2	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 pbit 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 & pbit 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, pbit & U-interface values (1:1 VLAN, multiple user port)	Conditionnally Mandatory
6.2.2.5	Strict priority downstream scheduling among 4 queues on ONU and OLT based on pbit 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 & pbit 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 & pbit 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, pbit values & 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 & pbit values (1:1 VLAN, multiple user port)	Conditionnally Mandatory
6.2.2.11	Strict priority downstream scheduling among 4 queues on ONU and OLT based on VID, pbit values & MAC DA (VBES, multiple user port)	Conditionnally 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
6.4	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
6.5	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
6.6	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
6.10	Alarms	
6.10.1	Alarms synchronization	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 Interoperability Tests

6.1 VLAN Manipulation

Broadband Forum documents TR-101 [1] and TR-156 [3] 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 1 below provides a summary of the required manipulations and the associated requirement within TR-156 [3]. Table 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

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:

- Test setup as shown in Figure 4-1

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 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.

Table 6-2: Test 6.1.1.1 Upstream Frame Definitions

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.

2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as untagged frames.
4. Downstream frames from Frame-sets 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 an priority-tagged interface.

Test Setup:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as priority-tagged frames.
4. Downstream frames from Frame-sets 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 an Q-tagged interface.

Test Setup:

- Test setup as shown in Figure 1

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 config 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any except VID2	0x0800													

Test Procedure:

1. Select random values for VID1 and VID2 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID2 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, Dus, and Eus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as Q-tagged frames, with QVID=VID1 and TPID=0x8100.
4. Downstream frames from Frame-sets 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 implement the user isolation functions required by the N:1 architecture, and that this functionality is configurable.

Test Setup:

- Test setup as shown in Figure 4-2 (multiple ONU setup)

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 config 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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 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:

1. After procedure step 6, frames from frame-sets Aus or Bus must not be received from the U-interface.
2. After procedure step 8, frames from frame-sets 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-156 [2]

For Reference:

- **R-8:** The Ethertype field for the 802.1ad tagging, i.e. S-Tags, MUST support at least the standardized value 0x88a8. However, for backward compatibility reason, this field SHOULD be configurable (per Access Node).

Test Objective:

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

Test Setup:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	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	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	Any except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x8100.

2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as untagged frames.
4. Downstream frames from Frame-sets 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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).

3. Downstream frames from Frame-set Ads must be received from the U-interface as untagged frames.
4. Downstream frames from Frame-sets 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:

- Test setup as shown in Figure 4-1

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 5. The ONU must be configured to insert an 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 transmited to)													V Interface (as received from)									
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC2	0x88a8	X	X	VID2	0x8100	X	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)											
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	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	X	X	VID2	0x0800													
Cds	MAC2	MAC1	0x88a8	X	X	VID3	0x8100	X	X	VID1	0x0800													
Dds	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	VID3	0x0800													
Eds	MAC2	MAC1	0x8100	X	X	VID2	0x8100	X	X	VID1	0x0800													
Fds	MAC2	MAC1	0x88a8	X	X	VID2	0x88a8	X	X	VID1	0x0800													

Test Procedure:

1. Select random values for VID1, VID2, and VID3 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus must be received from the V-interface as double tagged frames, with SVID=VID2, S-TPID=0x88a8, CVID=VID1, and C-TPID=0x8100.
2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as untagged frames.
4. Downstream frames from Frame-sets Bds, Cds, Dds, Eds, and 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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	Any, except VID1	0x0800											

Table 6-16: Test 6.1.2.3 Downstream Frame Definitions

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

Test Procedure:

1. Select random values for VID1 and VID2 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID2 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, Dus, and Eus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as Q-tagged frames, with QVID=VID1 and TPID=0x8100.
4. Downstream frames from Frame-sets 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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800	MAC1	MAC2	0x88a8	X	X	VID3	0x8100	X	X	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	X	X	0	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800											
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	Any, except VID1	0x0800											

Table 6-18: Test 6.1.2.4 Downstream Frame Definitions

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

Test Procedure:

1. Select random values for VID1, VID2, VID3, and VID4 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus must be received from the V-interface as double tagged frames, with SVID=VID3, S-TPID=0x88a8, CVID=VID2, and C-TPID=0x8100.
2. Upstream frames from Frame-sets Bus, Cus, Dus, and Eus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads must be received from the U-interface as Q-tagged frames, with QVID=VID1 and TPID=0x8100.
4. Downstream frames from Frame-sets Bds, Cds, Dds, Eds, and 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 is able to disable MAC learning on VLANs configured for the 1:1 architecture.

Test Setup:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	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	X	X	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	X	X	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	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC5	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	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	X	X	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	X	X	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 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:

1. Upstream frames from Frame-set Aus through Dus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
2. Downstream frames from Frame-set Ads through Dds must be received from the U-interface as untagged frames.
3. The bridge forwarding table displayed in step 9 MUST not include any of the MAC addressed used in Frame-sets.

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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any, except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).

3. Downstream frames from Frame-set Ads must be received from the U-interface as untagged frames.
4. Downstream frames from Frame-sets 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, Singled 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 an priority-tagged interface.

Test Setup:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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	X	X	VID1	0x0800											
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	0	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	Any, except VID1	0x0800													

Test Procedure:

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

1. Upstream frames from Frame-set Aus must be received from the V-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
2. Upstream frames from Frame-sets Bus, Cus, and Dus must be silently discarded (e.g. not received from the V-interface).

3. Downstream frames from Frame-set Ads must be received from the U-interface as priority-tagged frames.
4. Downstream frames from Frame-sets 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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)									
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID3	0x0800	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID3	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID4	0x0800	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID4	0x0800
Dus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID5	0x0800	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	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	X	X	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)											
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800
Bds	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID3	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID3	0x0800
Cds	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID4	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID4	0x0800
Dds	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID5	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID5	0x0800
Eds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800													
Fds	MAC2	MAC1	0x88a8	X	X	VID6	0x8100	X	X	VID2	0x0800													
Gds	MAC2	MAC1	0x8100	X	X	VID1	0x8100	X	X	VID2	0x0800													
Hds	MAC2	MAC1	0x88a8	X	X	VID1	0x88a8	X	X	VID2	0x0800													

Test Procedure:

1. Select random values for VID1 through VID6 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus through Dus must be received from the V-interface as double tagged frames, with SVID=VID1, S-TPID=0x88a8, and CVID=VID2 through VID5, respectively, and TPID=0x8100.
2. Upstream frames from Frame-sets Eus, and Fus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads through Dds must be received from the U-interface as Q-tagged frames, with QVID=VID2 through VID5, respectively, and TPID=0x8100.
4. Downstream frames from Frame-sets Eds, Fds, Gds, and Hds must be silently discarded (e.g. not received from the U-interface).

Remarks:

- None

6.1.3.4 S-tagged U-interface, Singled 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:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800											
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID2	0x0800													
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800													

Test Procedure:

1. Select random values for VID1 and VID2 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus must be received from the V-interface as single tagged frames, with SVID=VID2, S-TPID=0x88a8.
2. Upstream frames from Frame-sets Bus through Dus must be silently discarded (e.g. not received from the V-interface).

3. Downstream frames from Frame-set Ads must be received from the U-interface as S-tagged frames, with SVID=VID1 and TPID=0x88a8.
4. Downstream frames from Frame-sets 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-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.
- **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 12 in Table 6-1, when the U-interface of the ONU is configured as a double-tagged interface.

Test Setup:

- Test setup as shown in Figure 4-1

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 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 transmited to)													V Interface (as received from)									
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID3	0x0800	MAC1	MAC2	0x88a8	X	X	VID2	0x8100	X	X	VID3	0x0800
Bus	1	1	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID4	0x0800	MAC1	MAC2	0x88a8	X	X	VID2	0x8100	X	X	VID4	0x0800
Cus	1	1	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID5	0x0800	MAC1	MAC2	0x88a8	X	X	VID2	0x8100	X	X	VID5	0x0800
Dus	1	1	MAC1	MAC2	0x88a8	X	X	VID1	0x8100	X	X	VID6	0x0800	MAC1	MAC2	0x88a8	X	X	VID2	0x8100	X	X	VID6	0x0800
Eus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800											
Fus	1	1	MAC1	MAC2	0x88a8	X	X	VID7	0x8100	X	X	VID3	0x0800											
Gus	1	1	MAC1	MAC2	0x8100	X	X	VID1	0x8100	X	X	VID3	0x0800											
Hus	1	1	MAC1	MAC2	0x88a8	X	X	VID1	0x88a8	X	X	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)											
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	VID3	0x0800	1	1	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID3	0x0800
Bds	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	VID4	0x0800	1	1	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID4	0x0800
Cds	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	VID5	0x0800	1	1	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID5	0x0800
Dds	MAC2	MAC1	0x88a8	X	X	VID2	0x8100	X	X	VID6	0x0800	1	1	MAC2	MAC1	0x88a8	X	X	VID1	0x8100	X	X	VID6	0x0800
Eds	MAC2	MAC1	0x88a8	X	X	VID7	0x8100	X	X	VID2	0x0800													
Fds	MAC2	MAC1	0x8100	X	X	VID2	0x8100	X	X	VID3	0x0800													
Gds	MAC2	MAC1	0x88a8	X	X	VID2	0x88a8	X	X	VID3	0x0800													

Test Procedure:

1. Select random values for VID1 through VID7 between 1 and 4094.
2. Select 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:

1. Upstream frames from Frame-set Aus through Dus must be received from the V-interface as double tagged frames, with SVID=VID2, S-TPID=0x88a8, and C-VID = VID3 through VID6, respectively, and C-TPID=0x8100.
2. Upstream frames from Frame-sets Eus through Hus must be silently discarded (e.g. not received from the V-interface).
3. Downstream frames from Frame-set Ads through Dds must be received from the U-interface as double-tagged frames, with SVID=VID1, S-TPID=0x88a8, and C-VID = VID3 through VID6, respectively, and C-TPID=0x8100.
4. Downstream frames from Frame-sets Eds, Fds, and 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 "hairpin turn" upstream traffic received from one ONU, sending the traffic back down the same PON to a second ONU.

Test Setup:

- Test setup as shown in Figure 4-2

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 config 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 require two ONU devices, configured to belong to the same VBES service.

Table 6-31: Test 6.3.1.6 Upstream Frame Definitions

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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 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:

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

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 are able to 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:

- Test setup as shown in Figure 4-1

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 Config #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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID2	0x0800

Test Procedure:

1. Select random values for VID1 through VID2 between 1 and 4094.
2. Select 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 Pbit1 through Pbit4 between 0 and 7, inclusive.
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:

1. Upstream frames from Frame-set Aus MUST be received with the P-bit value set to Pbit3.
2. Upstream frames from Frame-set Bus MUST be received with the P-bit value set to Pbit4.
3. Downstream frames from Frame-set Ads MUST be received with the P-bit value set to Pbit1.
4. Downstream frames from Frame-set Bds MUST be received with the P-bit value set to Pbit2.

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 are able to 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:

- Test setup as shown in Figure 4-1

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 Config #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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	VID1	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit3	X	VID2	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit6	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit6	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit3	X	VID2	0x0800

Test Procedure:

1. Select random values for VID1 through VID2 between 1 and 4094.
2. Select 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 Pbit1 through Pbit6 between 0 and 7, inclusive.
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:

1. Upstream frames from Frame-set Aus MUST be received with the P-bit value set to Pbit4.
2. Upstream frames from Frame-set Bus MUST be received with the P-bit value set to Pbit5.
3. Upstream frames from Frame-set Cus MUST be received with the P-bit value set to Pbit6.

4. Downstream frames from Frame-set Ads MUST be received with the P-bit value set to Pbit1.
5. Downstream frames from Frame-set Bds MUST be received with the P-bit value set to Pbit2.
6. Downstream frames from Frame-set Cds MUST be received with the P-bit value set to Pbit3.

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 are able to 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:

- Test setup as shown in Figure 4-1

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 Config #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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0806	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0806
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x86dd	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0806	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0806
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	VID1	0x86dd	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x86dd

Test Procedure:

1. Select random values for VID1 between 1 and 4094.
2. Select 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 Pbit1 through Pbit5 between 0 and 7, inclusive.
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:

1. Upstream frames from Frame-set Aus MUST be received with the P-bit value set to Pbit3.
2. Upstream frames from Frame-set Bus MUST be received with the P-bit value set to Pbit4.
3. Upstream frames from Frame-set Cus MUST be received with the P-bit value set to Pbit5.

4. Downstream frames from Frame-set Ads MUST be received with the P-bit value set to Pbit1.
5. Downstream frames from Frame-set Bds MUST be received with the P-bit value set to Pbit1.
6. Downstream frames from Frame-set Cds MUST be received with the P-bit value set to Pbit2.

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 are able to 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:

- Test setup as shown in Figure 4-3

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 Config #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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800
Cus	1	2	MAC1	MAC3	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	MAC1	MAC3	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	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)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800
Cds	MAC3	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	VID1	0x0800	1	2	MAC3	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800

Test Procedure:

1. Select random values for VID1 between 1 and 4094.
2. Select random unicast values for MAC1 through MAC3, which are not already in use by the OLT, ONU, or other connected devices.
3. Select random values for Pbit1 through Pbit5 between 0 and 7, inclusive.
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:

1. Upstream frames from Frame-set Aus MUST be received with the P-bit value set to Pbit3.
2. Upstream frames from Frame-set Bus MUST be received with the P-bit value set to Pbit4.
3. Upstream frames from Frame-set Cus MUST be received with the P-bit value set to Pbit5.
4. Downstream frames from Frame-set Ads MUST be received with the P-bit value set to Pbit1.

5. Downstream frames from Frame-set Bds MUST be received with the P-bit value set to Pbit2.
6. Downstream frames from Frame-set Cds MUST be received with the P-bit value set to Pbit1.

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-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 are able to 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:

- Test setup as shown in Figure 4-1

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 Config #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 transmited to)														V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag								Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	DSCP	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800	DSCP1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800	DSCP2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800
Cus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID2	0x0800	DSCP3	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	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)												
			Outer VLAN Tag				Inner VLAN Tag										Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	DSCP	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit3	X	VID1	0x0800	DSCP1	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID1	0x0800
Bds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit4	X	VID1	0x0800	DSCP2	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit2	X	VID1	0x0800
Cds	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	Pbit5	X	VID1	0x0800	DSCP3	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	Pbit1	X	VID2	0x0800

Test Procedure:

1. Select random values for VID1 through VID2 between 1 and 4094.
2. Select 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 Pbit1 through Pbit5 between 0 and 7, inclusive.
4. Select random values for DSCP1 through DSCP3 between 0 and 63, inclusive.
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:

1. Upstream frames from Frame-set Aus MUST be received with the P-bit value set to Pbit3.
2. Upstream frames from Frame-set Bus MUST be received with the P-bit value set to Pbit4.
3. Upstream frames from Frame-set Cus MUST be received with the P-bit value set to Pbit5.

4. Downstream frames from Frame-set Ads MUST be received with the P-bit value set to Pbit1.
5. Downstream frames from Frame-set Bds MUST be received with the P-bit value set to Pbit2.
6. Downstream frames from Frame-set Cds MUST be received with the P-bit value set to Pbit1.

Remarks:

- None

6.2.2 Frame Mapping

6.2.2.1 Strict priority upstream scheduling among 4 queues on ONU and OLT based on pbit 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 on 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:

- Test setup as shown in Figure 4-1

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 to 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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits3	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits3	x	CVID1	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits4	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits4	x	CVID1	0x0800

E (3)	1	1	MAC1	MAC2					0x8100	CPbits5	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits5	x	CVID1	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits6	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits6	x	CVID1	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits7	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits7	x	CVID1	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits8	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits8	x	CVID1	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits8 between 0 and 7. 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. Each Pbit value (0 through 7) may be using only once for the CPbits1 through CPbits8 value.
3. Select 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 (ie 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 (ie 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 (ie 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 (ie Traffic Class 3) are received.
    c. No frame from traffic streams G & H (ie 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 (ie Traffic Class 2) are received.
    c. No frame from traffic streams D, E & F (ie Traffic Class 3) and G & H (ie 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 (ie Traffic Class 2), D, E & F (ie Traffic Class 3) and G & H (ie 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 on 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:

- Test setup as shown in Figure 4-1

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 to 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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID4	0x0800
E (3)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID5	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID5	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID6	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID6	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID7	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID7	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID8	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID8	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 through CVID8 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 between 0 and 7. 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 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 & pbit 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 on 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:

- Test setup as shown in Figure 4-1

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 to 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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID2	0x0800
E (3)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800
F (3)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID3	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID3	0x0800
G (4)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID4	0x0800
H (4)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID4	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID4	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 through CVID4 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7. 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 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, pbit & 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 on 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:

- Test setup as shown in Figure 4-3

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 to 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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800
B (2)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800
C (2)	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800
D (3)	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID2	0x0800	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID2	0x0800
E (3)	1	2	MAC1	MAC3					0x8100	CPbits1	x	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800
F (3)	1	2	MAC1	MAC3					0x8100	CPbits2	x	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID3	0x0800
G (4)	1	2	MAC1	MAC3					0x8100	CPbits3	x	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits3	x	CVID3	0x0800

H (4)	1	2	MAC1	MAC3					0x8100	CPbits4	x	CVID3	0x0800	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits4	x	CVID3	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 through CVID3 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits4 between 0 and 7. 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. Each Pbit value (0 through 7) may be using only once for the CPbits1 through CPbits8 value.
3. Select 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 pbit 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 on 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits3	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits3	x	CVID1	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits4	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits4	x	CVID1	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits5	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits5	x	CVID1	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits6	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits6	x	CVID1	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits7	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits7	x	CVID1	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits8	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits8	x	CVID1	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits8 between 0 and 7. 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 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 (ie 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 (ie 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 (ie 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 (ie Traffic Class 3) are received.
    c. No frame from traffic streams G & H (ie 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 (ie Traffic Class 2) are received.
    c. No frame from traffic streams D, E & F (ie Traffic Class 3) and G & H (ie 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 (ie Traffic Class 2), D, E & F (ie Traffic Class 3) and G & H (ie 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 insure 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 on 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID3	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID4	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID5	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID5	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID6	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID6	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID7	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID7	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID8	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID8	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 through CVID8 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 between 0 and 7. 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 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 insure 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 & pbit 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 on 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID2	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID3	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID3	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID3	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID4	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID4	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID4	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and CVID1 through CVID4 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7. 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 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 insure 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 & pbit 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 on 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:
- Test setup as shown in Figure 4-1

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 & pbit
-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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800
B (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800
C (2)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800
D (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID2	0x0800
E (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID2	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID1	0x0800
F (3)	MAC1	MAC2	0x88A8	SPbits1	x	SVID2	0x8100	CPbits2	x	CVID1	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID1	0x0800
G (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID2	0x8100	CPbits1	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits1	x	CVID2	0x0800
H (4)	MAC1	MAC2	0x88A8	SPbits1	x	SVID2	0x8100	CPbits2	x	CVID2	0x0800	1	1	MAC1	MAC2					0x8100	CPbits2	x	CVID2	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 through SVID2 and CVID1 through CVID2 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits2 between 0 and 7. 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 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 insure 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, pbit values & 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 on 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC8					0x88A8	SPbits1	x	SVID1	0x0800	1	1	MAC1	MAC8					0x88A8	SPbits1	x	SVID1	0x0800
B (2)	MAC2	MAC8					0x88A8	SPbits2	x	SVID1	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits2	x	SVID1	0x0800
C (2)	MAC2	MAC8					0x88A8	SPbits1	x	SVID2	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits1	x	SVID2	0x0800
D (3)	MAC3	MAC8					0x88A8	SPbits2	x	SVID2	0x0800	1	1	MAC3	MAC8					0x88A8	SPbits2	x	SVID2	0x0800
E (3)	MAC4	MAC8					0x88A8	SPbits1	x	SVID1	0x0800	1	1	MAC4	MAC8					0x88A8	SPbits1	x	SVID1	0x0800
F (3)	MAC5	MAC8					0x88A8	SPbits2	x	SVID1	0x0800	1	1	MAC5	MAC8					0x88A8	SPbits2	x	SVID1	0x0800
G (4)	MAC6	MAC8					0x88A8	SPbits1	x	SVID2	0x0800	1	1	MAC6	MAC8					0x88A8	SPbits1	x	SVID2	0x0800
H (4)	MAC7	MAC8					0x88A8	SPbits2	x	SVID2	0x0800	1	1	MAC7	MAC8					0x88A8	SPbits2	x	SVID2	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1.
Traffic Streams B & C have to be assigned to Traffic Class 2.
Traffic Streams D, E & F have to be assigned to Traffic Class 3.
Traffic Streams G & H have to 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 different random values for SVID1 and SVID2 between 1 and 4094.
2. Select different random values for SPbits1 and SPbits2 between 0 and 7. 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 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 insure 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 & pbit 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 on 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:
- Test setup as shown in Figure 4-3

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, pbit
-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 of 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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits1	x	CVID1	0x0800
B (2)	MAC1	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits2	x	CVID1	0x0800
C (2)	MAC1	MAC3	0x88A8	SPbits1	x	SVID2	0x8100	CPbits1	x	CVID1	0x0800	1	1	MAC1	MAC3					0x8100	CPbits1	x	CVID1	0x0800
D (3)	MAC2	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits3	x	CVID2	0x0800	1	2	MAC2	MAC3					0x8100	CPbits3	x	CVID2	0x0800
E (3)	MAC2	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits4	x	CVID2	0x0800	1	2	MAC2	MAC3					0x8100	CPbits4	x	CVID2	0x0800
F (3)	MAC2	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits1	x	CVID3	0x0800	1	2	MAC2	MAC3					0x8100	CPbits1	x	CVID3	0x0800
G (4)	MAC2	MAC3	0x88A8	SPbits1	x	SVID1	0x8100	CPbits2	x	CVID3	0x0800	1	2	MAC2	MAC3					0x8100	CPbits2	x	CVID3	0x0800
H (4)	MAC2	MAC3	0x88A8	SPbits1	x	SVID2	0x8100	CPbits3	x	CVID4	0x0800	1	2	MAC2	MAC3					0x8100	CPbits3	x	CVID4	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1 AND mapped to U-interface 1.
Traffic Streams B & C have to be assigned to Traffic Class 2 AND mapped to U-interface 1.
Traffic Streams D, E & F have to be assigned to Traffic Class 3 AND mapped to U-interface 2.
Traffic Streams G & H have to 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 different random values for SVID1 through SVID2 and CVID1 through CVID4 between 1 and 4094.
2. Select different random values for SPbits1 and CPbits1 through CPbits4 between 0 and 7. 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 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 insure 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, pbit values & 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 on 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:
- Test setup as shown in Figure 4-3

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 of 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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
A (1)	MAC1	MAC8					0x88A8	SPbits1	x	SVID1	0x0800	1	1	MAC1	MAC8					0x88A8	SPbits1	x	SVID1	0x0800
B (2)	MAC2	MAC8					0x88A8	SPbits2	x	SVID1	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits2	x	SVID1	0x0800
C (2)	MAC2	MAC8					0x88A8	SPbits1	x	SVID2	0x0800	1	1	MAC2	MAC8					0x88A8	SPbits1	x	SVID2	0x0800
D (3)	MAC3	MAC8					0x88A8	SPbits2	x	SVID2	0x0800	1	2	MAC3	MAC8					0x88A8	SPbits2	x	SVID2	0x0800
E (3)	MAC4	MAC8					0x88A8	SPbits1	x	SVID1	0x0800	1	2	MAC4	MAC8					0x88A8	SPbits1	x	SVID1	0x0800
F (3)	MAC5	MAC8					0x88A8	SPbits2	x	SVID1	0x0800	1	2	MAC5	MAC8					0x88A8	SPbits2	x	SVID1	0x0800
G (4)	MAC6	MAC8					0x88A8	SPbits1	x	SVID2	0x0800	1	2	MAC6	MAC8					0x88A8	SPbits1	x	SVID2	0x0800
H (4)	MAC7	MAC8					0x88A8	SPbits2	x	SVID2	0x0800	1	2	MAC7	MAC8					0x88A8	SPbits2	x	SVID2	0x0800

Note:
Traffic Stream A has to be assigned to Traffic Class 1 AND mapped to U-interface 1.
Traffic Streams B & C have to be assigned to Traffic Class 2 AND mapped to U-interface 1.
Traffic Streams D, E & F have to be assigned to Traffic Class 3 AND mapped to U-interface 2.
Traffic Streams G & H have to 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 different random values for SVID1 and SVID2 between 1 and 4094.
2. Select different random values for SPbits1 and SPbits2 between 0 and 7. 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 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 insure 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:
- Test setup as shown in Figure 4-1

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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
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:

1. Select a random value for SVID1 between 1 and 4094.
2. Select 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 configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator
6. Verify at the V-interface that the only packets dropped are from stream marked with drop precedence.
7. Stop traffic streams A & B.
8. 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:

1. 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:
- Test setup as shown in Figure 4-1

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	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value	value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
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:

1. Select a random value for SVID1 between 1 and 4094.
2. Select 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 configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator

6. Verify at the V-interface that the only packets dropped are from stream marked with drop precedence.
7. Stop traffic streams A & B.
8. Repeat steps 4 to 7 using traffic streams C&D.
9. Stop traffic streams C&D.
10. Repeat steps 4 to 7 using traffic streams E&F.
11. Stop traffic streams E&F.
12. Repeat steps 4 to 7 using traffic streams G&H.
13. Stop traffic streams G&H.

Pass/Fail Criteria:
The test passes if the following are true otherwise the test fails:

1. 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
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:

1. Select a random value for SVID1 between 1 and 4094.
2. Select 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 configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R.
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator.
6. Verify at the U-interface that the only packets dropped are from stream marked with drop precedence.
7. Stop traffic streams A&B.
8. 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:

1. 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 insure 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:
- Test setup as shown in Figure 4-1

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				EtherType	ONU	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				EtherType
	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value		Port#	value	value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	value
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:

1. Select a random value for SVID1 between 1 and 4094.
2. Select 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 configuration described above to be activated on the ONU.
4. Configure the Ethernet Traffic Generator to transmit the traffic streams A & B each of rate R
5. Enable any frame captured mechanisms on the Ethernet Traffic Generator
6. Verify at the U-interface that the only packets dropped are from stream marked with drop precedence.
7. Stop traffic streams A & B.
8. Repeat steps 4 to 7 using traffic streams C&D.
9. Stop traffic streams C&D.
10. Repeat steps 4 to 7 using traffic streams E&F.
11. Stop traffic streams E&F.
12. Repeat steps 4 to 7 using traffic streams G&H.
13. Stop traffic streams G&H.

Pass/Fail Criteria:

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

1. 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 insure 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 IMGP 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

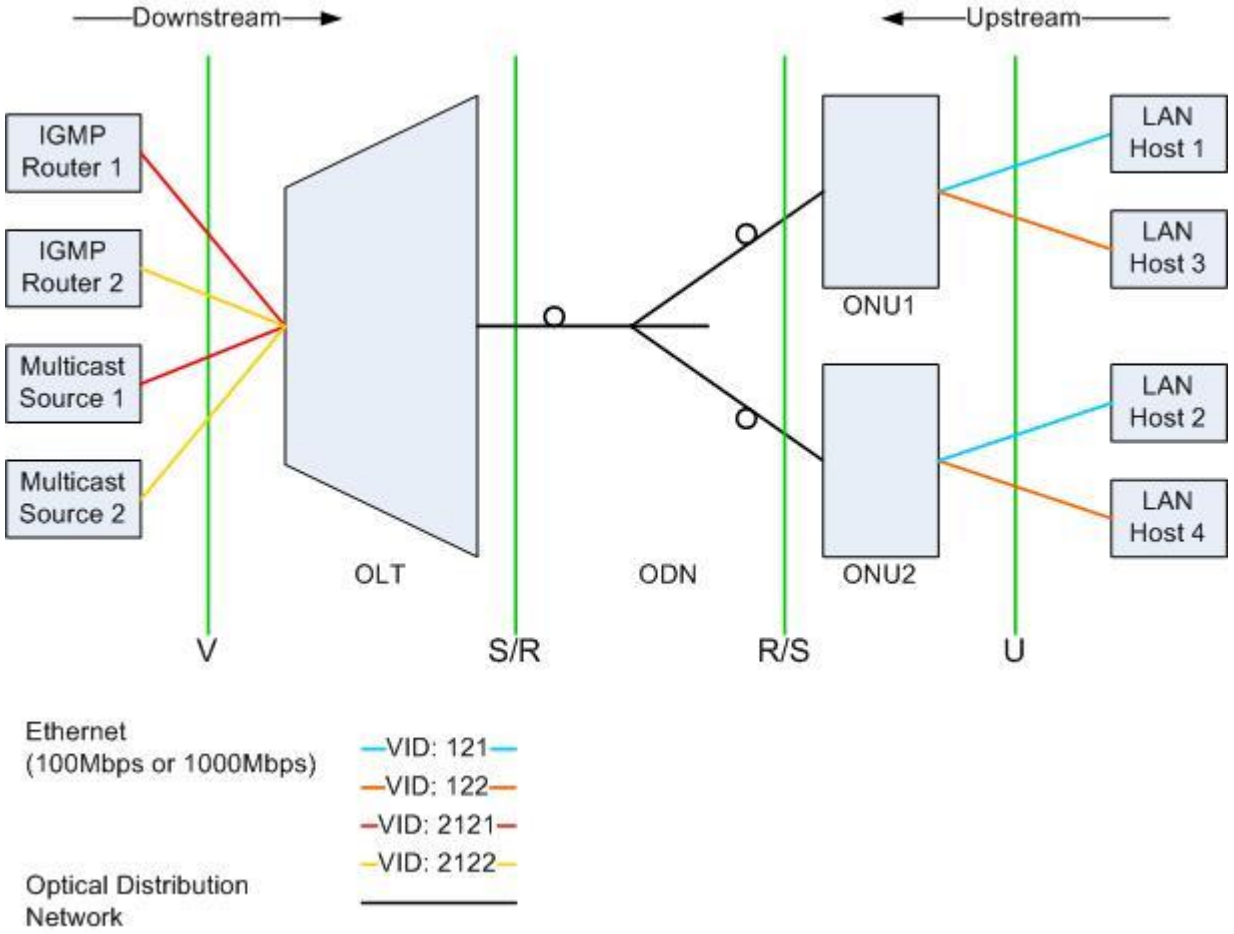
Host	Source MAC Address	Source IP Address	Inner VLAN VID	Inner VLAN TPID	Outer VLAN VID	Outer VLAN TPID
Multicast_Source_1	00:03:02:03:04:01	132.177.123.2	2121	0x88a8	None	None
Multicast_Source_2	00:03:02:03:04:02	132.177.123.3	2122	0x88a8	None	None

Table 6-60 defines the configuration for various multicast groups, including the group address, traffic bit-rate. 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	Bit-rate (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 a Ethernet Traffic Generator, as depicted in Figure 4-2: Setup for interoperability tests requiring multiple ONUs. The VLAN tag manipulations described int he 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 either a unicast GEM port, or 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 port and/or VLAN, these messages are transparently forwarded.

Test Objective:
To verify the OLT and ONT combination is able to deliver and receive downstream IGMP messages.

Test Setup:
- Test setup as shown in Figure 6-1

1. **Pretest Conditions:**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 to 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:

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 bi-directional 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 port and/or VLAN, these messages are transparently forwarded.

Test Objective:
To verify the OLT and ONT combination is able to deliver and receive upstream IGMP messages.

Test Setup:
- Test setup as shown in Figure 6-1

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 to 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 a 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:

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 support configurable silent discard of all IGMP messages received on an ONU user port and/or VLAN.

Test Objective:
To verify the OLT and ONT combination is able to configure the silent discard of upstream IGMP messages received by the ONU.

Test Setup:
- Test setup as shown in Figure 6-1

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 messaged received by the ONU on VLAN VID 121.

Test Procedure:
1. Enable to 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:

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 IP 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 within a multicast-VLAN, and enter the IGMP snooping function.

Test Objective:
To verify the OLT and ONT combination is able to configure both allowed and not-allowed multicast groups.

Test Setup:
- Test setup as shown in Figure 6-1

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 to 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:

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 is able to block user generated (received by the UNI port) multicast traffic.

Test Setup:
- Test setup as shown in Figure 6-1

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 upstream IGMP membership report.

Test Procedure:

1. Enable to Ethernet Traffic Generator connected to the V-interface and Ethernet Traffic Generator connected to U-interface of ONU2 to begin to begin capturing Ethernet frames.
2. Cause the Ethernet Traffic Generator connected to the U-interface to transmit an 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:

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 on a multicast-VLAN.

Test Objective:
To verify the OLT and ONT combination is able to rate-limit IGMP messages received from user-facing ports.

Test Setup:
- Test setup as shown in Figure 6-1

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 to 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:

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 bit-rate, and may require the applied transmitted message rates may need to be adjusted to exceed the configured bit-rate 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 IGMP v3 (as per RFC 3376) transparent snooping function. This MUST be configurable on a per VLAN basis.
  - Note: V3 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:
- Test setup as shown in Figure 6-1

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 to 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:

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:
- Test setup as shown in Figure 6-1

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.

Test Procedure:
1. Enable to 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:

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:
- Test setup as shown in Figure 6-1

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 to 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:

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 are able to mark upstream IGMP messages with specific P-bit values.

Test Setup:
- Test setup as shown in Figure 6-1

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 to 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:

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 are able to limit the maximum number of multicast groups an U-interface may join at one time.

Test Setup:
- Test setup as shown in Figure 6-1

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 to 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:

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:
- Test setup as shown in Figure 6-1

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 to 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:

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

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:
- Test setup as shown in Figure 6-1

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 to 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 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 an 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:

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 flooded by forwarding to a downstream 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:
- Test setup as shown in Figure 6-1

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 to 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:

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. Test setup as shown in Figure 6-1

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 to 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:

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 using a downstream 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:
- Test setup as shown in Figure 6-1

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 to 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:

1. The Ethernet Traffic Generator connected to the U-interface of the ONU must receive the downstream broadcast frame.

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 is able to provide service to users with duplicate MAC addresses

Test Setup:
- As shown in Figure 4-3

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:
- Two users have been provisioned with the same N:1 VLAN service
- 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800											
B	1	2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800											

Table 6-62: Test 6.5.1 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)												
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads												1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800
Bds												1	2	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	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 a random value for VID1 and VID2 between 1 and 4094.
2. Select unicast values for MAC1 through 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:

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 is able to deny service to users with duplicate MAC addresses

Test Setup:
- As shown in Figure 4-3

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:
- Two users have been provisioned with the same N:1 VLAN service
- 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 transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800
B	1	2	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800

Table 6-64: Test 6.5.2 Downstream Frame Definitions

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

Test Procedure:

1. Select a random value for VID1 through VID2 between 1 and 4094
2. Select unicast values for MAC1 through MAC2
3. Configure the OLT to dis-allow 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:

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 is able to provide a Mechanism to prevent Broadband Network Gateway MAC address spoofing

Test Setup:
- As shown in Figure 4-3

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:
- Two users have been provisioned with the same N:1 VLAN service
- 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 6.5.2 Upstream Frame Definitions

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Aus	1	1	MAC3	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800	MAC3	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800
Bus	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800	MAC1	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800
Cus	1	2	MAC3	MAC1	N/A	N/A	N/A	N/A	0x8100	N/A	N/A	VID1	0x0800											

Table 6-66: Test 6.5.2 Downstream Frame Definitions

Traffic Stream	V Interface (as transmitted to)											U Interface (as received from)											
			Outer VLAN Tag				Inner VLAN Tag									Outer VLAN Tag				Inner VLAN Tag				
	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
Ads	MAC2	MAC1	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800	1	1	MAC2	MAC1	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800
Bds	MAC2	MAC3	N/A	N/A	N/A	N/A	0x88a8	X	X	VID2	0x0800	1	1	MAC2	MAC3	N/A	N/A	N/A	N/A	0x8100	X	X	VID1	0x0800

Test Procedure:

1. Select a random value for VID1 through VID2 between 1 and 4094
2. Select 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:

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 SHOULD inspect upstream and downstream DHCP packets in order to discover the mapping of IP address to MAC address and populate an ARP table associating these addresses with their respective U-interface and VLAN.
- R-118: The OLT SHOULD ensure that downstream broadcast ARP requests are not sent on U-interfaces that do not have the requested IP address.

Test Objective:
To verify in IOP context that the OLT is able to 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:
- As shown in Figure 4-3

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:
- Two users have been provisioned with the same N:1 VLAN service
- The Ethernet Traffic Generator should be configured to transmit DHCP DISCOVER and REQUEST upstream at two distinct U interfaces U1 and U2.
- The Ethernet Traffic Generator should be configured to respond with DHCP OFFER and ACK downstream at V interface.
- The Ethernet Traffic Generator should be configured to transmit broadcast ARP requests downstream at V interface.
- 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:

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: Optional

Reference Documents:
- BBF TR-156 R-117 R-119

For Reference:
- R-119: The OLT SHOULD provide mechanisms to prevent user IP address spoofing, by discarding upstream IP packets received from U-interfaces that do not match the configured or DHCPdiscovered source IP address.

Test Objective:
To verify in IOP context that the OLT is able to 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:
- As shown in Figure 4-3

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:
- Two users have been provisioned with the same N:1 VLAN service
- The Ethernet Traffic Generator should be configured to transmit DHCP DISCOVER and REQUEST upstream at two distinct U interfaces U1 and U2.
- The Ethernet Traffic Generator should be configured to respond with DHCP OFFER and ACK downstream at V interface.
- 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:

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:

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 is able to limit the number of source MAC addresses learned and forwarded from each user port and that this limit is configurable

Test Setup:
- As shown in Figure 4-1

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:
- A user interface U has been provisioned with a N:1 VLAN service
- 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:

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

6.6 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 ONU SHOULD allow configuring and applying the following filters. 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.

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:

- Test Setup1 (as shown in Figure 4-1)

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 OL, 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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)									
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
C	1	1	MAC1	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select unicast values for MAC1 through MAC4, 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 Frame-Set A & B simultaneously.

Pass/Fail Criteria:

1. Upstream frames from Frame-Set A shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream frames 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 ONU SHOULD allow configuring and applying the following filters. 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:
        ii. Denying access from a specific MAC address.

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:

- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
C	1	1	MAC1	MAC4	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC1	MAC4	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800

Test Procedure:

1. Select unicast values for MAC1 through MAC4, 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. If Test Setup1 is in use, upstream frames from Frame-Set A shall be silently discarded. All other upstream frames 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 ONU SHOULD allow configuring and applying the following filters. The ONU MUST apply any configured filters in the upstream direction.
    2. Destination MAC address filter. This filter may be used in one of the following ways:
        i. Allowing access to a specific destination.

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:

Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
C	1	1	MAC4	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select unicast values for MAC1 through MAC4, 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. If Test Setup1 is in use, upstream frames from Frame-Set A shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream shall be silently discarded.
2. If Test Setup2 is in use, upstream frames from Frame-Set A and B shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream 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-124, The ONU SHOULD allow configuring and applying the following filters. The ONU MUST apply any configured filters in the upstream direction.
    2. Destination MAC address filter. This filter may be used in one of the following ways:
        i. denying access to a specific destination.

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:

- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
A	1	1	MAC1	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											
C	1	1	MAC4	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800	MAC4	MAC2	N/A	N/A	N/A	N/A	0x88a8	X	X	VID1	0x0800

Test Procedure:

1. Select unicast values for MAC1 through MAC4, 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. If Test Setup1 is in use, upstream frames from Frame-Set A shall be silently discarded. All other upstream frames 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 ONU SHOULD be able to filter reserved group MAC destination addresses (in the 01:80:C2 range – See TR-101/R-95)

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:

- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	VID1	0x0800
C	1	1	MAC4	MAC2	N/A	N/A	N/A	N/A	Untagged	N/A	N/A	N/A	0x0800											

Test Procedure:

1. Select values for MAC1 through MAC4, which are not already in use by any ONU or other connected devices. MAC1 through MAC3 MUST NOT begin with the prefix 01:80:C2:00:00, MAC4 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. If Test Setup1 is in use, upstream frames from Frame-Set A shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream 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. IPoE, 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:
- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	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 unicast values for MAC1 to 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. Upstream frames from Frame-Set A shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream frames 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. IPoE, 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:

- Test Setup1 (as shown in Figure 4-1)
-

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	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	X	X	VID1	PPPoE Session 0x8864

Test Procedure:

1. Select unicast values for MAC1 to 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. Upstream frames from Frame-Set B & C shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream frames shall be silently discarded.

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:
  ii. Denying a specific EtherType frame access (e.g. IPoE, 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:

- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	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	X	X	VID1	PPPoE Session 0x8864

Test Procedure:

1. Select unicast values for MAC1 to 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

1. Upstream frames from Frame-Set B & C shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream frames shall be silently discarded.

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:
  ii. Denying a specific EtherType frame access (e.g. IPoE, 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:

- Test Setup1 (as shown in Figure 4-1)

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 (Test Setup1)

Traffic Stream	U Interface (as transmited to)													V Interface (as received from)										
					Outer VLAN Tag				Inner VLAN Tag							Outer VLAN Tag				Inner VLAN Tag				
	ONU	UNI Port	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype	MAC DA	MAC SA	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Ethertype
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	X	X	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 unicast values for MAC1 to 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 Frame-Sets simultaneously.

Pass/Fail Criteria:

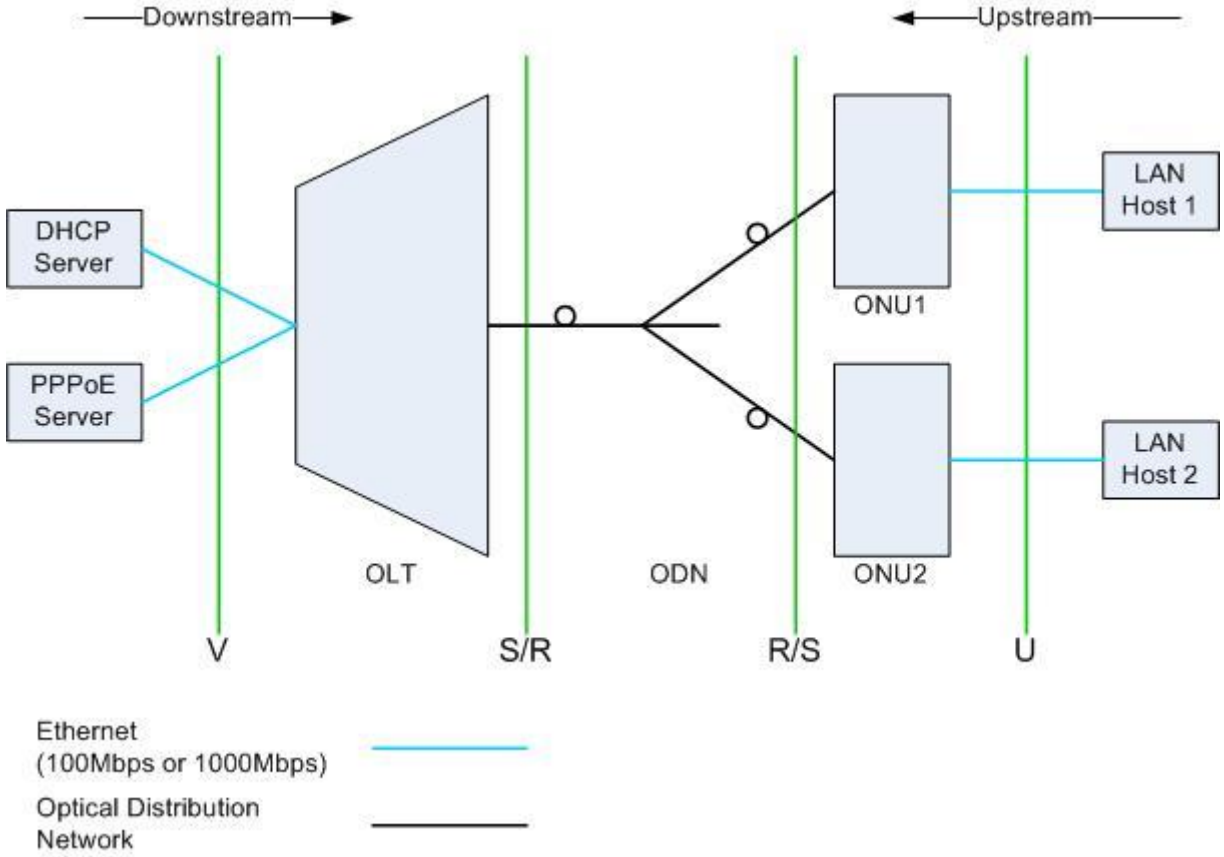
1. Upstream frames from Frame-Set A shall be received at V-Interface by the Ethernet Traffic Generator. All other upstream frames shall be silently discarded.

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-156 [2]
- BBF TR-101 [1]

For Reference:
- BBF TR-156:
  - 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-101.
- BBF TR-101:
  - R-119, R-120, R-121

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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:

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-156 [2]
- BBF TR-101 [1]

For Reference:

- BBF TR-156:
  - 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-101.
- BBF TR-101:
  - R-118, R-119, R-120, R-121, R-124, R-126

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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:

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-156 [2]
- BBF TR-101 [1]

For Reference:
- BBF TR-156:
  - 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-101.
- BBF TR-101:
  - R-118, R-119, R-120

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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.
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:

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-156 [2]
- BBF TR-101 [1]

For Reference:
- BBF TR-156:
  - 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-101.
- BBF TR-101:
  - R-119, R-120, R-121

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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:

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-156 [2]
- BBF TR-101 [1]

For Reference:

- BBF TR-156:
  - 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 3.9.1 /TR-101.
- BBF TR-101:
  - R-98, R-112, R-114

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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:

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-156 [2]
- BBF TR-101 [1]

For Reference:

- BBF TR-156:
  - 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 3.9.1 /TR-101.
- BBF TR-101:
  - R-98, R-112, R-113, R-114, R-124, R-126

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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. The included Option 82 Remote ID must not be the same value provision 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:

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-156 [2]
- BBF TR-101 [1]

For Reference:
- BBF TR-156:
  - 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 3.9.1 /TR-101.
- BBF TR-101:
  - R-113

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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.
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:

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-156 [2]
- BBF TR-101 [1]

For Reference:
- BBF TR-156:
  - 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 3.9.1 /TR-101.
- BBF TR-101:
  - R-100, R-101, R-102, R-103, R-104, R-105

Test Objective:
To verify the OLT/ONT combination is able to support the insertion and removal of the Agent Circuit ID and Agent Remote ID as described in TR-156 and TR-101 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 provision for a single untagged U-interface, as described in 6.1.1.3 Q-tagged U-interface Test Case. 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]". Note, this format is the default format listed in BBF TR-156 [3].
3. Enable able 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.
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:

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 ranging, 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:

The purpose of this test is to verify that:

- The ONU can reach the state O5 using the serial number method
- The OMCC is established and activated

Test Setup:

- As shown in Figure 4-1
    - Note: the Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should not have already register 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. A 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. In order to verify that OMCC channel is up, send reboot ONU from the OLT

Pass/Fail Criteria:

1. The OLT and ONU are synchronized (O5 state) following serial number method (at step 3)
2. The ONU reboots at step 4

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

Test Objective:

The purpose of this test is to verify:

- The ONU can reach the state O5 using the registration-ID mechanism
- The OMCC is established and activated

Test Setup:

- As shown in Figure 4-1
    - Note: the Ethernet Traffic Generator is not needed.

Pretest Conditions:

1. The OLT should not have already register 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. A 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, enter at the ONU 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. In order to verify that OMCC channel is up, send reboot ONU from the OLT

Pass/Fail Criteria:

1. The OLT and ONU are synchronized (O5 state) following serial number method (at step 3)
2. The ONU reboots at step 4

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

Test Objective:

- To verify that the OLT and ONU correctly complete the ONU Bring-up method as described in ITU-T G.988. A new ONU is defined as an ONU that has never completed the OLT's MIB synchronization process.

Test Setup:

- Test setup as shown in Figure 4-1
    - 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:

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 are able to perform the methods necessary to bring up an ONU that was previously connected to the OLT.

Test Setup:
- Test setup as shown in Figure 4-1
    - 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:

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, 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:
- Test setup as shown in Figure 4-1

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 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:

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 Analyser 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

Test Objective:

- The purpose of this test is to verify that the ONU and the OLT are able to synchronize their MIB in case of MIB de-synchronization.

Test Setup:

- As shown in Figure 4-1

Note: the Ethernet Traffic Generator is 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 as 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 by OMCI with respect to the traffic table below
2. Ethernet traffic generator is connected with the ONU and Ethernet port of the ONU is up.

	Downstream Direction												
Traffic Stream	V interface												
	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ethertype	IP DA	IP SA
	Value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Value	Value	Value
A (user1)	MAC2	MAC1	n/a	n/a	n/a	n/a	0x88a8	SPbits1	0	SVID1	x	x	x

Downstream Direction								
U interface								
Outer VLAN Tag				Inner VLAN Tag				UNI
TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Port #
n/a	n/a	n/a	n/a	0x8100	CPbits1	0	CVID1	1

	Upstream Direction													
Traffic Stream	U interface													
	UNI	MAC DA	MAC SA	Outer VLAN Tag				Inner VLAN Tag				Ethertype	IP DA	IP SA
	Port #	Value	Value	TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID	Value	Value	Value
A (user1)	1	MAC1	MAC2	n/a	n/a	n/a	n/a	0x8100	CPbits1	0	CVID1	x	x	x

Upstream Direction							
V interface							
Outer VLAN Tag				Inner VLAN Tag			
TPID	Pbits	DEI	VID	TPID	Pbits	DEI	VID
n/a	n/a	n/a	n/a	0x88a8	SPbits1	0	SVID1

Test Procedure:

1. Create the bidirectional GEM port between the ONU and the OLT
   - Select random values between 1 and 4094 for SVID1 and CVID1,
   - Select random values between 0 and 7 for SPBIT1 and CPBIT1
   - Select 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 direction
4. Disconnect the optical fiber of the ONU
5. Connect the optical fiber of the ONU
6. Verify that frames are transmitted in both direction
7. Disconnect the optical fiber of the ONU
8. In order 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 direction.

Pass/Fail Criteria:

1. The frames between V and U interface are passing in both direction at step 3.
2. The frames between V and U interface are passing in both direction at step 6.
3. The frames between V and U interface are blocked in both direction at step 10.

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 is able to 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:

- As shown in Figure 4-1
- 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 as 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:

1. The OLT detects the alarm (at step 2)
2. The OLT detects the alarm recovery (at step 4)
3. The OLT detects the alarm after a fiber re-connection (at step 8)
4. The OLT detects the alarm recovery after a electrical reboot (at step 12).

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 is able to upgrade ONU software.

Test Setup:

- As shown in Figure 4 1
  - 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 as 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. When rebooting the ONU the new software is active and “up and running”
5. Commit the software of the ONU
6. When rebooting again the ONU, verify again that the ONU is active and “up and running”

Pass/Fail Criteria:

1. OLT reports successful software download (at step1)
2. OLT can send active software and the ONU activates software (at step 3)
3. OLT can send commit software and the ONU committed software (at step 5)

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:

- As shown in Figure 4-1
  - 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 as 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 as 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:

1. If supported by the OLT, at least one software instance must be listed as committed, active, and valid (step 2)
2. 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 (step 6).
3. If supported by the OLT, verify the newly downloaded software image is listed as invalid (step 8)
4. The ONU must reboot in the original software version automatically (step 10).

Remarks:

- Some OLT equipment requires specific ONU software versions be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-gain 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 is able to cause the ONT to switch its active software instance when two valid images are present.

Test Setup:

- As shown in Figure 4-1
  - 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 as 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:

1. If supported by the OLT, at least one software instance must be listed as committed, active, and valid (step 2)
2. 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 (step 4).
3. 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) (step 5)
4. The ONU must reboot in the original software version automatically (step 7).

Remarks:

- Some OLT equipment requires specific ONU software versions be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-gain 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 is able to cause the ONT to switch its committed software instance when two valid images are present.

Test Setup:

- As shown in Figure 4-1
    - 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 as 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:

1. If supported by the OLT, at least one software instance must be listed as committed, active, and valid (step 2)
2. 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 (step 4).
3. 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) (step 5).
4. The ONU must reboot in the original software version automatically (step 8).
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 be used and does not support upgrades to the ONU software separately from the OLT software.
- Some OLT equipment might not allow for fine-gain control over the active/committed state of each software instance.

End of Broadband Forum Technical Report TR-255