

TR-309
**XG-PON and XGS-PON TC Layer Interoperability Test
Plan**

Issue: 2 Amendment 1
Issue Date: May 2020

Notice

The Broadband Forum is a non-profit corporation organized to create guidelines for broadband network system development and deployment. This Technical Report has been approved by members of the Forum. This Technical Report is subject to change. This Technical Report is owned and copyrighted by the Broadband Forum, and all rights are reserved. Portions of this Technical Report may be owned and/or copyrighted by Broadband Forum members.

Intellectual Property

Recipients of this Technical Report are requested to submit, with their comments, notification of any relevant patent claims or other intellectual property rights of which they may be aware that might be infringed by any implementation of this Technical Report, or use of any software code normatively referenced in this Technical Report, and to provide supporting documentation.

Terms of Use

1. License

Broadband Forum hereby grants you the right, without charge, on a perpetual, non-exclusive and worldwide basis, to utilize the Technical Report for the purpose of developing, making, having made, using, marketing, importing, offering to sell or license, and selling or licensing, and to otherwise distribute, products complying with the Technical Report, in all cases subject to the conditions set forth in this notice and any relevant patent and other intellectual property rights of third parties (which may include members of Broadband Forum). This license grant does not include the right to sublicense, modify or create derivative works based upon the Technical Report except to the extent this Technical Report includes text implementable in computer code, in which case your right under this License to create and modify derivative works is limited to modifying and creating derivative works of such code. For the avoidance of doubt, except as qualified by the preceding sentence, products implementing this Technical Report are not deemed to be derivative works of the Technical Report.

2. NO WARRANTIES

THIS Technical Report IS BEING OFFERED WITHOUT ANY WARRANTY WHATSOEVER, AND IN PARTICULAR, ANY WARRANTY OF NONINFRINGEMENT AND ANY IMPLIED WARRANTIES ARE EXPRESSLY DISCLAIMED. ANY USE OF THIS Technical Report SHALL BE MADE ENTIRELY AT THE USER'S OR IMPLEMENTER'S OWN RISK, AND NEITHER THE BROADBAND FORUM, NOR ANY OF ITS MEMBERS OR SUBMITTERS, SHALL HAVE ANY LIABILITY WHATSOEVER TO ANY USER, IMPLEMENTER, OR THIRD PARTY FOR ANY DAMAGES OF ANY NATURE WHATSOEVER, DIRECTLY OR INDIRECTLY, ARISING FROM THE USE OF THIS Technical Report, INCLUDING BUT NOT LIMITED TO, ANY CONSEQUENTIAL, SPECIAL, PUNITIVE, INCIDENTAL, AND INDIRECT DAMAGES.

3. THIRD PARTY RIGHTS

Without limiting the generality of Section 2 above, BROADBAND FORUM ASSUMES NO RESPONSIBILITY TO COMPILE, CONFIRM, UPDATE OR MAKE PUBLIC ANY THIRD PARTY ASSERTIONS OF PATENT OR OTHER INTELLECTUAL PROPERTY RIGHTS THAT MIGHT NOW OR IN THE FUTURE BE INFRINGED BY AN IMPLEMENTATION OF THE Technical Report IN ITS CURRENT, OR IN ANY FUTURE FORM. IF ANY SUCH RIGHTS ARE DESCRIBED ON THE Technical Report, BROADBAND FORUM TAKES NO POSITION AS TO THE VALIDITY OR INVALIDITY OF SUCH ASSERTIONS, OR THAT ALL SUCH ASSERTIONS THAT HAVE OR MAY BE MADE ARE SO LISTED.

All copies of this Technical Report (or any portion hereof) must include the notices, legends, and other provisions set forth on this page.

Issue History

Issue Number	Approval Date	Publication Date	Issue Editor	Changes
1	18 May 2020	18 May 2020	Marcin Drzymala, Orange	Original

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

Editor: Marcin Drzymala, Orange

Work Area Director(s): Marta Seda, Calix
Samuel Chen, Broadcom

Project Stream Leader(s): Vincent Buchoux, LAN

Table of Contents

1 Executive Summary 5

2 Purpose and Scope..... 6

 2.1 Purpose 6

 2.2 Scope 6

3 References and Terminology..... 7

 3.1 Conventions 7

 3.2 References 7

 3.3 Definitions 8

 3.4 Abbreviations 8

4 Technical Report Impact..... 9

 4.1 Energy Efficiency 9

 4.2 Security..... 9

 4.3 Privacy..... 9

5 Test Configuration and Equipment 10

 5.7 Alien ONU Test Configuration 10

6 Test Case Summary 11

 6.3 XG-PON and XGS-PON Comprehensive TC Layer Tests..... 11

7 Basic TC Layer Tests 12

8 Comprehensive TC Layer Tests 13

 8.7 Alien ONU Detection and resilience to alien ONU 13

Table of Figures

Figure 7 - Alien ONU detection and resilience to alien ONU test set-up 10

1 Executive Summary

Broadband Forum, in addition to ITU-T PON technologies conformance and interoperability test plans for service architecture (TP-247 [1] and TR-255 [2]), has also developed PON Transmission Convergence (TC) and Physical Media Dependent (PMD) layer interoperability test plans, TR-309 [12] and TR-423 [11].

The scope of TR-309 Issue 2 [12] is the verification of XG-PON and XGS-PON OLT and ONU interoperability with respect to the TC sub-layer (ITU-T G.987.3 [6], ITU-T G.9807.1 [8] Annex C), and, indirectly as a result of testing the TC layer, to the PMD sub-layer (ITU-T G.987.2 [5], ITU-T G.9807.1 [8] Annex B). Additional specific PMD layer test cases are covered in TR-423.

TR-309 Issue 2 Amendment 1 adds the following test case:

- Alien ONU Detection and resilience to alien ONU

2 Purpose and Scope

2.1 Purpose

TR-309 Issue 2 defines a set of test cases whose purpose is to verify interoperability between an XG-PON or XGS-PON OLT, and an ONU. These test cases address the PMD sub-layer (G.987.2 [5], ITU-T G.9807.1 [8] Annex B) and the TC sub-layer (G.987.3 [6], ITU-T G.9807.1 [8] Annex C).

Executing these test cases will help OLT and ONU's implementation of the specifications operate as a functional system. The tests are partitioned into two categories:

1. Basic TC layer tests - which focus on the frame structure and isolated TC layer functions
2. Comprehensive TC layer tests - which are oriented towards a more comprehensive TC layer behavior

TR-309 Issue 2 Amendment 1 adds a test to the Comprehensive TC Layer tests.

2.2 Scope

The test cases specified in TR-309 Issue 2 are focused on exploring multi-supplier interoperability at the XG-PON/XGS-PON PMD and TC sub-layer level of XG-PON/XGS-PON systems or XGPON/XGS-PON test platforms.

The test cases provided in the body of TR-309 Issue 2 provide a minimum set of PMD and TC sub-layer interoperability tests and are not an exhaustive set of PMD and TC sublayer test cases. The focus of the tests provided in TR-309 Issue 2 are on interoperability and not conformance, i.e. checking the operation of multiple vendor equipment with each other from PMD and TC layer perspective rather than exhaustive functional test of the behavior of the equipment, as is, or connected to some "golden" opponent device.

TR-309 Issue 2 contains test cases for features and capabilities that are optional according to G.987.x/G.9807.1. Test status of such cases is labeled as "conditional". Only features and capabilities claimed to be supported by both the OLT and the ONU are to be tested.

3 References and Terminology

3.1 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 in RFC 2119 [3].

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.

3.2 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] TP-247 Issue 4	G-PON ONU Conformance Test Plan	BBF	2020
[2] TR-255	G-PON Interoperability Test Plan	BBF	2013
[3] G.987	10-Gigabit-capable passive optical network (XG-PON) systems: Definitions, abbreviations and acronyms (06/12)	ITU-T	2012
[4] G.987.1	10-Gigabit-capable passive optical networks (XG-PON): General requirements (01/10)	ITU-T	2010
[5] G.987.2	10-Gigabit-capable passive optical networks (XG-PON): Physical media dependent (PMD) layer specification (02/16)	ITU-T	2016
[6] G.987.3	10-Gigabit-capable passive optical networks (XG-PON): Transmission convergence (TC) layer specification (01/14)	ITU-T	2014
[7] G.988	ONU Management and Control Interface Specification (OMCI) (10/12)	ITU-T	2012

[8]	G.9807.1	10-Gigabit-capable symmetric passive optical network (XGS-PON) (06/16)	ITU-T	2016
[9]	RFC 2119	Key words for use in RFCs to Indicate Requirement Levels	IETF	1997
[10]	G.988 Amd.1	Recommendation G.988 (2012) Amendment 1 (05/14)	ITU-T	2014
[11]	TR-423 Issue 2	PON PMD Layer Conformance Test Plan	BBF	2018
[12]	TR-309 Issue 2	XG-PON and XGS-PON TC Layer Interoperability Test Plan	BBF	2018

3.3 Definitions

TR-309 Issue 2 Amendment 1 adds the following new definition to TR-309.

Alien ONU Alien ONU is an ONU which does not transmit valid PON PSBu pattern. It is a light source transmitting at the same wavelength as regular ONUs connected on the PON causing disturbances. In most cases, it will be a P2P ONU connected to ODN.

3.4 Abbreviations

TR-309 Issue 2 Amendment 1 adds the following new abbreviation to TR-309:

VOA Variable Optical Attenuator

4 Technical Report Impact

4.1 Energy Efficiency

TR-309 Issue 2 Amendment 1 has no impact on energy efficiency.

4.2 Security

TR-309 Issue 2 Amendment 1 has no impact on security.

4.3 Privacy

TR-309 Issue 2 Amendment 1 has no impact on privacy.

5 Test Configuration and Equipment

TR-309 Issue 2 Amendment 1 adds the following new configuration to TR-309:

5.7 Alien ONU Test Configuration

The following setup is used for Alien ONU test:

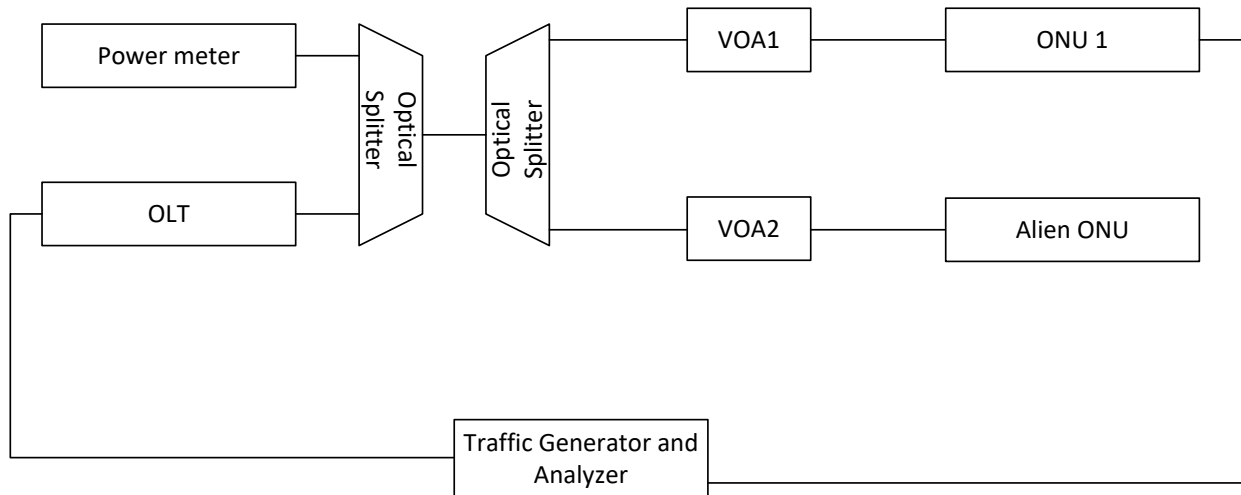


Figure 7: Alien ONU detection and resilience to alien ONU test set-up

6 Test Case Summary

6.3 XG-PON and XGS-PON Comprehensive TC Layer Tests

TR-309 Issue 2 Amendment 1 adds the following test case:

	Test Set		
Test Name	10G/2.5G	10G/10G	10G/10G+2.5G TDMA Coexistence
Alien ONU	(test section)		
8.7 Alien ONU Detection and resilience to alien ONU	Mandatory	Mandatory	Mandatory

7 Basic TC Layer Tests

No new tests.

8 Comprehensive TC Layer Tests

8.7 Alien ONU Detection and resilience to alien ONU

Test Status: Refer to Section 6

Reference Documents:

- ITU-T G.9807.1 (2016)/Amd.1 (10/2017) C.19.4, C.19.5

Test Objective:

The test case verifies how OLT deal with alien ONU. The requirement is that Alien ONU should be detected and proper alarm/event should be displayed.

Test Setup:

Please refer to Figure 7.

Pretest Conditions:

1. ONU1 is powered and connected to ODN.
2. ONU1 has been created at the OLT
3. Only 1 user traffic class should be configured per ONU (via defined OMCI messages below), requiring 1 GEM port (Alloc-ID, T-CONT, Port-ID)
4. Enable FEC
5. Enable OLT for Alien detection if necessary.
6. The Ethernet Traffic Generator should be configured to transmit Ethernet frames (maximization of the traffic load in upstream, and 1Mbit/s in downstream).
7. Four types of alien ONUs should be prepared: GbE Tx 1310 nm, 10GbE Tx 1270 nm, 10GbE Tx 1310 nm, 10GbE Tx 1330 nm
8. Alien ONU should be disconnected from the set-up

Test Configuration:

Profiles from the ONU discovery test (TR-309 Issue 2/7.1.1) are used in this test.

Additional parameters (e.g. VLAN tag mapping, order of generator and analyzer enable) are to be coordinated after pairing.

Parameters for bandwidth allocation structures:

- Alloc-ID: 1024
- Start time: at the discretion of the OLT
- Grant size: at the discretion of the OLT
- FWI: 0
- Burst profile: 0

If the specified Port-ID and/or Alloc-ID cannot be provisioned manually, automatic provisioning is allowed. In such case, these parameters will be coordinated after pairing.

Test Procedure:

1. Power on ONU1
2. Using VOA1 set the OLT Rx Power at sensitivity level according to ITU-T G.9807.1 Table: B.9
3. Run the traffic and confirm that no packet loss in upstream is observed. Stop the traffic.
4. Power off ONU1
5. Disconnect fiber from OLT.
6. Connect GbE Tx 1310nm as Alien ONU. Power on the alien ONU

7. Using VOA2 set the OLT Rx Power of Alien ONU to level equal to: $Rx_{alien} = Rx_{ONU1} - \text{Extinction ratio} - 1$ (for N1 transceiver it will be $Rx_{alien} = -26 - 6 - 1 = -33$ dBm)
8. Turn off Alien ONU
9. Power on ONU1
10. Connect fiber to the OLT
11. Wait for ONU1 ranging
12. Clear all counters and run the traffic
13. Turn on Alien ONU
14. Check whether OLT discovered Alien ONU.
15. Observe for frame loss in upstream for 60 sec
16. Reset ONU1, check whether ONU1 is able to range
17. Power off ONU1
18. Disconnect fiber from OLT
19. Reduce VOA2 attenuation by 1 dB
20. Repeat 8-19 until Alien ONU causes that no upstream traffic is transmitted in 15.
21. Repeat 2-20 for $Rx_{ONU1} = \text{Sensitivity} - 4$ dB, $\text{Sensitivity} - 8$ dB and Overload
22. Repeat 2-21 for Alien ONUs: 10GbE Tx 1270 nm, 10GbE Tx 1310 nm, 10GbE Tx 1330 nm
23. Fill in the table

Alien ONU type	GbE 1310 nm			
Level RxONU1	Sensitivity	Sensitivity + 4	Sensitivity + 8	Overload
Alien detected	True/False	True/False	True/False	True/False
Rxalien at which OLT discovers alien [dBm]				
Rxalien at which ONU1 was unable to range [dBm]				
Rxalien at which packet loss started for upstream [dBm]				
Rxalien at which upstream transmission was stopped [dBm]				
Alien ONU type	GbE 1270 nm			
Level RxONU1	Sensitivity	Sensitivity + 4	Sensitivity + 8	Overload
Alien detected	True/False	True/False	True/False	True/False
Rxalien at which OLT discovers alien [dBm]				
Rxalien at which ONU1 was unable to range [dBm]				
Rxalien at which packet loss started for upstream [dBm]				
Rxalien at which upstream transmission was stopped [dBm]				
Alien ONU type	10GbE 1310 nm			
Level RxONU1	Sensitivity	Sensitivity + 4	Sensitivity + 8	Overload
Alien detected	True/False	True/False	True/False	True/False
Rxalien at which OLT discovers alien [dBm]				
Rxalien at which ONU1 was unable to range [dBm]				
Rxalien at which packet loss started for upstream [dBm]				
Rxalien at which upstream transmission was stopped [dBm]				
Alien ONU type	10GbE 1330 nm			
Level RxONU1	Sensitivity	Sensitivity + 4	Sensitivity + 8	Overload
Alien detected	True/False	True/False	True/False	True/False
Rxalien at which OLT discovers alien [dBm]				
Rxalien at which ONU1 was unable to range [dBm]				

Rxalien at which packet loss started for upstream [dBm]				
Rxalien at which upstream transmission was stopped [dBm]				

Pass/Fail Criteria:

1. OLT was able to detect Alien ONU at Rxalien \leq sensitivity level

End of Broadband Forum Technical Report TR-309