



TECHNICAL REPORT

**TR-155**

**GPON ONU requirements for CPE**

**Issue: 2**

**Issue Date: September 2017**

## 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 copyrighted by the Broadband Forum, and all rights are reserved. Portions of this Technical Report may be 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 IS EXPRESSLY DISCLAIMED. ANY USE OF THIS TECHNICAL REPORT SHALL BE MADE ENTIRELY AT THE IMPLEMENTER'S OWN RISK, AND NEITHER THE BROADBAND FORUM, NOR ANY OF ITS MEMBERS OR SUBMITTERS, SHALL HAVE ANY LIABILITY WHATSOEVER TO ANY IMPLEMENTER OR THIRD PARTY FOR ANY DAMAGES OF ANY NATURE WHATSOEVER, DIRECTLY OR INDIRECTLY, ARISING FROM THE USE OF THIS TECHNICAL REPORT.

### 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.

The text of this notice must be included in all copies of this Technical Report.

**Issue History**

<b>Issue Number</b>	<b>Approval Date</b>	<b>Publication Date</b>	<b>Issue Editor</b>	<b>Changes</b>
1	May 2011	May 2011	Jean-Yves Cloarec, France Telecom  Christele Bouchat, Alcatel-Lucent	Original
2	4 September 2017	25 October 2017	Greg Bathrick Calix	Added reference for XGS-PON

Comments or questions about this Broadband Forum Technical Report should be directed to [help@broadband-forum.org](mailto:help@broadband-forum.org).

**Editors**

Greg Bathrick      Calix

**Fiber Access Networks  
WA Directors**

Greg Bathrick      Calix  
Wei Lin              Huawei Technologies

**Table of Contents**

Executive Summary .....	6
1 Purpose and Scope .....	7
1.1 Purpose.....	7
1.2 Scope.....	7
2 References and Terminology .....	8
2.1 Conventions .....	8
2.2 References.....	8
2.3 Definitions.....	10
2.4 Abbreviations .....	10
3 Technical Report Impact .....	11
3.1 Energy Efficiency .....	11
3.2 IPv6.....	11
3.3 Security .....	11
3.4 Privacy .....	11
4 GPON ONU baseline requirements .....	12
5 Remote management of the GPON ONU .....	13
6 GPON ONU initial provisioning.....	14
6.1 GPON ONU embedded in a Layer 3 CPE .....	14
6.2 GPON ONU embedded in a Layer 2 CPE .....	15
Appendix I: example of a flow diagram .....	17

## **Executive Summary**

TR-155 specifies the requirements of a GPON ONU for CPE. The GPON ONU could be embedded in a Routing Gateway with GPON uplink or in a stand alone layer 2 GPON ONU.

TR-155 Issue 2 broadens the applicability of TR-155 to include XG(S)-PON support.

## 1 Purpose and Scope

### 1.1 Purpose

TR-155 presents the requirements of a GPON ONU for CPE. The GPON ONU is a set of functions that could be embedded in a Routing Gateway with GPON uplink or it could be part of a GPON ONU without routing functions.

### 1.2 Scope

TR-155 specifies the requirements of a GPON ONU for CPE. The CPE may or may not embed routing capabilities, i.e. it may operate at layer 2 or at layer 3.

It inherits from the GPON ONU requirements of TR-156 [5], TR-124 [3], TR-142 [4], and provides additional requirements specific to a GPON ONU for CPE.

A subsection of TR-155 especially provides requirements for supporting a captive portal local to the GPON ONU, to allow the local setting of a registration ID. When the GPON ONU is not part of a Routing Gateway, the GPON ONU provides all connectivity necessary to terminals for accessing the local captive portal. These features are deactivated as soon as the ONU ranges successfully with the OLT.

Note: The remainder of this Technical Report uses the term G-PON in a generic manner to refer to any ITU-T TDM PON including G-PON, and XG(S)-PON

## 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 in RFC 2119 [1].

<b>MUST</b>	This word, or the term “REQUIRED”, means that the definition is an absolute requirement of the specification.
<b>MUST NOT</b>	This phrase means that the definition is an absolute prohibition of the specification.
<b>SHOULD</b>	This word, or the adjective “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.
<b>SHOULD NOT</b>	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.
<b>MAY</b>	This word, or the adjective “OPTIONAL”, means that this item is one of an allowed set of alternatives. An implementation that does not include this option <b>MUST</b> 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](http://www.broadband-forum.org).

Document	Title	Source	Year
[1] <a href="#">RFC 2119</a>	<i>Key words for use in RFCs to Indicate Requirement Levels</i>	IETF	1997
[2] TR-069	<i>CPE WAN Management Protocol</i>	Broadband Forum	2010
[3] TR-124	<i>Functional Requirements for Broadband Residential Gateway Devices</i>	Broadband Forum	2010



[4]	TR-142	<i>Framework for TR-069 enabled PON Devices</i>	Broadband Forum	2010
[5]	TR-156	<i>Using GPON Access in the context of TR-101</i>	Broadband Forum	2010
[6]	TR-181 Issue 2	<i>Device Data Model for TR-069</i>	Broadband Forum	2010
[7]	G.984 series and their amendments	<i>Gigabit-capable Passive Optical Networks</i>	ITU-T	2008
[8]	G.988 and its amendments	<i>ONU management and control interface (OMCI) specification</i>	ITU-T	2010
[9]	G.987 series and their amendments	<i>10 Gigabit-capable Passive Optical Networks</i>	ITU-T	2013
[10]	G.9807.1 series and their amendments:	<i>10 Gigabit-capable Symmetric Passive Optical Networks</i>	ITU-T	2016

### 2.3 Definitions

The following terminology is used throughout this Technical Report.

<b>Layer 2 GPON ONU</b>	GPON CPE without IP routing capabilities.
<b>Layer 3 GPON ONU</b>	GPON CPE embedding IP routing capabilities.
<b>OLT</b>	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 [7], 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.
<b>ONU</b>	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. In some contexts, an ONU implies a multiple subscriber device.

### 2.4 Abbreviations

This Technical Report uses the following abbreviations:

<b>ACS</b>	Auto-Configuration Server
<b>CPE</b>	Customer Premises Equipment
<b>CWMP</b>	CPE WAN Management Protocol
<b>FTTH</b>	Fiber to the Home
<b>GEM</b>	Generic Encapsulation Method
<b>GPON</b>	Gigabit-capable Passive Optical Network
<b>ME</b>	Managed Entity
<b>MTU</b>	Multi-Tenant Unit – or Maximum Transmission Unit
<b>ODN</b>	Optical Distribution Network – as defined in G.984.1 [7]
<b>OLT</b>	Optical Line Termination – as defined in G.984.1 [7]
<b>OMCI</b>	ONU Management and Control Interface
<b>ONU</b>	Optical Network Unit – as defined in G.984.1 [7]
<b>PLOAM</b>	Physical Layer Operations, Administration and Maintenance – as defined in G.984.3 [7]
<b>RG</b>	Residential Gateway
<b>TR</b>	Technical Report
<b>VLAN</b>	Virtual Local Area Network

### **3 Technical Report Impact**

#### **3.1 Energy Efficiency**

TR-155 has no impact on Energy Efficiency.

#### **3.2 IPv6**

TR-155 addresses IPv4 only.

#### **3.3 Security**

TR-155 has no impact on Security.

#### **3.4 Privacy**

Any issues regarding privacy are not affected by TR-155.

#### **4 GPON ONU baseline requirements**

These are the base requirements for a GPON ONU CPE:

- [R-1] The GPON ONU MUST comply with the GPON section of TR-124 [3] (IF.WAN.GPON.).
- [R-2] The GPON ONU MUST comply with the ONU requirements of TR-156 [5].

## 5 Remote management of the GPON ONU

Remote management of the GPON ONU complies with the requirements of Section 7.1/TR-156 [5] and TR-142 [4]. TR-142 [4] defines a framework for remote management of CPE over GPON and in particular clarifies the boundary and relation between TR-069 [2] and OMCI management domains:

- [R-3] The GPON ONU MUST be configured by the OLT, using OMCI, as defined in Section 6/TR-142.
- [R-4] Parameters of the GPON ONU may be monitored by an ACS, in this case the CPE MUST use CWMP as defined in TR-069 and the GPON data model defined in future revisions of TR-181 Issue 2 [6].

## 6 GPON ONU initial provisioning

As described in TR-156 [5], the primary method used for ranging between GPON ONU and GPON OLT is based on the ONU serial number. When the network provider does not wish to provision ONU serial numbers, he has to provision Registration ID instead. When the ONU serial number is not recognized by the OLT, the OLT requests the ONU to send its Registration ID. This method is defined in Section 7.2/TR-156 [5]. The “Registration ID”, identifies a subscriber. It is locally provisioned into the GPON ONU which serves that subscriber.

The ONU communicates the Registration ID to the OLT upon request of the latter, using the PLOAM channel G.984.3 [7]. The OLT provides a positive indication of the Registration ID verification result to the ONU via OMCI through the Credentials Status attribute G.988 [8]. Before the Registration ID verification result becomes available, the Credentials Status attribute indicates that the Registration ID verification is pending.

To allow the local provisioning of the Registration ID, the GPON ONU has to support different requirements depending on whether it is embedded in a Layer 3 CPE or in a Layer 2 CPE, as described hereafter:

### 6.1 GPON ONU embedded in a Layer 3 CPE

The requirements in this sub-section apply only when the GPON ONU is embedded in a Layer 3 CPE.

- [R-5] A captive portal as specified in TR-124 [3] (LAN.CAPTIVE.) MUST be embedded in the Layer 3 CPE.
- [R-6] The captive portal of the Layer 3 CPE MUST allow entering the Registration ID via a specific web page.
- [R-7] From the moment the user enters the Registration ID until the moment the positive verification result becomes available, the captive portal SHOULD display an appropriate pending status indication to the user while blocking attempts to re-enter the Registration ID.
- [R-8] The ONU MUST use the Credentials status attribute of the ONU-G ME to detect the result of registration verification as determined by the OLT.
- [R-9] After successful registration, the Layer 3 CPE MUST store the Registration ID in a non volatile memory and MUST deactivate the specific web page of the captive portal.
- [R-10] In case registration failure, the captive portal MUST invite the user to enter a new Registration ID.

## 6.2 GPON ONU embedded in a Layer 2 CPE

By definition a Layer 2 CPE does not have any Layer 3 capabilities but to allow communication with the captive portal for entering the Registration ID, the GPON ONU provides all features to provide the connectivity to the captive portal before the registration process. Those requirements are defined below:

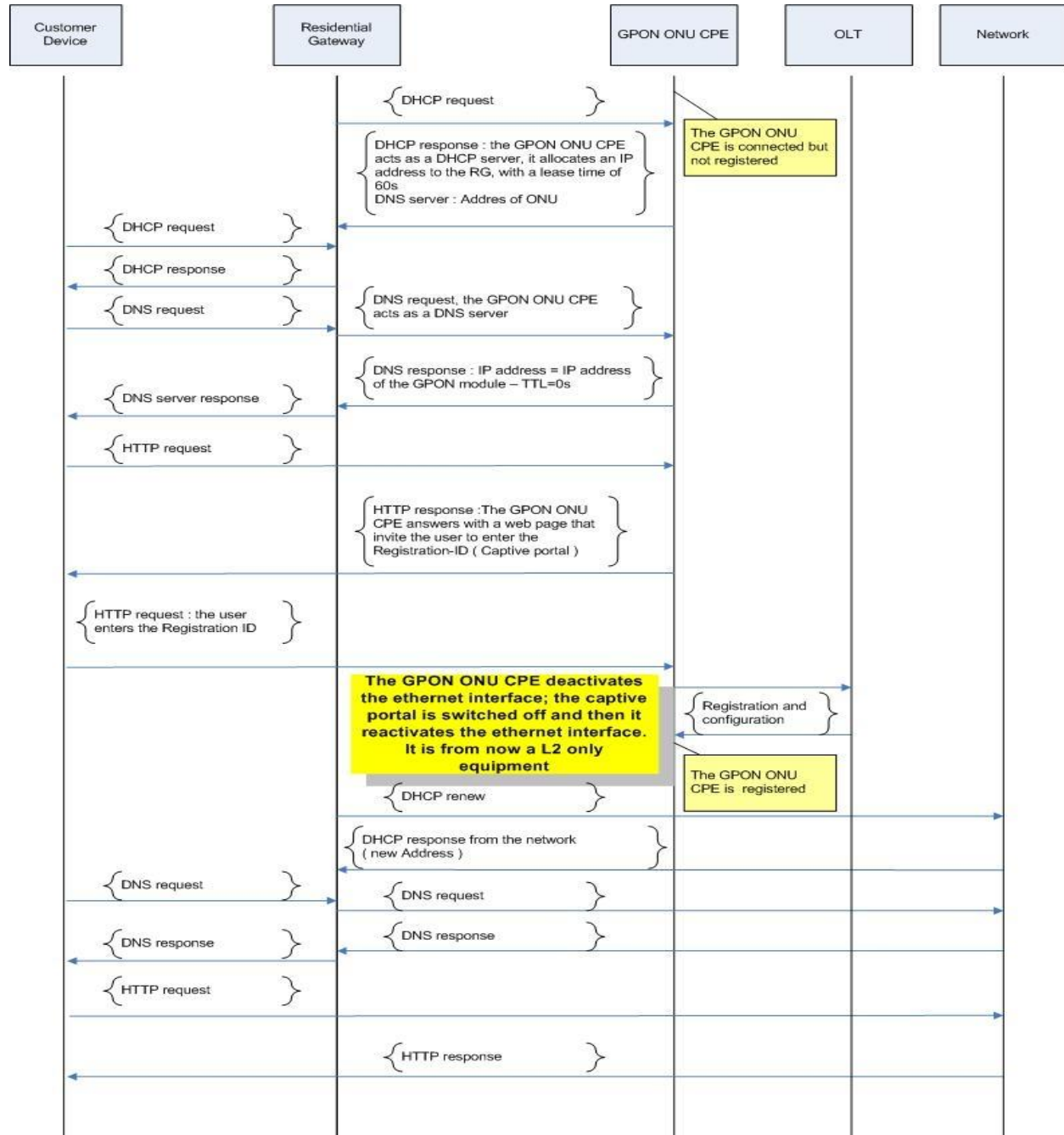
- [R-11] The local configuration of the GPON ONU via the ONU LAN ports **MUST** be limited to initiate the GPON ONU with a Registration ID that will enable the ONU to be identified by the OLT.
- [R-12] The GPON ONU **MUST** implement one logical IP interface, accessible through the LAN port on which the end device is connected and the VLAN used by the end device.
- [R-13] The GPON ONU **MUST** activate the logical IP interface described at [R-12] only when it has not ever been ranged previously on any PON since factory setting.
- [R-14] The IP interface of the GPON ONU described at [R-12] **MUST** be pre-provisioned in factory with any public IP address.  
Note that the usage of a public IP address and the related subnet (see [R-16]), avoiding conflict with LAN subnet in RGW connected use case, is possible because it's only locally used (there is no IP connectivity between the ONU and the Access Network).
- [R-15] The GPON ONU **MUST** implement a DHCP server, a PPPoE server, a DNS server and a HTTP server, accessible through any of the ONU LAN ports and any VLAN only when it has not ever been ranged previously on any PON since factory setting.
- [R-16] The DHCP server of the GPON ONU described at [R-15] **MUST** respond to any DHCP request and return an IP configuration with an IP subnet to which the GPON ONU's IP address described at [R-14] belongs, together with the GPON ONU's IP address described at [R-14] as a Domain Name Server and a Lease Time of 60 seconds.
- [R-17] The PPPoE server of the GPON ONU described at [R-15] **MUST** respond to any PPPoE request whatever the parameters the PPPoE request contain.
- [R-18] Using PPP/LCP and IPCP, the GPON ONU **MUST** provide an IP address and the GPON ONU's IP address described at [R-14] as a DNS server address without any authentication.

- [R-19] The DNS Server described at [R-15] of the GPON ONU MUST respond to any DNS request, whatever the targeted domain name it contains, with the GPON ONU's IP address, and a Time To Live of 0 seconds.
- [R-20] The HTTP server of the GPON ONU MUST respond to any HTTP request, whatever the targeted URL it contains, and return an HTML page, with no-cache directive, presenting a captive portal as specified in TR-124 [3] (LAN.CAPTIVE.) that provides a graphical interface allowing entering a Registration ID.
- [R-21] From the moment the user enters the Registration ID until the moment the positive verification result becomes available, the captive portal SHOULD display an appropriate pending status indication to the user while blocking attempts to re-enter the Registration ID.
- [R-22] The ONU MUST use the Credentials status attribute of the ONU-G ME to detect the result of registration verification as determined by the OLT.
- [R-23] After successful registration, the GPON ONU MUST terminate the PPPoE session (if applicable), switch off the DHCP and DNS servers and switch off and on all its LAN interfaces.
- [R-24] In case of registration failure, the captive portal of the GPON ONU MUST invite the user to enter a new Registration ID.
- [R-25] The GPON ONU MUST store the Registration ID in a non volatile memory.
- [R-26] The GPON ONU MUST implement a physical means to force the GPON ONU returning to its factory settings, i.e. allowing to flush its memory from the Registration ID.



## Appendix I: example of a flow diagram

Following is an example of a flow diagram between a Customer Device, a CPE, a separate Layer 2 GPON ONU, an OLT, and DHCP, DNS and HTTP servers in an operator’s network.



*External GPON ONU with DHCP Access*

End of Broadband Forum Technical Report TR-155