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Technical Standard
of China Telecommunications Corporation
Q/CT 2360-2011

Technical requirements for GPON equipment of
China Telecom

中国电信 GPON 设备技术要求

(V2.0)

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Issued in: April, 2011

Implemented in: April, 2011

Issued by: China Telecommunications Corporation

Table of Contents

Foreword.....	6
1 Scope	7
2 Normative references	7
3 Abbreviations.....	10
4 Reference model of GPON system	13
5 Types of service and equipment.....	14
5.1 Type of service	14
5.2 Type of equipment	14
6 GPON protocol requirements	19
6.1 Protocol reference model of the GPON system	19
6.2 PMD sublayer	19
6.3 TC sublayers	20
6.4 OMCI sublayers	21
7 Requirements for SNIs and UNIs	29
8 Ethernet functional requirements.....	31
8.1 Ethernet basic functions	31
8.2 VLAN functions	34
8.3 VLAN stacking function	41
9 Dynamic bandwidth allocation (DBA)	41
9.1 DBA general requirements	41
9.2 DBA functional requirements of OLT	42
9.3 DBA functional requirements of ONU	42
10 Multi-service QoS mechanism.....	43
10.1 General requirements for the multi-service QoS	43
10.2 Service level agreement (SLA)	43
10.3 Functions of service traffic classification	43
10.4 Priority marking	44
10.5 Priority queuing mechanism	45
10.6 Traffic speed limit	45

11	Security.....	48
11.1	Data security of PON interfaces.....	48
11.2	Restriction on MAC address number.....	48
11.3	Filtering and suppression	48
11.4	User authentication and subscriber access loop (port) identification.....	49
11.5	ONU authentication.....	49
11.6	Silence mechanism	56
11.7	Detection and treatment of the ONU with abnormal light emission.....	56
11.8	Other safety functions.....	56
12	Multicast function.....	57
12.1	Multicast implementation modes	57
12.2	Multicast mechanism and protocol requirements	57
12.3	Functional requirements for the distributed IGMP/MLD mode.....	58
12.4	Functional requirements for the controllable multicast.....	62
12.5	Multicast performance requirements	66
13	System protection.....	66
13.1	1 + 1 redundancy protection for the equipment main control panel	66
13.2	Dual homing protection of OLT upstream interface.....	67
13.3	Configuration recovery	68
13.4	Power redundancy protection.....	68
13.5	Optical link protection switching	68
14	Optical link measurement and diagnosis	75
14.1	General requirements.....	75
14.2	Parameter measurement of the OLT optical transceiver	75
14.3	Parameter measurement of the ONU optical transceiver	76
15	ONU software upgrading	77
16	Alarm functional requirements.....	78
17	Functional requirements for performance statistics	78
18	Voice service requirements	80
19	TDM service requirements	81
20	Time synchronization.....	82
21	Requirements for the service bearing performance indexes	82
21.1	Requirements for the Ethernet/IP service performance indexes.....	82

21.2	Requirements for the voice service performance indexes.....	83
21.3	Performance indexes of $n \times 64\text{Kbit/s}$ digital connection and E1 channel in circuit emulation mode.....	84
21.4	Requirements for the clock and time synchronization performance indexes.....	85
21.5	Reliability requirements.....	86
22	Requirements for the operation management and maintenance.....	86
22.1	General requirements.....	86
22.2	ONU remote management.....	86
22.3	Requirements for the ONU local management.....	87
23	ONU hardware requirements.....	89
23.1	Indicator requirements.....	89
23.2	Switches and buttons.....	90
23.3	Dying gasp and power-off protection time.....	90
23.4	Equipment tags.....	90
24	Other requirements.....	91
24.1	Environmental requirements.....	91
24.2	Power supply requirements.....	91
24.3	Equipment energy-saving requirements.....	92
24.4	Electrical safety requirements.....	93
Appendix A.....		95
A.1	Requirements for the SFU power supply.....	95
A.2	MDU power supply requirements.....	100
Appendix B.....		102
B.1	Definition of extended multicast operations profiles.....	102
B.2	EMOP application examples.....	110

Technical requirements for GPON equipment of China Telecom

1 Scope

This Standard specifies the requirements for the equipment model and specifications, protocol requirements, system basic functions, functional capacity and performance related to service bearing, system protection, operation and maintenance management, equipment environment and electrical safety of the gigabit-capable passive optical network (GPON) system.

This Standard applies to the OLT and ONU equipment for the GPON system under the network environment of China Telecom.

2 Normative references

The provisions in the following documents become the provisions of this enterprise technical standard through reference in this enterprise technical standard. For dated references, the subsequent amendments (excluding corrections) or revisions do not apply to this Standard. However, parties who reach an agreement based on this Standard are encouraged to study if the latest versions of these documents are applicable. For undated references, the latest versions apply to this Standard.

GB/T 7611 *Characteristics of the electrical interface at hierarchical bit rate for digital network*

GB/T 9254 *Information technology equipment – Radio disturbance characteristics – Limits and methods of measurement*

GB/T 17618 *Information technology equipment – Immunity characteristics – Limits and methods of measurement*

GB/T 17626 (All parts) *Electromagnetic compatibility – Testing and measurement techniques*

GB/T 20185 *Optical interface requirements for equipment and systems relating to the synchronous digital hierarchy*

YD/T 983 *Limits and methods of measurement of electromagnetic compatibility for telecommunication power supply equipment*

YD/T 1054 *Access network technical specification – Integrated digital loop carrier (IDLC)*

YD/T 1082 *Overvoltage and overcurrent protection for access network equipment as well as technical conditions for adaptability of fundamental environment*

YD/T 1292 *Technical requirement for H.248 media gateway control protocol*

YD/T 1530 *Technical requirements for access network – Extended bandwidth 2nd-generation asymmetric digital subscriber line (ADSL2+)*

YD/T 1996 (All parts) *Technical requirements for access network –Very high speed digital subscriber line 2 (VDSL2)*

YD/T **** *Technical requirements for access network – Gigabit-capable passive optical network (GPON)*

YD/T **** *Technical requirements for access network – EPON/GPON systems bearing TDM service*

YD/T **** *Technical requirements for access network – Subscriber access loop (port) identification in broadband access networks*

CCSA Communication Standard Technical Report *Energy efficiency metrologies and test methods of access equipment – GPON system*

IEEE 802.1ad *IEEE standard for local and metropolitan area networks – Virtual local area network (VLAN) protocol – Amendment 4: Provider bridges*

IEEE 802.1D *IEEE standard for local and metropolitan area networks –Media access control (MAC) bridges*

IEEE 802.1Q *IEEE standard for local and metropolitan area networks – Virtual local area network (VLAN) protocol*

IEEE 802.3 *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications*

IEEE 802.3af *Information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier sense multiple access with collision detection (CSMA/CD) access method and physical layer specifications – Amendment: Data terminal equipment (DTE) power via the media dependent interface (MDI) enhancements*

IEEE 802.3as *Frame expansion*

ITU-T G.652 *Characteristics of a single-mode optical fiber and cable*

ITU-T Y.1291 *An architectural framework for support of quality of service in packet networks*

ITU-T G.984.1 *Gigabit-capable passive optical network (GPON) – Part 1: General requirements*

ITU-T G.984.2 *Gigabit-capable passive optical network (GPON) – Part 2: Physical media dependent (PMD) layer requirements*

ITU-T G.984.3 *Gigabit-capable passive optical network (GPON) – Part 3: Transmission convergence (TC) layer requirements*

ITU-T G.984.4 *Gigabit-capable passive optical network (GPON) – Part 4: ONT management and control interface (OMCI) requirements*

ITU-T G.984.4 *Implementer's guide*

ITU-T G.988 *Gigabit-capable passive optical network (GPON) – ONU management and control interface (OMCI) specification*

IEEE 1588-2008 *Precision clock synchronization protocol for networked measurement and control systems*

IETF RFC 2236 *Internet group management protocol (IGMP), Version 2*

IETF RFC 2474 *Definition of the differentiated services field (DS field) in the IPv4 and IPv6 headers*

IETF RFC 2710 *Multicast listener discovery (MLD) for IPv6*

IETF RFC 2819 *Remote network monitoring management information base*

IETF RFC 2933 *Internet group management protocol MIB*

IETF RFC 3019 *IPv6 management information base for the multicast listener discovery protocol*

IETF RFC 3261 *Session initiation protocol (SIP)*

IETF RFC 3376 *Internet group management protocol (IGMP), Version 3*

IETF RFC 3810 *Multicast listener discovery version 2 (MLDv2) for IPv6*

IETF RFC 3925 *Vendor-identifying vendor options for dynamic host*

configuration protocol version 4 (DHCPv4)

IETF RFC 3985 Pseudo wire emulation edge-to-edge (PWE3) architecture

IETF RFC 4197 Requirements for edge-to-edge emulation of time division multiplexed (TDM) circuits over packet switching networks

IETF RFC 4553 Structure-agnostic TDM over packet (SAToP)

IETF RFC 5086 Structure-aware time division multiplexed (TDM) circuit emulation service over packet switched network (CESoPSN)

Broadband Forum TR-069 CPE WAN management protocol

Broadband Forum TR-142 Framework for TR-069 enabled PON devices

SFF-8472 Specification for diagnostic monitoring interface for optical transceivers

Q/CT 1923-2007 Specifications for SIP protocol in soft switching network of China Telecom – General requirements

Q/CT 1927-2007 Specifications for H.248 media gateway control protocol of China Telecom

Q/CT 2094-2010 General technical requirements for SIP protocol in IMS network of China Telecom

Q/CT 2270-2010 Technical requirements for home gateway (e8) of China Telecom

3 Abbreviations

The following abbreviations are applicable to this Standard.

ACL	Access Control List
ARP	Address Resolution Protocol
BC	Boundary Clock
BPDU	Bridge Protocol Data Unit
CATV	Community Antenna Television
CBR	Constant Bit Rate
CBU	Cellular Backhaul Unit
CDR	Call Detail Record
CRC	Cyclic Redundancy Check
CE	Conducted Emission
CVLAN	Customer VLAN
DA	Destination Address

MLD	Multicast Listener Discovery
MOS	Metal Oxide Semiconductor
MSB	Most Significant Bit
MSTP	Multiple Spanning Tree Protocol
MTU	Multi-Tenant Unit
MVR	Multicast VLAN Registration
ND	Neighbor Discovery
NT	Network Terminator
NTP	Network Time Protocol
ODN	Optical Distribution Network
OLT	Optical Line Terminal
OMCC	ONU Management and Control Channel
OMCI	ONU Management and Control Interface
ONT	Optical Network Terminal
ONU	Optical Network Unit
OSI	Open System Interconnection
P2MP	Point to Multipoint
PESQ	Perceptual Evaluation of Speech Quality
PLOAM	Physical Layer OAM
PMD	Physical Medium Dependent
PON	Passive Optical Network
PPPoE	Point-to-Point Protocol over Ethernet
PPS	Pulse Per Second
PTP	Precision Time Protocol
PVC	Permanent Virtual Circuit
PST	PON Section Trace
PWE3	Pseudo Wire Emulation Edge-to-Edge
QoS	Quality of Service
RED	Random Early Detection
RF	Radio Frequency
RSTP	Rapid Spanning Tree Protocol
SA	Source Address
SBU	Single Business Unit
SCB	Single Copy Broadcast
SFU	Single Family Unit
SIP	Session Initiation Protocol
SLA	Service Level Agreement
SLAAC	Stateless Address Auto Configuration
SNI	Service Node Interface
SP	Strict Priority
SR-DBA	Status Reporting DBA
STM	Synchronous Transfer Mode
SVLAN	Service VLAN
TC	Transmission Convergence

5 Types of service and equipment

5.1 Type of service

The type of service might be carried by the GPON system includes Ethernet/IP service, voice service, TDM service, and CATV service. TDM service refers to the E1 circuit emulation service. The GPON system shall have the capacity of carrying the Ethernet/IP service. It is recommended to use voice service. TDM and CATV services are considered as optional supports.

The GPON system shall support to use IPv4 and IPv6 to carry the above services simultaneously.

5.2 Type of equipment

5.2.1 OLT

OLT equipment containing one or more PON interfaces shall support Ethernet/IP service, and shall also provide Ethernet upstream interface. It is recommended to support circuit emulation mode of various services, including the TDM service, and to provide corresponding upstream interfaces.

The service slots of OLT shall support random intermixing of the customer boards of the GPON board, 1G-EPON board, 10G-EPON board, XG-PON board, gigabit Ethernet board (downstream interface), and 10 gigabit Ethernet board (downstream interface). ADSL2+ and VDSL2 boards are considered as optional supports.

The PON interface of OLT shall support pluggable PON optical module.

5.2.2 ONU

There might be various types of ONU equipment. This Standard specifies the following six major types according to recent application scenarios of the GPON equipment.

SFU (single family unit) type ONU

It is mainly used for providing individual home customers with Ethernet/IP service, along with the broadband access terminal function. CATV service is considered as an optional support. SFU type ONU has 1 or 4 Ethernet interfaces. The CATV RF interface, which is mainly applied to the FTTH scenario (can be used in conjunction with the home gateway, so as to provide stronger service capacity), is considered as an optional support as well.

According to different service types and interface quantity of ONU, 2 specific

Table 5-3 Specific Forms of MDU Type ONU

Serial No.	Quantity of Ethernet interfaces	Quantity of ADSL2+ interfaces	Quantity of VDSL2 interfaces	Quantity of POTS interfaces	CATV RF interface
MDU-1	8/16/24 FE	0	0	0	Optional
MDU-2	8/16/24 FE	0	0	8/16/24/32/48	Optional
MDU-3	0	16/24/32/48/64	16/24/32/48/64	24/32/48/64	0

(Note: The quantities listed in the table above refer to the interface quantity of the boards in the stationary or plug-in equipment.)

The MDU equipment for the Ethernet interface (MDU-1 and MDU-2) shall use one of the three following architectures:

- a) Stationary cassette type (MDU-1 or MDU-2): The height shall be 1U (4.445cm), and the recommended width shall be standard 19 inches. For MDU-2, the quantity of POTS interfaces shall be the same with that of Ethernet interfaces.
- b) Plug-in cassette type (MDU-2): The height shall be 1U (4.445cm), and the recommended width shall be standard 19 inches. There shall not be less than 2 service slots. This type of MDU-2 equipment shall support the flexible intermixing of the Ethernet interface board and the POTS board. The interface quantity of each Ethernet interface board shall be 8 or 16, while the interface quantity of each POTS board shall be 8, 16 or 24.
- c) Small plug-in type (MDU-2): The height shall be 2U (8.89cm), and the recommended width shall be standard 19 inches. There shall not be less than 4 service slots. This type of MDU-2 equipment shall support the flexible intermixing of the Ethernet interface board and the POTS board. The interface quantity of each Ethernet interface board shall be 8 or 16, while the interface quantity of each POTS board shall conform to the provision for MDU-2 specified in Table 5-3. It is recommended to support intermixed DSL interface boards. The modular design of upstream interfaces shall also be supported, which can flexibly replace the upstream interfaces with 1G-EPON, 10G-EPON, XG-PON, GE, 10GE and other upstream interfaces via pluggable upstream modules.

The MDU equipment for the DSL interface (MDU-3) shall use one of the two following architectures:

- a) Small plug-in type: The height shall be 2U (8.89cm), and the recommended width shall be standard 19 inches. There shall not be less than 4 service slots.
- b) Medium-sized plug-in type: The height shall be over 2U (8.89cm), and the

Table 5-5 Specific Forms of MTU Type ONU

Serial No.	Quantity of Ethernet interfaces	Quantity of E1 interfaces	Quantity of POTS interfaces
MTU-1	16 FE	4/8	0
MTU -2	8/16 FE	4/8	8/16

CBU (cellular backhaul unit) type ONU

It is mainly used for being connected into base stations for providing Ethernet/IP and TDM services. CBU type ONU has multiple Ethernet and 1PPS+ToD interfaces. The E1 interface, which is mainly applied to the backhaul scenario of mobile base stations, is considered as an optional support.

3 specific forms of CBU type ONU are given in Table 5-6.

Table 5-6 Specific Forms of CBU Type ONU

Serial No.	Quantity of Ethernet interfaces	Quantity of E1 interfaces	Quantity of 1PPS+ToD interfaces
CBU-1	4 FE or GE	4	2
CBU-2	4 FE or GE	8	2
CBU-3	4 FE or GE	0	2

5.2.3 PoE function of ONU

It is recommended to use specific model of SFU equipment to support the PoE function (can be used for providing power supply for the AP laid out at the wireless hotspot), which is to transmit data and current at the same time via the data cable (1, 2, 3 and 6) of the RJ45 Ethernet electrical port to provide power supply for other power receiving equipment supporting PoE. The relevant PoE function shall conform to the IEEE 802.3af standard.

The ONU equipment supporting PoE shall also support internal PoE power supply. The maximum power supply distance shall not be less than 100m. The maximum output power provided by the equipment hanging on each Ethernet electrical port shall not be less than 15W. Furthermore, the service power shall be configurable within the range of 1W ~ 15W.

The PoE plus function is considered as an optional support for the specific model of SFU equipment. The maximum output power provided by the equipment hanging on each Ethernet electrical port shall not be less than 30W. Furthermore, the service power shall be configurable. The relevant functions shall conform to the IEEE 802.3at standard.

Specific model of SFU equipment shall be recommended to support the power receiving function of the PoE. The relevant PoE function shall conform to the IEEE 802.3af or IEEE 802.3at standard.

conform to the relevant requirements specified in the G.984.2 Amd1. Furthermore, it is recommended to support Class C+. The central wavelength of the upstream channel is 1,310nm. The wavelength shall be within the range of 1,290nm ~ 1,330nm. Specific parameters of the optical interface shall conform to the relevant requirements specified in the G.984.2 Amd2.

The GPON system shall support the downstream transmission bit rate of 2488.32Mbit/s, and the upstream transmission bit rate of 1244.16Mbit/s.

6.3 TC sublayers

6.3.1 General requirements for TC sublayers

The TC sublayers of the GPON system shall conform to the provisions specified in the G.984.3, and shall use GPON encapsulation method (GEM). TC sublayers shall support downstream FEC. The upstream FEC shall be considered as an optional support.

Alloc-ID value of the OMCC channel of ONU shall be the same with the ONU-ID value, and shall be within the range of 0 ~ 253.

ONU shall support emergency state (O7). After receiving the message of Disable_Serial_Number, ONU shall switch from activated state to O7 state, and turns off the laser. If failing to switch to O7 state, OLT shall report an alarm. After rebooting, the ONU in O7 state shall be still in O7 state. If ONU does not enter O7 state, OLT shall report an alarm.

The time interval for ONU to report REI shall default to 10s. After ONU enters O5 state, OLT can set the time interval of REI reporting via the BER Interval message.

6.3.2 Upstream burst mode overhead

The GPON upstream burst mode overhead is composed of guard time, preamble, and delimiter. The maximum length of the entire overhead is 128 bytes.

OLT indicates the length of the guard time domain in the ONU upstream burst mode overhead and the pattern value of the upstream delimiter used by ONU in the Upstream_Overhead message. The GPON system shall use the 32-bit guard time, 20-bit delimiter, and pattern value of 0XB5983. The domain length of the upstream delimiter is 24 bits. The pattern value of the type 3 preamble indicated in the upstream_overhead message is considered as high-order 4 bits in the 24-bit delimiter, which means that the pattern value of complete 24-bit delimiter is 0XAB5983.

	[Translator: empty row]				
65500-65528	Reserved				
65529	ONU capability	Required	Required	Required	Required
65530	LOID authentication	Required	Required	Required	Required
65531	Extended multicast operation profiles	Required	Required	Required	Required

In the HGU/SBU/MDU/MTU, Virtual Ethernet interface point (VEIP) shall be supported to be considered as the switching point of the OMCI and non-OMCI management domains (only the TR-069 protocol shall be considered in the FTTH scenario, and there is no need to consider the SNMP protocol for the time being) on the data plane. This ME can only be managed via the OMCI, and is visible but not manageable to the non-OMCI management domain. Likewise, all the modules on the UNI side beneath the VEIP are visible but not manageable to the OMCI management domain, but only visible and manageable to the non-OMCI management domain. In addition, each ONU shall only have one VEIP.

During the MIB upload, ONU shall only report the required ME and the supporting optional ME specified in this Standard (Table 6-1), instead of the ME related to the LOID authentication and performance monitoring, and the T-CONT ME of the OMCC channel. ONU shall be used according to the equipment type, and shall report any one from the VEIP and PPTP during the MIB upload. SFU shall only use and report the PPTP, and shall not use the VEIP; while HGU shall only use and report the VEIP, and shall not use the PPTP. OLT shall determine the ONU equipment type according to the property of the ONU Type in the ME: ONU Capability. If reporting the ME excluded in this Standard, OLT shall ignore, and shall determine to be right. OLT shall not be mandatorily configured with the ME excluded in the Table 6-1. Furthermore, ONU shall not enforce OLT to configure the ME excluded in the Table 6-1.

For conducting the fault monitoring and diagnosis of the optical link in the GPON system, Test and Test result commands shall be used for calling ANI-G to collect the parameters of the ONU optical modules.

6.4.2 Principles of ME creation/deletion/configuration

ME creation/deletion/configuration process shall follow the rules below:

- (1) For the ME without any directional relationship, do NOT enforce regulations and restrictions on the creation/deletion/configuration sequence.
- (2) For the ME with uni-directional relationship, CREATE the directed ME with priority, and DELETE the directed ME at last.

and Multicast Services of the Multi-port SFU in the FTTH Scenario

The TR069 management channel of the HGU equipment shall also use the MAC bridge shown in the Figure 6-2. There is no need of referring to the MAC bridge specially established for the management channel shown in the Figure 14.1 of the G.984.4 *Implementer's guide (second revision)*.

The ONU using VEIP shall also use ME: Circuit pack and Cardholder. The property of the management capability in the UNI-G shall be set as 0x02.

6.4.4 OMCI configuration requirements of the multicast service in the FTTH scenario

OLT and ONU shall be able to establish the multicast service channel by referring to the OMCI configuration models shown in the Figure 6-2 and Figure 6-3. USE the managed entity EMOP (extended multicast operations profile) whose class value is 65531 (decimal) to realize multicast access control, inter-VLAN multicast, and other functions. SEE Appendix B for specific provisions.

After OLT configures the multicast entity relationship of ONU, ONU shall save the relevant information of the multicast channel, including the multicast dependent entity (EMOP, Multicast GEM interworking termination point), and multicast VLAN dependent entity (VLAN tagging filter), when the customer leaves the multicast group. When the ONU customers join the multicast group again, OLT shall not configure the multicast-related ME any longer.

In IGMP snooping mode, the contents of the dynamic access control list table of EMOP and the multicast address table in the multicast GEM interworking termination point shall refer to the table entries in the full range of 224.0.1.0 to 239.255.255.255. In controllable multicast mode, OLT sends the multicast access of ONU to the ONU via the dynamic access control list table of EMOP. Furthermore, when the customers join or leave the multicast group, do NOT dynamically refresh the multicast control table in the multicast gempport IWTP.

In order to realize the inter-VLAN multicast of ONU, USE the ME (extended multicast operations profile) whose class value is 65531 (decimal). SEE Appendix B for specific provisions. USE the properties of the upstream IGMP tag control and upstream IGMP TCI in this ME to process the IGMP message in the upstream direction. USE the properties of the downstream IGMP and multicast TCI to accomplish the VLAN processing of the multicast stream and IGMP message in the downstream direction. SEE the Section B.2 in the Appendix B for the application examples of EMOP.

6.4.5 Message transaction identifier in the OMCI

The transaction identifier of the Response message in the OMCI shall be the

same with that of the corresponding Request message. The transaction identifier of the actively reported event message shall be 0x0000. When using the Test message, the transaction identifiers of the Response and Test Result messages shall be the same with that of the Test message.

6.4.6 Capability set reporting of ONU

ADD the ME (ONU capability) in order to facilitate the OLT understanding of the ONU equipment. This ME is the only ME created locally by the ONU in the overall situation. CREATE this read-only ME after electrifying the ONU. The class value of this ME shall be 65529 (decimal).

ONU capability

Relationship: ME created by the ONU

Attributes:

ME ID: 0x0000 (2 bytes)

Operator ID: the identifier representing the operator, and the default configurations shall be "C", "T", "C" and "NULL" (4 bytes) (R) (mandatory)

CTC Spec Version: version information of the GPON enterprise standards of China Telecom, and do not take the enterprise standard versions below V2.0 into considerations for the time being (R) (mandatory) (1 byte)

0x00: GPON enterprise standard of China Telecom (V2.0)

Other values are reserved

ONU type: ONU equipment type (R) (mandatory) (1 byte)

0x00: SFU

0x01: HGU

0x02: SBU

0x03: CBU

0x04: MDU

0x05: MTU

Other values are reserved

ONU Tx power supply control: this property identifies whether the transmitter

For the E1 signals carried by the ONU, ONU shall be able to use the self-adaption method, differential method, or the line clock of the PON interface to recover the service timing.

7 Requirements for SNIs and UNIs

7.1 Requirements for the service node interfaces (SNIs) of OLT

The service nodes of OLT shall be able to provide FE interfaces, GE interfaces, and 10GE interfaces as required. At least 4 GE upstream interfaces shall be provided.

For the multi-service OLT equipment providing TDM data line services, the service nodes shall support E1 interfaces, and STM-1 or STM-4 interfaces.

OLT shall support pluggable optical modules of the upstream interface.

7.1.1 GE interface

GE interfaces shall conform to the provisions specified in the IEEE 802.3.

7.1.2 10GE interface

10GE interfaces shall conform to the provisions specified in the IEEE 802.3.

7.1.3 10/100BASE-T interface

10/100BASE-T interfaces shall conform to the provisions specified in the IEEE 802.3.

7.1.4 E1 interface

E1 interfaces shall conform to the provisions specified in the GB/T 7611.

7.1.5 STM-N interface

STM-N interfaces shall conform to the provisions specified in the GB/T 20185.

7.1.6 1PPS+ToD interface

1PPS+ToD input interfaces are used for supporting the input or output of the phase synchronization information (1PPS) and current time value (ToD). SEE relevant industry standards for the specific requirements.

7.2 Requirements for the user network interfaces (UNIs) of ONU

The user network interfaces of ONU include 10/100BASE-T interfaces,

Technical requirements for home gateway (e8) of China Telecom.

8 Ethernet functional requirements

8.1 Ethernet basic functions

8.1.1 MAC switching function

8.1.1.1 MAC address switching function of OLT

OLT shall support MAC address switching and dynamic MAC address learning. The MAC address learning capability shall not be less than 1,000pcs/s.

The MAC address buffer capacity of each PON interface on the GPON interface board of the OLT shall not be less than 2K. For the OLT whose maximum number of PON interface is greater than or equal to 32, the MAC address buffer capacity at the convergence switching section shall not be less than 64K, which is suggested to be $2K \times$ maximum number of PON interface. For the OLT whose maximum number of PON interface is less than 32, the MAC address buffer capacity at the convergence switching section shall not be less than $2K \times$ maximum number of PON interface.

The MAC address aging time of OLT shall be configurable.

8.1.1.2 MAC address switching function of SFU/HGU/SBU type ONU

The SFU/HGU/SBU type ONU with more than one Ethernet interface shall support MAC address switching and dynamic MAC address learning. The MAC address learning capability shall not be less than 1,000pcs/s. The unicast MAC address buffer capacity shall not be less than 32.

8.1.1.3 MAC address switching function of MDU/MTU type ONU

The unicast MAC address buffer capacity of MDU/MTU type ONU shall not be less than $32 \times$ number of broadband user interfaces.

The MAC address aging time of ONU shall be configurable.

8.1.2 Layer-2 switching capability

8.1.2.1 Layer-2 switching capability of OLT

OLT shall support the layer-2 switching function of Ethernet services. The layer-2 switching capability shall ensure the wire-speed forwarding of upstream and downstream services.

number of aggregate interfaces of the link aggregation group for the FE interface shall not be less than 8, the maximum number of aggregate interfaces of the link aggregation group for the GE interface shall not be less than 4, and the maximum number of aggregate interfaces of the link aggregation group for the 10GE interface shall not be less than 2.

The interface link aggregation in and between the upstream boards shall be supported. The equipment's FE and GE interfaces in the board must be able to support the link aggregation function specified in the IEEE 802.3ad under the condition of single VLAN or enabling the SVLAN, so as to realize the functions of bandwidth expansion and link protection. The link aggregation function shall support the load balancing and main-standby switching between the links, and shall be configurable as well.

The link aggregation function of OLT upstream interfaces shall support 1: 1 backup protection. The switching time shall be less than 200ms, and is suggested to be less than 50ms.

8.1.9 Port loopback function

OLT shall be able to remotely turn on or off the Ethernet port loopback function of the ONU via OMCI messages. ONU shall support the Ethernet port loopback function. USE the property of Ethernet loopback configuration of the managed entity "physical path termination point Ethernet UNI" to perform the Ethernet port loopback function of the ONU.

8.2 VLAN functions

8.2.1 Definition of VLAN mode

VLAN translation refers to the 1: 1 translation between input VLAN and output VLAN.

N: 1 VLAN aggregation is to aggregate multiple upstream VLAN (such as VLAN 1, 2, ..., X) services into one VLAN (such as VLAN Y), and to reversely map the downstream service (e.g. VLAN Y) into multiple VLANs (VLAN 1, 2, ..., X) (based on MAC or Cos, it is not suggested to use the VLAN aggregation based on Session ID and other layer-3 identifiers and above). When realizing the N: 1 aggregation, ENSURE the layer-2 isolation between the original different VLAN services.

For the concrete rules of conduct of various VLAN modes, the provisions are as follows:

- (1) VLAN transparent transmission mode: In this mode, OLT or ONU equipment conducts transparent up forwarding instead of processing the received

upstream Ethernet frames (regardless of whether the Ethernet frames have VLAN tags); for the downstream Ethernet frames, transparent forwarding mode also applies. SEE Table 8-1 for the details of equipment processing mode.

Table 8-1 Equipment Processing Mode in VLAN Transparent Transmission Mode

Direction	Whether the Ethernet packet is tagged	Processing mode
Upstream	With VLAN tag	FORWARD the Ethernet packet without making any changes (keep the original VLAN tag).
	Without VLAN tag	FORWARD the Ethernet packet without making any changes.
Downstream	With VLAN tag	FORWARD the Ethernet packet without making any changes (keep the original VLAN tag).
	Without VLAN tag	FORWARD the Ethernet packet without making any changes.

(2) VLAN tagging mode: In this mode, OLT or ONU equipment adds a VLAN tag for each received upstream Ethernet frame; for the downstream Ethernet frames, strip their VLAN tags instead. SEE Table 8-2 for the details of equipment processing mode.

Table 8-2 Equipment Processing Mode in VLAN Tagging Mode

Direction	Whether the Ethernet packet is tagged	Processing mode
Upstream	With VLAN tag	DISCARD.
	Without VLAN tag	LABEL new VLAN tags (the main parameter is VID). FORWARD afterwards. In current circumstances, the equipment is only required to be able to configure the VID values. IGNORE the received TPID and Pri fields. SET the TPID and Pri of the tag as default values (TPID = 0x8100, Pri = 0).
Downstream	With VLAN tag	FORWARD to corresponding ports according to the VID. STRIP the tag. If the VLAN ID of the downstream tagged message is not equal to the configured VID, DISCARD this message.
	Without VLAN tag	DISCARD.

(3) VLAN translation mode: In this mode, OLT or ONU equipment translates the VLAN tag labeled by the user himself/herself in the upstream Ethernet frames (its VID might not be exclusive, it is likely that other users in the same system use the same VID) into the only VLAN tag on the network side. PERFORM reverse operation in the downstream direction. When OLT or ONU equipment supports VLAN translation, the VLAN translation shall support the EtherType value to be 0x8100. Other EtherType values are considered as optional supports. SEE Table 8-3 for the equipment

		trunk processing according to the VID. No requirements for the processing of other fields (such as TPID, CFI and Pri) are made temporarily. The equipment ignores the received TPID and Pri fields, and uniformly sets the TPID of the message VLAN tag as default value (TPID = 0x8100). KEEP the original value of the Pri.
	Without VLAN tag	LABEL default VLAN on the untagged message. FORWARD afterwards.
Downstream	With VLAN tag	FORWARD down if the VLAN ID carried by the message belongs to the "allowable VLAN access" of this interface. If the VLAN ID carried by the message is "default VLAN", STRIP the VLAN tag, and FORWARD down afterwards. DISCARD if the VLAN carried by the message does not belong to the "allowable VLAN access" of this interface. In current circumstances, the equipment is only required to translate the VID. No requirements for the translation of other fields (such as TPID, CFI and Pri) are made temporarily. The equipment ignores the received TPID and Pri fields, and sets the translated TPID of the VLAN tag as default value (TPID = 0x8100). KEEP the original value of the Pri.
	Without VLAN tag	DISCARD.

8.2.2 VLAN function of OLT

OLT shall support IEEE 802.1Q protocol. The PON interface side of the OLT shall support not only the VLAN tagging/untagging, VLAN trunk, VLAN transparent transmission, VLAN translation, N: 1 VLAN aggregation, VLAN priority marking, and VLAN filtering based on GEM port, PON interface, etc., but also the VLAN division and priority marking based on GEM port, PON interface, EtherType (at least support PPPoE, IPoE and IPv6oE).

OLT shall support two managed entities, namely VLAN tagging filter data, and extended VLAN tagging operation, for managing the VLAN function.

The entry number of the VLAN translation supported by the OLT's main switching board shall be 4,094. Each PON interface on the PON interface board shall support no less than 512 entries of VLAN translation.

The OLT's N: 1 VLAN aggregation includes different VLAN aggregations under the same ONU, specified N: 1 VLAN aggregations among different ONUs, different VLAN aggregations under the same PON interface, and specified N: 1 VLAN aggregations among different PON interfaces.

OLT shall support the mixed use of VLAN translation and N: 1 VLAN aggregation (1: 1 ratio and N: 1 ratio apply at the same time). In the meanwhile, the OLT equipment is required not to affect its forwarding performance during the realization of 1: 1 VLAN translation, N: 1 VLAN aggregation, and mixed use.

When OLT performs different N: 1 VLAN aggregations in the same ONU, N shall not be less than 8; when performing specified N: 1 VLAN aggregations among different ONUs (the same kind of service convergence of multiple users for one VLAN, including the specified N: 1 VLAN aggregations in the same PON interface and among different PON interfaces), N shall not be less than at least $64 \times$ number of PON interfaces.

The network side of the OLT shall support VLAN trunk. In the meanwhile, OLT shall support 4K VLAN number. VLAN ID shall be within the range of $1 < 4094$. Each PON interface shall also support 4K VLAN number.

8.2.3 VLAN function of ONU

ONU shall support IEEE 802.1Q protocol. Furthermore, ONU shall support VLAN transparent transmission, VLAN tagging, VLAN translation, N: 1 VLAN aggregation, and VLAN trunk. MDU shall support the VLAN division based on physical user interface and EtherType (at least support PPPoE, IPoE and IPv6oE).

ONU shall support two managed entities, namely extended VLAN tagging operation configuration data, and VLAN tagging filter data, for managing the VLAN function. ONU's operations in VLAN trunk, VLAN transparent transmission, VLAN tagging, VLAN translation, and N: 1 VLAN aggregation modes shall conform to the above-mentioned provisions for the definition of VLAN mode. These five VLAN modes shall use the entities of extended VLAN tagging operation configuration data and VLAN tagging filter data for management.

8.2.3.1 VLAN function of SFU/SBU/MTU type ONU

Each Ethernet UNI of SFU/SBU/MTU type ONU shall support at least 8 VLAN IDs. VLAN ID shall be within the range of $1 < 4094$. SFU/SBU/MTU type ONU shall support VLAN transparent transmission, VLAN tagging, VLAN translation, and VLAN trunk operations. N: 1 VLAN aggregation is considered as an optional support.

The complete SFU/SBU type ONU and each Ethernet UNI shall support at least 8 entries of VLAN translation.

Each Ethernet UNI of the MTU type ONU shall also support at least 8 entries of VLAN translation.

8.2.3.2 VLAN function of HGU type ONU

The VLAN function of HGU type ONU shall conform to the provisions specified in the *Technical requirements for home gateway (e8) of China Telecom*.

8.2.3.3 VLAN function of MDU type ONU

MDU type ONU shall support VLAN transparent transmission, VLAN tagging, VLAN translation, VLAN trunk, N: 1 VLAN aggregation, and VLAN filtering (based on trunk realization). MDU type ONU shall support at least “8 × maximum number of broadband interfaces” (including Ethernet interfaces, ADSL2+ interfaces, or VDSL2 interfaces) VLAN IDs. VLAN ID shall be within the range of $1 < 4094$.

Each Ethernet/VDSL2 interface of the MDU type ONU shall support at least 8 entries of VLAN translation. The complete MDU type ONU shall support at least “8 × number of Ethernet/VDSL2 interfaces” entries of VLAN translation. The MDU type ONU shall support not only the α - α VLAN translation, but also the same VLAN ID on the network side after the VLAN translation of multiple Ethernet/VDSL2 interfaces. Furthermore, MDU type ONU can ensure the normal forwarding of upstream and downstream services. It shall also support part of VLAN's α - α and β - γ VLAN translation operations (α , β and γ are VLAN IDs).

The Ethernet/VDSL2 interfaces of the MDU type ONU shall support N: 1 VLAN aggregation (N shall not be less than 8), and at least 4 N: 1 VLAN aggregation

groups, and $\sum_{i=1}^M N_i$ shall not be less than 8 (M refers to the number of the aggregation groups configured at the interfaces).

The N: 1 VLAN aggregation of MDU type ONU's Ethernet/VDSL2 interfaces shall support the following kinds of usage modes:

Multiple N: 1 VLAN aggregations shall be supported under the same Ethernet/VDSL2 interface (the N: 1 VLAN aggregations from α , β , γ ... to A belong to one N: 1 VLAN aggregation).

CONDUCT the N: 1 aggregation where $N = 1$ to part of VLAN. CONDUCT the N: 1 aggregation where $N > 1$ to part of VLAN.

CONDUCT the α - α N: 1 aggregation where $N = 1$ to part of VLAN. CONDUCT the N: 1 aggregation where $N > 1$ to part of VLAN.

In the meantime, different interfaces of the MDU equipment are required not to affect the equipment's forwarding performance during the realization of VLAN translation, N: 1 VLAN aggregation, and mixed use of different modes.

The MDU equipment's ADSL2+ interfaces shall support the VLAN division according to PVC, one VLAN division for each PVC (1: 1 mapping from PVC to VLAN), and one VLAN division for multiple PVCs (N: 1 mapping from PVC to VLAN, which is to converge multiple PVCs for multiple users to carry the same

10 Multi-service QoS mechanism

10.1 General requirements for the multi-service QoS

The GPON system shall provide necessary QoS mechanism, so as to guarantee the QoS that is able to provide various priority services according to the SLA protocol in the upstream and downstream directions.

The GPON system shall support the QoS mechanism based on ITU-T Y.1291, including the service traffic classification (traffic classification), priority marking (marking), queuing and scheduling, traffic shaping and traffic policing, congestion avoidance, buffer management, etc.

10.2 Service level agreement (SLA)

The GPON system shall support the SLA parameter setting for each user or service. For instance, the system can make provisions on the fixed bandwidth, assured bandwidth, maximum bandwidth, and other SLA parameters for different users and services, and shall support to make respective configurations for the upstream and downstream services.

10.3 Functions of service traffic classification

10.3.1 Upstream service traffic classification of OLT

OLT shall support the upstream service traffic classification based on the relevant parameters in the Ethernet frames. CONDUCT priority marking according to the requirements specified in the Section 10.4. In default state, OLT trusts the priority marking provided by the ONU, and does not enable this function.

The parameters that can be applied to the service traffic classification include: GEM Port, MAC DA, MAC SA, VLAN ID, User Priority (IEEE 802.1D), EtherType (such as PPPoE, IPoE, IPv6oE, etc.), destination IPv4 address, source IPv4 address, destination IPv6 address, source IPv6 address, destination IPv6 address prefix, source IPv6 address prefix, IP protocol version (v4 and v6), IP protocol type (TCP, UDP, ICMPv4, ICMPv6, IGMP, MLD, etc.), IP priority (v4 TOS, DSCP, and v6 Traffic Class), IP Flow Label (IPv6), destination L4 protocol port, source L4 protocol port, etc. It is suggested to support the deep flow inspection (first 80 bytes) classification of the message.

10.3.2 Upstream service traffic classification of SFU/SBU type ONU

ONU shall support the upstream service traffic classification based on the physical port and relevant parameters in the Ethernet frames. MAP different

10.6.1.1 Upstream service traffic speed limit of OLT

OLT shall support DBA mechanism, so as to realize the upstream bandwidth allocation and upstream service traffic speed limit of each Alloc_ID.

L2 traffic shaping is considered as an optional support for the OLT equipment's upstream interface (SNI).

10.6.1.2 Upstream service traffic speed limit of ONU

The user interfaces of the MDU and MTU type ONU equipment shall support the upstream speed limit of interfaces.

The upstream speed limit of interfaces is considered as an optional support for the user interfaces of the SFU, SBU and HGU type ONU equipment.

In the meanwhile, ONU performs upstream service traffic scheduling according to the OLT's DBA authorization, so as to realize the upstream service traffic speed limit.

10.6.2 Downstream service traffic speed limit

10.6.2.1 Downstream service traffic speed limit of OLT

For downstream services, OLT shall support the rate control for user VLAN, GEM port or different classification traffics, and the L2 traffic shaping or policing mechanism.

10.6.2.2 Downstream service traffic speed limit of ONU

The user interfaces of the MDU and MTU type ONU equipment shall support the downstream speed limit of interfaces. The speed limit based on service traffic is considered as an optional support.

The downstream speed limit of interfaces is considered as an optional support for the user interfaces of the SFU, SBU and HGU type ONU equipment.

10.7 Priority scheduling

10.7.1 Priority scheduling of OLT

OLT shall support the downstream service scheduling conducted according to the SLA. OLT's downstream service scheduling shall support SP (strict priority queue scheduling), WRR (weighted round robin queue scheduling, or other weighted scheduling algorithms), and SP + WRR algorithms, and shall be configurable. The SP + WRR algorithm applies to the default.

The priority scheduling of upstream services shall be jointly accomplished via the OLT's dynamic bandwidth allocation (DBA) and ONU's local scheduling.

10.7.2 Priority scheduling of ONU

ONU shall be able to conduct local scheduling of upstream services according to the OLT's bandwidth authorization. ONU's scheduling algorithm shall support SP algorithm, and shall be able to support WRR (weighted round robin queue scheduling, or other weighted scheduling algorithms), or SP + WRR algorithm, which shall be configurable. SFU, HGU and SBU type ONU default uses SP algorithm. MDU and MTU type ONU equipment is suggested to use SP + WRR algorithm.

The local scheduling of downstream services is considered as an optional support for the HGU, MDU and MTU type ONU equipment. SP or WRR or SP + WRR algorithm is optional. It is suggested to use SP + WRR algorithm.

For the system using SP + WRR algorithm, SP scheduling shall be applied to the service traffic (such as network control protocol message, and TDM service) with the priority values of "7" and "6" by the OLT (upstream) and ONU (downstream). The WRR scheduling mechanism shall be applied to the services with other priorities.

10.8 Buffer management

10.8.1 Buffer capacity of ONU

ONU shall support buffer management. Do NOT make any provisions on the specific mechanism.

The total buffer capacity of each SFU in the upstream and downstream directions shall not be less than 256KB. The maximum available buffer capacity in the upstream and downstream directions shall not be less than 128KByte.

MDU/MTU's buffer capacity shall be at least $64\text{KB} \times \text{number of user interfaces}$. Furthermore, the buffer is shared by the user interfaces.

ONU shall support the congestion avoidance mechanism. Tail-Drop, RED and WRED algorithms are applicable to the congestion avoidance. The equipment shall at least support Tail-Drop algorithm.

10.8.2 Buffer management of OLT

Do NOT make any provisions on the specific buffer capacity, so as to ensure that QoS and OLT shall provide enough buffer.

OLT shall support the congestion avoidance mechanism. Tail-Drop, RED and

shall support the suppression of IGMP/MLD, DHCP, ARP/ND and other protocol messages based on user interfaces.

ONU shall support the termination and transparent transmission of the BPDU (802.1D) messages received by the user interface, which shall be configurable.

OLT, MDU and MTU type ONU equipment shall support to discard the Ethernet frames with unknown source MAC address, so as to prevent the MAC address spoofing.

11.4 User authentication and subscriber access loop (port) identification

GPON shall support the PPPoE, DHCPv4, DHCPv6 and DHCPv6-PD user authentications, and the corresponding subscriber access loop (port) identifications (PPPoE relay agent, and DHCPv4/v6 relay agent). DHCPv4's subscriber access loop identifications use Option82, DHCPv6's subscriber access loop identifications use Option18, and SLAAC RS use Line ID. The specific implementation modes and formats shall conform to the requirements specified in the industry standard *Technical requirements for access network – Subscriber access loop (port) identification in broadband access networks*.

OLT and MDU shall support DHCP snooping and DHCP spoofing under the physical ports and sub-interfaces (including the sub-interfaces of single-layer and double-layer VLAN tags).

It is suggested that the ONU's built-in voice module support the DHCP Option60. The format of DHCP Option60 shall conform to the relevant provisions specified in the *Technical requirements for home gateway (e8) of China Telecom*.

11.5 ONU authentication

The GPON system shall support two kinds of ONU authentications:

- 1) Authentication based on physical identifications: the authentication method using ONU's physical identifications (SN with the physical identification of ONU in the GPON system) as authentication identifications. The specific requirements are given in Section 11.5.1.
- 2) Authentication based on logical identifications: the authentication method using ONU's logical identifications as authentication identifications. The logical identifications use LOID + Password. The specific requirements are given in Section 11.5.2.

In the GPON system, the specific authentication method of each ONU is selected by the OLT along with corresponding authentication. OLT shall be able to configure ONU's authentication method. OLT authenticates its ONU via

logical identifications by default.

11.5.1 ONU authentication based on physical identifications

ONU shall support SN's ability of authenticating the ONU legitimacy, and shall also refuse illegal ONU access.

11.5.2 ONU authentication based on logical identifications

In the GPON system, in order to realize flexible ONU authentication method that is easy to maintain, this Standard defines a kind of ONU authentication method based on logical identifications. The logical identifications include two parts, namely LOID (LOID – Logical ONU ID) and Password. Password users are responsible for the LOID verification. For the ONUs failing to pass the authentication (illegal ONUs), it is suggested to use the silence mechanism specified in the Section 11.6.

OLT and network management system shall support two kinds of treatments during the ONU authentication based on logical identifications: LOID judgment only, and LOID + Password judgment at the same time, which shall be configurable.

ONU shall be able to provide the local configuration interface of logical identifications (LOID and password), and save logical identifications locally. After restoring factory settings, ONU shall not delete the information of this logical identification. When the ONU authentication fails, ONU's local configuration interface shall be able to display ONU's cause of failure (SEE ME for the details: the authentication status property of LOID authentication).

In the ONU authentication system based on logical identifications, the logical identification LOID + Password used for authentication is saved in the ONU. It is suggested that EMS server and OLT save all the ONU's logical identifications (LOID and Password). OLT initiates the ONU authentication, verifies the LOID and Password reported by the ONU in coordination with the EMS server, and then controls ONU access according to the verification results.

11.5.3 Message format of the ONU authentication based on logical identifications

DEFINE a new ME: LOID authentication, so as to realize the ONU authentication based on logical identifications. This ME locally created by the ONU is the only one ME in the overall situation. After electrifying the ONU, CREATE this ME. After ONU rebooting, the authentication status property of this ME shall restore to the default value, while other properties remain the same. The class value of this ME is 65530 (decimal).

LOID authentication

Relationship: ME created by the ONU

Attributes:

ME ID: 0x0000 (2 bytes)

Operator ID: the identifier representing the operator, and the default configurations shall be “C”, “T”, “C” and “NULL” (4 bytes) (R) (mandatory)

LOID: ONU’s logical identification, and all the default values are “NULL” (the hexadecimal number is 0x00) (R) (24 bytes) (mandatory)

Password: ONU’s authentication password, and all the default values are “NULL” (the hexadecimal number is 0x00) (R) (12 bytes) (mandatory)

Authentication status: the authentication status of ONU identifications. The default value of ONU is 0x00. After ONU rebooting, this property shall restore to 0x00 (W, R) (1 byte) (mandatory)

0x00: initial state

0x01: successful authentication

0x02: LOID does not exist

0x03: LOID exists, but the password is wrong

0x04: LOID conflicts, indicating that this LOID has already had successful ONU authentication

0x05-0xff: Reserved

Actions: Get, Set

Notifications: None

If the actual length of LOID/Password is less than 24/12 bytes, ENTER the ASCII code “NULL” (the hexadecimal number is 0x00) at the least significant bit of actual LOID/Password to complement 24/12 bytes. Actual LOID and Password (excluding the “NULL” entered for complementing 24/12 bytes) shall neither start with the special characters from “NULL” to “SPACE” (the hexadecimal values are within the range of 0x00 to 0x20), “@” character, “DEL” character, and punctuations, nor end with the above characters.

11.5.4 Authentication process of logical identifications

In the ONU authentication system based on logical identifications, OLT shall be able to maintain two kinds of authentication statuses of the ONU: authorized and unauthorized statuses. The authentication statuses of the ONU determine whether the ONU can access network. When enabling the ONU authentication based on logical identifications, ONU has already been in O5 state. The initial authentication status generally refers to unauthorized status. In this status, OLT allows no data input and communication output from this ONU (OLT discards the received data messages from this ONU), except OMCI and PLOAM messages. When ONU passes the ONU authentication based on logical identifications, the authentication status of this ONU switches to authorized status. In this status, OLT allows ONU to make normal communications. For the ONU in non-O5 state, the authentication status refers to unauthorized status (i.e. 0x00).

After establishing the OMCC channel, IMPLEMENT the authentication process of logical identifications immediately. After accomplishing the ONU's authentication process of logical identifications, PERFORM the operations of MIB reset, MIB data sync, and MIB upload. In addition, after OLT sends the "MIB reset" message, ONU shall not modify all the properties of LOID authentication. All the properties of LOID authentication shall not be reported during MIB upload.

The authentication process based on logical identifications is shown in Figure 11-1. After jumping to the O5 state, ONU's authentication status is still "unauthorized". After establishing the OMCC channel, OLT sends the "Get" message to the ONU for initiating the ONU authentication according to the current authentication type in use [If OLT uses LOID authentication method, OLT only needs to send the "Get (LOID)" message instead of sending the "Get (Password)" message]. After receiving the "Get" message, ONU sends the "Get Response" message to the OLT, and then reports LOID and Password. OLT verifies the legitimacy and correctness of the logical identification of this ONU. If passing the verification, OLT sets ONU as "authorized" status, and sends the "Set" message (Authentication status = 0x01), so as to notify the successful ONU authentication. If the verification goes wrong, OLT maintains ONU in unauthorized status, and sends the "Set" message to the ONU (Authentication status = 0x02/03/04), so as to notify the failed ONU authentication and the cause of failure. After ONU successfully configures the message of returning to "Set", OLT sends the "Deactivate_ONU-ID" message, and ONU jumps to the O2 state.

If the LOID conflict used when authenticating two ONUs occurs, the ONU passing the authentication first will be used normally. OLT shall refuse the ONU initiating the authentication later, and sends the authentication failure notification (Authentication status = 0x04). In the meanwhile, OLT shall report

ONU shall be able to respond.

11.6 Silence mechanism

It is suggested that OLT support the following silence mechanism when performing the authentication based on physical and logical identifications.

For the ONUs failing to pass the authentication (including “SN/LOID does not exist”, “LOID exists but the password is wrong”, and “SN/LOID conflict”), REDUCE the negative impacts on the system caused by ONU’s attempt on continuous activation. Furthermore, considering the engineering convenience, this ONU shall still be given certain authentication opportunities. When ONU fails to pass the authentication, OLT shall record the SN of this ONU, report to the network element management system, and send the “Deactivate_ONU-ID” message to this ONU. After receiving this message, ONU jumps to the O2 state. In the meanwhile, OLT turns on the timer TReg. Before timer timeout, OLT allocates no ONU-ID to this ONU failing to pass the authentication. Therefore, ONU will not enter the O4 state. After timer timeout, this ONU failing to pass the authentication can restart complete activation and authentication process. TReg’s timeout time is configurable. The value is 60s by default.

11.7 Detection and treatment of the ONU with abnormal light emission

OLT shall support the function of detecting and diagnosing the ONU’s abnormal light emission, and controlling the power supply of the optical transmitter (Tx) at the PON interface of the ONU. The transmitter (Tx) and receiver (Rx) of the ONU’s optical module shall have independent power supplies. ONU shall support to turn off/on the power supply of its optical transmitter under the control of OLT. When the ONU’s abnormal light emission is detected by the OLT, or when it is necessary to perform the optical link diagnosis, the specific power supply of ONU’s optical transmitter can be turned off by sending the “Disable_Serial_Number” message with the “disable” option, and can be turned on by sending the “Disable_Serial_Number” message with the “enable” option. After rebooting, the ONU in O7 state shall be able to ensure that the power supply of its optical transmitter is still in OFF state.

The self-inspection for abnormal light emission is considered as an optional support for the ONU. SHUT down the power supply of the optical transmitter.

After turning off the power supply of the optical transmitter, it shall display via the LOS indicator (always on). After the power restoration, LOS indicator shall change the state accordingly.

11.8 Other safety functions

OLT shall support the binding between PON interface and ONU, and shall be

OLT shall support IGMP/MLD proxy and IGMP/MLD snooping. ONU shall support IGMP/MLD snooping, or IGMP/MLD snooping with proxy reporting/query, or IGMP/MLD proxy.

The multicast protocol shall support IGMP V2 (RFC 2236) and MLD V1 (RFC 2710). IGMP V3 (RFC 3376) and the MIB (RFC 2933) of the multicast management protocol, MLD V2 (RFC 3810) and the MIB (RFC 3019) of the multicast management protocol shall be considered as optional supports.

Whether the distributed IGMP/MLD mode or the dynamic controllable multicast mode, shall support the IPv4 and IPv6 multicast at the same time, which is to support IGMP and MLD at the same time.

12.3 Functional requirements for the distributed IGMP/MLD mode

In the distributed IGMP/MLD mode, ONU implements IGMP/MLD snooping, while OLT implements IGMP/MLD proxy. OLT and ONU realize dynamic group member management via the standard IGMP/MLD protocol, which mainly realizes the dynamic entry/exit and maintenance of multicast group members via the messages of "IGMP/MLD Report/Leave" and "IGMP/MLD Query". The multicast service authority control in this mode is realized via the IPTV service platform [IPTV platform obtains users' access authority information to the multicast services via the set-top box authentication, and pushes different electronic program guides (EPGs) to the users according to its access authorities. Users can only access the relevant programs displaying on the specific EPG, and thus realize the multicast access authority control].

In this mode:

ONU forms the correspondence between group members and switch interface (which is the multicast forwarding table, the forwarding table entries of this multicast forwarding table use Group address/multicast MAC address, instead of MVLAN + Group address/multicast MAC address, as the index) by snooping the IGMP/MLD member report messages sent from the multicast application terminal (such as set-top box) to the multicast router. ONU forwards the received downstream multicast data packets to the corresponding interfaces with group members according to the multicast forwarding table. ONU roughly controls the multicast access authorities of each UNI based on the multicast VLAN of each interface. ONU performs inter-VLAN multicast to the downstream multicast data messages (for instance, REPLACE the VLAN tag of the multicast data message where VLAN = M to the user IPTV VLAN tag where VID = I).

As an IGMP/MLD proxy, OLT intercepts all the IGMP/MLD requests sent by the multicast application terminal. After corresponding treatment, OLT

forwards the requests to the upper-layer multicast router, and forms the correspondence between group members and PON interface (which is also a multicast forwarding table). In the meanwhile, OLT forwards the multicast data packets to each PON interface according to this multicast forwarding table. That is to say, OLT respectively emulates a multicast host and a multicast router on each upstream interface and downstream interface.

In the forwarding process of the multicast service traffic, CONDUCT normal IGMP/MLD query, report, and other interactions of the IGMP/MLD protocol messages to the multicast router, OLT, ONU, and multicast application terminal (such as set-top box). The OLT enabling the IGMP/MLD proxy shall be responsible for sending downstream IGMP/MLD query messages (including general query messages, and group-specific query messages) to the ONU under the PON interface. The IGMP/MLD general/group-specific query message sent by the OLT has multicast VLAN tag. ONU broadcasts this IGMP/MLD general/group-specific query message to all the group interfaces of this multicast VLAN/specific group. ONU also conducts inter-VLAN multicast to downstream multicast query messages (for instance, REPLACE the VLAN tag of the multicast query message where VLAN = M to the user IPTV VLAN tag where VID = I). ONU shall discard the following two kinds of IGMP/MLD general/group-specific query messages after receiving them:

IGMP/MLD general/group-specific query messages without any VLAN tags;

IGMP/MLD general/group-specific query messages with VLAN tags, however, their VLAN IDs do not belong to the multicast VLAN ID set where this ONU is configured (for instance, assume that one ONU is configured with 1000, 1001 and 1002 multicast VLANs, there are one or more UNIs on this ONU belonging to these three multicast VLANs; if there is one IGMP/MLD general/group-specific query message with the VLAN tag where VID = 1004, no matter whether 1004 is unicast VID or multicast VID in this GPON system, ONU shall discard this IGMP/MLD general/group-specific query message).

(Another kind of simplified implementation mode is as follows: ONU forwards the IGMP/MLD general query message in each multicast VLAN to all the Ethernet interfaces of this ONU, without considering whether each Ethernet interface belongs to this multicast VLAN. Under this circumstance, a UNI not belonging to some multicast VLAN will also receive the IGMP/MLD general query message of this multicast VLAN. This kind of implementation mode will not affect the functions of the multicast application terminal.)

Furthermore, ONU shall strip/reserve the multicast VLAN tag of the IGMP/MLD query message according to the OLT control. For the downstream IGMP/MLD group-specific query messages, OLT shall label the multicast VLAN tag (carried

realized):

- 1) ONU sends the “Last Member Query” message, and monitors the response of each UNI to the “Last Member Query” message:

After receiving the IGMP Leave/MLD Done message, ONU sends [Last Member Query Count] group-specific query messages (Last Member Query) to the UNI receiving this Leave/Done message, and starts to respond the timer; when ONU fails to receive the IGMP/MLD report message sent by the multicast application terminal (Multicast Client) in the [Last Member Query Interval] assigned by the [Last Member Query Count] group-specific query messages, ONU thinks that there aren't any other multicast group members under this interface. Therefore, ONU will stop forwarding the service traffic of this multicast group to this user interface (will delete the corresponding table entries in its multicast forwarding table), and will transparently transmit this IGMP Leave/MLD Done message to the OLT. If receiving the IGMP/MLD report message corresponding to this multicast group from this interface before group-specific query timeout, ONU will remain the original multicast forwarding table, will continue to forward this multicast service traffic to this interface, and will discard this IGMP Leave/MLD Done message.

- 2) OLT sends the “Last Member Query” message, and ONU monitors the response of each UNI to the “Last Member Query” message:

After receiving the IGMP Leave/MLD Done message, ONU sends this IGMP Leave/MLD Done message to the OLT. OLT's actions after receiving this IGMP Leave/MLD Done message are totally the same with the above situation where ONU operates in fast-leave enable mode: SEND [Last Member Query Count] group-specific query messages (Last Member Query) to this PON interface. DETERMINE the member status of the multicast group under this PON interface according to whether receiving the IGMP/MLD report message from this PON interface within the specified overtime ($[\text{Last Member Query Interval}] \times [\text{Last Member Query Count}]$). DECIDE whether to stop forwarding down this multicast service traffic afterwards. After receiving the group-specific query messages sent by the OLT, ONU forwards this message to all the interfaces belonging to this multicast group, and sets the multicast group timer for each UNI (CTC-Last Member Query Timer). If ONU fails to receive the IGMP/MLD report message of this multicast group from this UNI within the time of $[\text{Last Member Query Count}] \times [\text{Last Member Query Interval}]$ after forwarding any one group-specific query message to some UNI, DELETE the corresponding multicast table entries of this interface. If ONU receives the IGMP/MLD report message of this multicast group from this UNI within the specified time, do NOT delete the corresponding table entries in the

multicast forwarding table, and CONTINUE to forward multicast data message to this UNI.

In this way, it is recommended for the ONU to process the Last Member Query as follows:

ONU sets a timer for each specific group of each UNI (CTC-Last Member Query Timer). All the initial values are 0. The overtime of CTC-Last Member Query Timer is [Last Member Query Count] × [Last Member Query Interval]. When ONU receives the group-specific query message from the OLT, and forwards this group-specific query message to some UNI, TURN on the CTC-Last Member Query Timer. Before the overtime of CTC-Last Member Query Timer, ONU forwards the same (downstream) group-specific query message from the OLT (whether one or more) to the corresponding UNI, and performs no operations on the CTC-Last Member Query Timer. Before the overtime of CTC-Last Member Query Timer, if receiving the (upstream) IGMP/MLD report message of this multicast group from this UNI, ONU will transparently transmit this IGMP/MLD report message to the OLT, and will reset and turn off the CTC-Last Member Query Timer (without deleting the corresponding table entries in the local multicast forwarding table). Before the overtime of CTC-Last Member Query Timer, if not receiving the (upstream) IGMP/MLD report message of this multicast group from this UNI, ONU will delete the corresponding table entries in the local multicast forwarding table, and will reset and turn off the CTC-Last Member Query Timer.

In addition, it is suggested that ONU support the proxy-reporting function, which indicates that ONU filters the report messages sent from all the multicast application terminals, so as to reduce the impacts on the OLT processing performance caused by excessive upstream IGMP/MLD report messages.

Please refer to RFC 2236 for the definitions of the parameters involved in this Section, namely [Last Member Query Interval] and [Last Member Query Count]. In the two kinds of transmit modes of Last Member Query in the above-mentioned non-fast-leave mode, the values of the ONU's local parameters, namely [Last Member Query Interval] and [Last Member Query Count], are configured as fixed values. USE the default values specified in the RFC 2236 as well ([Last Member Query Interval] = 1s, [Last Member Query Count] = 2). The values of OLT's parameters, namely [Last Member Query Interval] and [Last Member Query Count], shall be configurable as well. It is suggested that the default values use the ones specified in the RFC 2236.

12.4 Functional requirements for the controllable multicast

12.4.1 OLT's multicast control

Note: PON ID is used for expressing the slot position and PON interface where the user locates.

OLT shall support to query and configure its user multicast access control list via the local CLI and EMS, which indicates that OLT can realize local and remote reading, supplement, deletion and modification of the entries of the user multicast service access control list.

OLT shall use the function of IGMP/MLD proxy to dynamically manage the group member information based on users' access to the specific channels under its PON interface, so as to apply for and cancel the multicast service traffic. The specific functions shall meet the requirements specified in the last Section.

The channel preview shall be able to set according to the single preview's duration, preview times, and preview interval, and shall also can be set according to the total preview duration. OLT shall be able to perform preview authority resetting. Automatic resetting can be performed via time setting. Generally speaking, the relevant preview parameters (duration, preview times, preview interval, total preview duration, etc.) are possessed of global properties, which indicates that all the user preview parameters for all channels are the same.

OLT shall support CDR (call detail record), which can record users' basic access information [including IGMP/MLD request types (entry and exit), IGMP/MLD request time, user identifications, channels applied for access, channel authorities, successful/failed IGMP/MLD requests, exit mode (mandatory and autonomous exit), CDR record generation time, etc.]

The CDR records of short multicast entry and exit are not required. The specific time parameters shall be configurable. The timekeeping of short multicast preview is not required. The specific time parameters shall be configurable.

OLT shall support the three following ways to regularly synchronize the CDR information to the management system, so as to ensure not to lose the CDR information:

Way 1: Report regularly;

Way 2: Automatically report after recording to a certain data volume;

Way 3: The administrator forces the OLT to report the CDR.

OLT shall support to control each user's multicast service channels that can be applied for at the same time (a counter). Each user's multicast service channels that can be applied for at the same time shall be configurable.

information shall be reported to the EMS. After the main- standby switching, the original “standby panel” becomes “primary panel”.

OLT shall support the real-time synchronization of the configuration information of the primary and standby main control panels (so as to prevent the standby main control panel from reconfiguring VLAN and other properties during switching, and thus to increase the service layer switching speed). The switching time of the main control panel shall be less than 50ms. The protection switching time of main control panels shall have no significant changes before and after enabling the link aggregation.

13.1.2 1 + 1 redundancy protection for the MDU main control panel of the plug-in DSL interface

It is suggested that the MDU of the plug-in DSL interface support the configuration of dual main control panels, and the 1 + 1 protection switching of main control panels.

The MDU supporting the 1 + 1 protection switching of main control panels shall support the real-time synchronization of the configuration information of the primary and standby main control panels (so as to prevent the standby main control panel from reconfiguring VLAN and other properties during switching, and thus to increase the service layer switching speed). When the primary main control panel performs automatic switching under the circumstances of detected software exceptions, hardware exceptions, panel extraction, and NMS forced switching command, all the service configurations shall be switched to the standby main control panel. After the main control panel switching occurs, the switching events, switching triggering conditions, and other necessary information shall be reported to the EMS. After the main- standby switching, the original “standby panel” becomes “primary panel”. The switching time of the main control panel shall be less than 50ms. The protection switching time of main control panels shall have no significant changes before and after enabling the link aggregation.

13.2 Dual homing protection of OLT upstream interface

OLT shall support the dual homing protection of upstream boards, which indicates that OLT's two upstream links are respectively connected onto two pieces of different upstream network equipment. After detecting an abnormality of the primary upstream link, OLT automatically switches to another standby upstream link. In this way, it is necessary for the upstream network equipment to support VRRP and other protection protocols.

OLT's upstream dual homing protection shall support the artificial return of the protected services.

The optical link protection mainly has the following four types. OLT shall support Types b, c and d. Type a is considered as an optional support for the OLT. Type c or d is considered as an optional support for the ONU.

- 1) Type a (as shown in Figure 13-1): Two PON interfaces of each OLT share one PON MAC chip. CONNECT to two optical modules via the 1: 2 electric switch to realize the protection of two PON interfaces. Type a is applicable to the protection between the PON interfaces in the same PON board.

OLT: OLT's standby optical modules are in cold standby state. OLT shall detect the state of link protection and its PON interfaces. The switching shall be accomplished by the OLT.

Optical splitter: USE a 2: N optical splitter.

ONU: DETECT the link status to decide whether to enter the POPUP status.

- 2) Type b (as shown in Figure 13-2): Two PON interfaces of each OLT respectively use independent PON MAC chips and optical modules, so as to realize the protection of two PON interfaces. OLT shall support two kinds of PON interface protection ways in the same PON board and among different PON boards, which shall be configurable.

OLT: OLT's standby PON interfaces are in cold standby state. The switching shall be accomplished by the OLT. OLT shall ensure that the service information of the main PON interface shall be able to be synchronously backed up to the standby PON interface, and thus the standby PON interface can remain the same ONU's service properties in the protection switching process.

Optical splitter: USE a 2: N optical splitter.

The PON interface switching shall support to be triggered by NMS, and triggered after OLT automatically detects the PON interface faults. In this type of system, when the main PON interface detects the optical signal abnormal alarm, single board offline alarm, etc. at the PON interface, the switching will be triggered. After the switching, services shall be able to recover.

ONU: DETECT the link status to decide whether to enter the POPUP status.

- 3) Type c (as shown in Figure 13-3): OLT's dual PON interfaces, ONU's dual optical modules, trunk optical fiber, optical splitter, and branch optical fiber are all dual redundant. Two optical modules of each ONU are respectively connected to OLT's main and standby PON interfaces. OLT shall support two kinds of PON interface protection ways in the same PON board and among

different PON boards, which shall be configurable.

OLT: Main and standby PON interfaces are in service (hot standby state). OLT shall ensure that the service information of the main PON interface shall be able to be synchronously backed up to the standby PON interface, and thus the standby PON interface can remain the same ONU's service properties in the protection switching process.

Optical splitter: USE two 1: N optical splitters.

ONU: ONU uses one PON MAC and two optical modules. Under normal circumstances, the standby optical module is in cold standby state.

Both ONU and OLT detect the link status, and decide whether to switch according to the link status.

- 4) Type d (as shown in Figure 13-4): OLT's dual PON interfaces, ONU's dual PON interfaces, trunk optical fiber, optical splitter, and distribution optical fiber are all dual redundant. Two PON interfaces of each ONU are respectively connected to OLT's main and standby PON interfaces. OLT shall support two kinds of PON interface protection ways in the same PON board and among different PON boards, which shall be configurable.

OLT: OLT's main and standby PON interfaces are in service. OLT shall ensure that the service information of the main PON interface shall be able to be synchronously backed up to the standby PON interface, and thus the standby PON interface can remain the same ONU's service properties in the protection switching process.

Optical splitter: USE two 1: N optical splitters.

ONU: ONU has two independent PON interfaces (respectively including PON MAC chip, optical module, etc.), which have been respectively registered on OLT's two PON interfaces. ONU's main and standby PON interfaces are in service (hot standby state). ONU shall ensure that the service information of the main PON interface shall be able to be synchronously backed up to the standby PON interface, and thus ONU can remain the same local service properties in the protection switching process of PON interfaces, without conducting ONU's initial configuration and service property configuration.

Both ONU and OLT detect the link status, and decide whether to switch according to the link status.

this optical link failure event will not be confirmed.

For different protection types, the (logic-layer) switching mechanisms for the optical link protection enabled by the OLT and ONU are respectively as follows:

1) Types a and b switching mechanism:

OLT: After detecting the above-mentioned optical link failure events, OLT shall be able to determine whether the trunk optical link or the branch optical link breaks down. When there is only 1 activated ONU at this PON interface, if this ONU suffers from LOS/channel degradation, or the OLT optical module failure is detected, it shall be considered as trunk optical link failure. After determining the trunk optical link failure, OLT shall immediately stop the current optical module transmission of the PON interface, and shall enable the optical module transmission of the standby PON interface. After switching, SEND the broadcast POPUP message to the ONU. SEE ITU-T G.984.3 for the follow-up process. After determining the branch optical link failure, OLT shall not enable the PON switching.

ONU: After detecting the above-mentioned optical link failure events, ONU shall immediately enter the POPUP state. SEE ITU-T G.984.3 for the follow-up process.

2) Type c switching mechanism:

OLT: After detecting the above-mentioned physical-layer triggering event at any activated ONU upstream optical link under the specific PON interface, OLT shall immediately stop sending downstream optical signals to this ONU, and shall switch the traffic of this ONU to the standby PON interface (which is to switch the disabled optical links one by one). Furthermore, SEND the POPUP message to the ONU via the standby PON interface. SEE ITU-T G.984.3 for the follow-up process.

ONU: After detecting the above-mentioned optical link failure events, ONU shall immediately switch the services to the standby PON interface, and shall enter the POPUP state. SEE ITU-T G.984.3 for the follow-up process.

3) Type d switching mechanism:

OLT: Under normal circumstances, OLT periodically sends PST messages at the standby PON interface (one message per second); when the standby PON interface breaks down, periodically SEND PST messages at the operating PON interface. When detecting the above-mentioned physical-layer triggering events at any activated ONU upstream optical link under the specific PON interface, or receiving the PST messages sent by the ONU (COMMAND the OLT to switch to the standby optical link), OLT shall

immediately switch the services of this ONU to the standby PON interface (the standby PON interface is in hot standby state, and there is no need of reactivation), and shall send PST messages to the ONU via the new main link. SEE ITU-T G.983.5 for the specific process.

ONU: Under normal circumstances, ONU periodically sends PST messages at the standby PON interface (one message per second); when the standby PON interface breaks down, periodically SEND PST messages at the operating PON interface. When detecting the above-mentioned physical-layer triggering events at the downstream optical link, or receiving the PST messages sent by the OLT (COMMAND the ONU to switch to the standby optical link), ONU shall immediately switch the services to the standby PON interface (the standby PON interface is in hot standby state, and there is no need of reactivation), and shall send PST messages to the OLT via the new main link. SEE ITU-T G.983.5 for the specific process.

For the three kinds of implementation modes of the optical link protection, namely OLT's protection among different PON interfaces of the same PON MAC chip (under the condition that one PON MAC chip supports multiple PON interfaces) in the same PON board; protection among different PON interfaces of different PON MAC chips in the same PON board; and protection among PON interfaces on different PON boards, OLT shall use uniform PON interface board hardware, and shall be configured with three kinds of optical link protection types as required, namely Types b, c and d.

13.5.4 Service interruption time

In the GPON system, for different optical link protection types, the service interruption time during the optical link protection switching shall respectively meet the following requirements (tentative):

- 1) Type a: The service interruption time shall be less than 150ms, and is suggested to be less than 50ms;
- 2) Type b: The service interruption time shall be less than 150ms, and is suggested to be less than 50ms;
- 3) Type c: The service interruption time shall be less than 150ms, and is suggested to be less than 50ms;
- 4) Type d: The service interruption time shall be less than 50ms.

13.5.5 Protection switching return mechanism

All the protection switching mechanisms of the GPON system shall be able to support the artificial return of the protected services. The service interruption

- 1) Operating temperature of the optical module: expressed as 16-bit signed binary number within the range of -128°C to $+128^{\circ}\text{C}$, in unit of $1/256$ Celsius degree. The measurement accuracy shall be greater than $\pm 3^{\circ}\text{C}$. The reporting format of the operating temperature of the optical module shall conform to the provisions specified in the Tables 3.13 and 3.14 of the SFF-8472 Draft 10Dot3 Dec. 2007.
- 2) Supply voltage of the optical module: expressed as 16-bit unsigned integer (0~65535) within the range of $0\text{V} \sim 6.55\text{V}$, in unit of $100\mu\text{V}$. The measurement accuracy shall be greater than $\pm 3\%$. This parameter refers to the supply voltage of the optical transmitter.
- 3) Bias current of the optical transmitter: expressed as 16-bit unsigned integer (0~65535) within the range of $0\text{mA} \sim 131\text{mA}$, in unit of $2\mu\text{A}$. The measurement accuracy shall be greater than $\pm 10\%$.
- 4) Output power of the optical transmitter: expressed as 16-bit unsigned integer (0~65535) within the range of 0mW to 6.5535mW (about $-40\text{dBm} \sim +8.2\text{dBm}$), in unit of $0.1\mu\text{W}$. The measurement accuracy shall be greater than $\pm 3\text{dB}$.
- 5) Received power of the optical receiver: average optical power from each online ONU received by the OLT, expressed as 16-bit unsigned integer (0~65535) within the range of 0mW to 6.5535mW (about $-40\text{dBm} \sim +8.2\text{dBm}$), in unit of $0.1\mu\text{W}$. The measurement accuracy within the range of -30dBm to -10dBm shall be greater than $\pm 1\text{dB}$.

14.3 Parameter measurement of the ONU optical transceiver

ONU shall support the optical line supervision specified in the G.984.2, including the optical module's operating temperature, supply voltage, bias current, transmitted power, and received power. ONU shall also support the internal calibration of the measured values of the above-mentioned indexes (the optical module is not forcibly required to support the internal calibration of the measured values, and ONU can be used for calibrating its optical module's measured values).

The requirements for the parameter measurement of the ONU optical transceiver are as follows:

- 1) Operating temperature of the optical module: expressed as 16-bit signed binary number within the range of -128°C to $+128^{\circ}\text{C}$, in unit of $1/256$ Celsius degree. The measurement accuracy shall be greater than $\pm 3^{\circ}\text{C}$.
- 2) Supply voltage of the optical module: expressed as 16-bit unsigned integer (0~65535) within the range of 0V to 1310.7V , in unit of $20\mu\text{V}$. The

not recommended. If using the “receiving and writing” mode, ONU shall be able to return the confirmation message within 1s.

16 Alarm functional requirements

The GPON system shall support alarm detection and report. OLT shall be able to learn about the alarm status of all the managed entities via the “Get All Alarms”. ONU shall be able to report the alarm notification (Alarm) and the threshold crossing alert (TCAs) via the “Alarm” message.

17 Functional requirements for performance statistics

OLT and ONU shall support the performance statistics of data packets. OLT shall support to respectively implement performance statistics at its PON interface and upstream interface. ONU shall support to respectively implement statistics at its PON interface and Ethernet interface. OLT and ONU’s performance statistics is deactivated by default, and can be activated/deactivated as required. OLT and ONU’s performance statistics cycle shall be 15min.

OLT shall be able to implement ONU performance statistics via the OMCI message. ONU performance statistics shall support to use managed entities, namely Ethernet performance monitoring history data 3 and Ethernet frame extended PM. Ethernet performance monitoring history data, MAC bridge port performance monitoring history data, and MAC bridge performance monitoring history data are considered as optional supports. QUERY the current statistical value via the action of “Get current data”.

The specific statistics supported by the OLT and ONU include:

Downstream Drop Events;

Upstream Drop Events;

Downstream Octets;

Upstream Octets;

Downstream Frames;

Upstream Frames;

Downstream Broadcast Frames;

Upstream Broadcast Frames;
Downstream Multicast Frames;
Upstream Multicast Frames;
Downstream CRC Errored Frames;
Upstream CRC Errored Frames;
Downstream Undersize Frames;
Upstream Undersize Frames;
Downstream Oversize Frames;
Upstream Oversize Frames;
Downstream Fragments;
Upstream Fragments;
Downstream Jabbers;
Upstream Jabbers;
Downstream Frames 64 octets;
Upstream Frames 64 octets;
Downstream Frames 65 to 127 octets;
Upstream Frames 65 to 127 octets;
Downstream Frames 128 to 255 octets;
Upstream Frames 128 to 255 octets;
Downstream Frames 256 to 511 octets;
Upstream Frames 256 to 511 octets;
Downstream Frames 512 to 1023 octets;
Upstream Frames 512 to 1023 octets;
Downstream Frames 1024 to 1518 octets;
Upstream Frames 1024 to 1518 octets;

The voice service frames shall be tagged as high-priority service, so as to ensure the transmission quality of the upstream VoIP service. It is suggested that voice services use strict priority scheduling.

All the interfaces shall support T38 fax, and G.711 and G.729A codes.

It is suggested that the hub ratio supported by the MTU fully equipped with POTS boards be 1: 1 (G.711 code), and the hub ratio supported by the MDU fully equipped with POTS boards be 1: 2 (G.711 code).

19 TDM service requirements

OLT of the GPON system is suggested to support the TDM function. For the SBUs and MTU type ONU applied to the commercial clients, the TDM function shall be supported. The functional requirements for the GPON system bearing TDM service shall conform to the provisions specified in the YD/T xxxx *Technical requirements for access network – EPON/GPON systems bearing TDM service*.

When the GPON system bears the data private line service (E1 or $n \times 64\text{kbit/s}$ data service), IETF's PWE3 mode shall be supported. Native TDM (TDM over GEM, G.984.3) is considered as an optional support. TDM circuit emulation shall support the unstructured emulation mode. The structured emulation mode is considered as an optional support. PWE3's specific realization shall conform to the IETF RFC 3985, RFC 4197, and other relevant specifications. The encapsulation mode shall support RFC 4553 (SATOP mode), and RFC 5086 (CESoPSN mode) is considered as an optional support. The GPON system bearing TDM service shall use adaptive clock recovery mode, which is to use the clock stamp in the data packet to recover the clock. The differential clock recovery mode is considered as an option.

The GPON system shall be able to configure the jitter buffer depth, and TDM PW payload size. TDM PW shall support two kinds of PWE3 tunnel encapsulation formats: MPLS + MPLS and IP + UDP. The IP + MPLS format is considered as an optional support, and shall be configurable. The GPON system shall support the event statistics related to the TDM PW, the notification processing of the PW status triggered by E1 link failure, and the alarm processing of the E1 link triggered by PW failure.

The PWE3 data packet of the GPON system does not include the RTP header with fixed length. RTP header is considered as an optional support. The definitions of RTP's format and byte field shall conform to the provisions specified in the RFC 3550. The byte length of the clock stamp used by the IWF on both ends of the TDM circuit uniformly uses 4 bytes. The synchronous data

unit of the clock stamp is bit.

The specific realization of the TDM of the GPON system using Native TDM mode shall conform to the provisions specified in the ITU-T G.984.3.

For the OLT equipment providing TDM service bearing, the crossing connection of the TDM (E1 and $n \times 64\text{Kbps}$) service is considered as an optional support. It is suggested to support the STM-N upstream interface.

20 Time synchronization

Time synchronization is considered as an optional support for the GPON system. The PON system used for bearing the CDMA network macro base station, micro base station, PICO and Femtocell home base station shall support time synchronization, so as to provide synchronous timing information for the base stations. OLT can support to use the PTP messages of IEEE 1588-2008, phase synchronization information (pulse per second), and absolute time value IPPS + ToD information input to obtain synchronous timing information, and to transmit to the CBU connected with the base stations so that the base stations can satisfy the requirements of their air interfaces for time and frequency accuracy.

The time synchronization mechanism of the GPON interface shall conform to the requirements specified in the ITU G.984.3 Amd 2. GPON OLT shall support the boundary clock (BC) mode. The transparent clock (TC) mode is considered as an optional support.

21 Requirements for the service bearing performance indexes

21.1 Requirements for the Ethernet/IP service performance indexes

Ethernet/IP data service shall be specified by the IEEE 802.3, and shall comply with the provisions of IEEE 802.1D. The layer-2 switching ability of the OLT and ONU shall ensure the link-speed forwarding of services. The Ethernet/IP data service performance indexes of the GPON system mainly include the transmission delay, throughput, packet loss rate, and long-term packet loss rate of the Ethernet service.

21.1.1 Throughput

When the GPON system only bears Ethernet/IP service, the throughput of the PON interface in the upstream direction shall not be less than 1Gbit/s (any

delay = 400ms), PESQ mean value shall be less than 2.0.

4) Subjective assessment of voice:

When the network is in good condition, MOS shall be greater than 4.0;

When the network is in poor condition (packet loss rate = 1%, jitter = 20ms, delay = 100ms), MOS shall be greater than 3.5;

When the network is in bad condition (packet loss rate = 5%, jitter = 60ms, delay = 400ms), MOS shall be greater than 3.0.

5) Encoding rate

For G.711, the encoding rate equals to 64kbit/s;

For G.729a, the encoding rate is required to be less than 18kbit/s.

6) Delay index (loopback delay)

VoIP delay includes coding and decoding delay, receiver input buffer delay, internal queue delay, etc. When using G.729a codes, the loopback delay is less than 150ms.

21.3 Performance indexes of $n \times 64\text{Kbit/s}$ digital connection and E1 channel in circuit emulation mode

21.3.1 Bit error rate

After being tested for 24h under normal working conditions, the bit error rate of $n \times 64\text{Kbit/s}$ digital connection and E1 channel of the GPON system shall be 0.

21.3.2 Transmission delay

Under normal working conditions, the transmission delay of $n \times 64\text{Kbit/s}$ digital connection and 2048Kbit/s channel from the equipment's user interface to network interface shall be less than 1.5ms; and the transmission delay of $n \times 64\text{Kbit/s}$ digital connection and 2048Kbit/s channel from the equipment's network interface to user interface shall be less than 1ms.

21.3.3 Jitter transmission character

The jitter transmission character of the E1 interface shall meet the provisions specified in Figure 18-1 and Table 18-1.

21.5 Reliability requirements

Since SFU/HGU needs to operate the bearing voice service for a long time after the optical access for replacing copper access, SFU/HGU's MTBF (mean time between failures) shall be at least 30,000h. During long-lasting operation, there shall be no service interruption or performance degradation.

22 Requirements for the operation management and maintenance

21.1 General requirements

The operation management and maintenance of the GPON system shall support the configuration, failure, performance, security, and other management functions of the OLT and ONU. The operation management and maintenance of the OLT is mainly conducted via the GPON network element management system (EMS, which is equipment network management).

There are two kinds of implementation modes of ONU's operation management and maintenance: local management, and remote management. Local management generally refers to the local configuration, failure, performance and security management conducted to the ONU by the maintenance personnel using PC machines via local network management interfaces (special Console interfaces, UNI FE interfaces, serial interfaces, etc.). Remote management refers to the remote configuration, failure, performance and security management realized by system administrators via the EMS system.

As proxies of the network management system, OLT uses OMCI and SNMP modes specified in the G.988 for ONU remote management; while EMS respectively uses SNMP protocol and TR-069 mode for MDU/MTU management and ONU remote management.

EMS, OLT and MDU/MTU shall support to use IPv4 and IPv6 for SNMP protocol bearing.

SEE the *PON EMS technical requirements of China Telecom* for the detailed EMS requirements.

21.2 ONU remote management

SFU shall support to use OMCI mode for ONU remote management.

OMCI and TR-069 modes shall be applied to the HGU type ONU remote management protocol.

- 3) The QoS configuration is considered as an optional support, for instance, the classification, queuing, marking and scheduling configurations of upstream services, queuing, scheduling and speed limit configurations of downstream services;
- 4) The DBA parameter configuration is considered as an optional support;
- 5) It is suggested to support Ethernet configuration, such as VLAN, frame filtering, multicast, MAC address aging, etc.;
- 6) The configuration of optical fiber protection switching, and other functions of the PON interface are considered as optional supports;
- 7) It is suggested to support ONU's ACL configurations;
- 8) It shall support local software/firmware upgrading.

22.3.3 Performance management requirements

- 1) It shall be able to enable the function of user interface performance measurement, collect and process the measured data, and analyze the measurement results.
- 2) It shall be able to perform real-time statistics of system performance management events (such as the service traffic condition of the interface), and to count every 15min and 24h within a certain time. The statistical parameters shall include the PON interface performance parameters, user-side service interface performance parameters, etc.
- 3) It shall support to measure the local downstream received power and upstream transmitted power.

22.3.4 Fault management requirements

The faults of PON interfaces or UNIs shall be indicated via the indicators.

22.3.5 Safety management requirements

- 1) The ONU local management shall define personal access, so as to provide safety precautions for the administrator/operating system access, and to reject the local operation maintenance and management of the illegal users and the ones entering wrong passwords;
- 2) The local management of MDU and MTU type ONU equipment shall record all the user operations, including user names, operation time, operation types, etc. When the illegal users log in, ONU shall give security alarms. Unauthorized operations are recorded by the system log. The system

24 Other requirements

24.1 Environmental requirements

24.1.1 Temperature and humidity requirements

The equipment shall be able to normally operate within the following scope of environment. OLT shall at least support Type 1. SFU shall support one of the three types. MDU shall support either Type 2 or Type 3.

Type 1: temperature: 0°C ~ 40°C; relative humidity: 10% ~ 90% (non-condensing)

Type 2: temperature: -30°C ~ 40°C; relative humidity: 10% ~ 90% (non-condensing)

Type 3: temperature: -10°C ~ 55°C; relative humidity: 10% ~ 90% (non-condensing)

Note: The above temperatures apply to 2m above the ground, and 0.4m ahead of the equipment.

24.1.2 Dust-proof requirements

The GPON equipment shall be able to normally operate in the following dust environments:

The environments where the dust diameter is greater than 5μm, the dust concentration is less than or equal to 3×10^4 particles/m³, and the dust particles are non-conductive, magnetic-conducted and corrosive.

24.1.3 Atmospheric pressure requirements

The equipment shall be able to normally operate in the environments under the following conditions of atmospheric pressure:

86kPa ~ 106kPa, suggested to support at least 62kPa.

24.2 Power supply requirements

24.2.1 OLT power supply requirements

OLT shall support DC or AC power supply, and shall be able to normally operate under the conditions given in 1) and 2).

1) Requirements for DC voltage and its fluctuation range:

Standard Technical Report *Energy efficiency metrologies and test methods of access equipment – GPON system*. It is suggested that the energy efficiency rating of OLTs and various kinds of ONUs come up to Level 3 and above before 2012 (tentative).

24.4 Electrical safety requirements

24.4.1 Insulation resistance

Under normal circumstances, the insulation resistance of the equipment shall not be less than 50MΩ.

24.4.2 Equipment grounding requirements

The equipment grounding resistance shall be less than 50MΩ.

24.4.3 Overvoltage and overcurrent protection

OLT and ONU equipment shall install overvoltage and overcurrent protectors. When the external power supply is abnormal, the overvoltage and overcurrent protectors protect the core elements of the equipment.

The AC power ports and user interfaces of the equipment shall meet the requirements for the lightning impulse simulation, power line induction, power line contact, and other indexes specified in the YD/T 1082-2000.

For the MDU equipment, the power ports shall have the protective capability of 4KV (differential and common modes). The user interfaces shall provide the protective capability of 1.5KV (differential and common modes).

For the SFU/HGU equipment, the power ports shall have the protective capability of 4KV (differential and common modes). The user interfaces shall provide the protective capability of 0.5KV (differential and common modes).

24.4.4 Electromagnetic compatibility

The electromagnetic compatibility indexes of the equipment shall conform to the provisions of GB 9254 and GB/T 17618.

24.4.5 Requirements for the ONU equipment noise

The acoustical power of the 1U cassette MDU/MTU equipment at $23 \pm 2^{\circ}\text{C}$ shall be less than 55dBa. It is suggested to adopt the fanless design.

The acoustical power of the small plug-in MDU/MTU (LAN/DSL interfaces) equipment at $23 \pm 2^{\circ}\text{C}$ shall be less than 72dBa, and is suggested to be less than 60dBa. It is suggested that the small plug-in MDU/MTU support the

Appendix A

(Informative)

Requirements for the ONU power supply

A.1 Requirements for the SFU power supply

A.1.1 Working conditions of the power adapter

SFU's power adapter shall meet the following conditions:

- 1) The input power voltage is within the range of 176V to 264V; the input power frequency is $50\text{Hz} \pm 5\%$; the line voltage waveform distortion rate is less than 5%. The equipment shall be able to operate normally.
- 2) The equipment shall be able to normally operate in the environment where the temperature is within the range of -5°C to $+45^{\circ}\text{C}$, and the relative humidity is within the range of 10% to 90%.
- 3) The equipment shall be able to be stored in the environment where the temperature is within the range of -40°C to $+70^{\circ}\text{C}$, and the relative humidity is within the range of 5% to 95%.

A.1.2 Requirements for the DC output interface of the power adapter

The power adapters of the SFU equipment shall take standardization and universality into consideration. The equipment's power interface and the DC output interface of the power adapter shall be uniform international standard round interfaces.

The specific requirements for the DC output interface of the power adapter of the SFU equipment are as follows. The power input interface of the SFU equipment shall match the equipment itself.

DC input voltage fluctuation range: $+11.4\text{V} \sim +12.6\text{V}$

The dimensions of the DC output interface of the power adapter shall conform to the following requirements:

Inner diameter of the metal part: $\Phi 2.1 \pm 0.1\text{mm}$

Outer diameter of the metal part: $\Phi 5.5 \pm 0.1\text{mm}$

Length of the metal part: $9.0 \pm 0.1\text{mm}$

The insulation resistance of power adapters shall not be less than 10MΩ.

A.1.3.5 Leakage current requirements

The leakage current of power adapters shall be less than 0.25mA.

A.1.3.6 Protection functions

The protection functions of the power adapter include overcurrent protection, short circuit protection, and overvoltage protection. The protection functions include the following contents:

Overcurrent protection: During overcurrent, the output will enter the hiccup mode. When the overcurrent disappears, the power adapter shall be able to automatically return back to normal.

Short circuit protection: When the output is short-circuited, the input power of the power adapter reduces without causing any damages. When the short circuit disappears, the power adapter shall be able to automatically return back to normal.

Overvoltage protection: When the AC input supply voltage exceeds the range of 176V to 264V, it causes no damages to the terminal equipment. The output instantaneous voltage shall be less than 150% of the rated instantaneous voltage. No explosions, smoking, fire breakout, or any other security problems can occur.

A.1.3.7 Shell temperature rise

Under full load, the shell temperature rise shall be less than 45°C.

Under 80% of the rated load, the shell temperature rise shall be less than 25°C.

A.1.4 Requirements for the emergency power supply

Considering the demands of continuous operation of important services during mains power outage, SFU equipment shall be equipped with an optional power supply. When the mains power is in normal condition, the mains power provides power supply for the equipment, and charges the emergency power supply for energy saving. During mains power outage, the emergency power supply discharges for providing power supply for the equipment. The output voltage of the SFU's emergency power supply is 12V. The emergency power supply of the SFU equipment is suggested to have the function of power supply management. When the equipment uses the emergency power supply for power supply, load hierarchical security applies. It is suggested to guarantee all the loads at the beginning of the mains power outage. After the mains power outage exceeds a certain time (BREAK the loads by setting the voltage value of the emergency

is within the range of 10% to 90%.

- 3) The equipment shall be able to be stored in the environment where the temperature is within the range of -40°C to +70°C, and the relative humidity is within the range of 5% to 95%.

The DC power supply modules shall be able to maintain the normal operation of this equipment within the voltage range of -40V to -57V.

A.2.2 Requirements for the emergency power supply

The input interfaces of the MDU's backup batteries are connected with the MDU's AC or DC modules, and the output interfaces are connected to the MDU equipment, so as to provide emergency power supply for the MDU equipment. When the mains power is in normal condition, the mains power provides power supply for the equipment, and charges the emergency power supply for energy saving. During mains power outage, the emergency power supply discharges for providing power supply for the equipment. The output voltage of the MDU's emergency power supply is -48V. The emergency power supply of the MDU equipment is suggested to have the function of power supply management. When the equipment uses the emergency power supply for power supply, load hierarchical security applies. It is suggested to guarantee all the loads at the beginning of the mains power outage. After the mains power outage exceeds a certain time (BREAK the loads by setting the voltage value of the emergency power supply), only GUARANTEE the normal operation of the voice service, so as to extend the backup power supply time of the voice service as long as possible. After using the backup batteries, NMS shall support to configure whether it is necessary to provide power supply for the modules (data module, and voice module).

The emergency power supply management shall conform to the requirements specified in Table A-2.

Immediate leave: This boolean attribute controls the immediate leave function. The value false disables immediate leave; true enables immediate leave. (R, W, Set-by-create) (mandatory) (1 byte)

Upstream IGMP TCI: Under control of the upstream IGMP/MLD tag control attribute, the upstream IGMP/MLD TCI attribute defines a VLAN ID and P bits to add to upstream IGMP/MLD messages. (R, W, Set-by-create) (optional) (2 bytes)

Upstream IGMP tag control: This attribute controls the upstream IGMP/MLD TCI attribute. If this attribute contains a value other than 0, a possible extended VLAN tagging operation ME is bypassed for upstream frames containing IGMP/MLD packets. (R, W, Set-by-create) (optional) (1 byte)

Value Meaning

- 0 Pass upstream IGMP/MLD traffic transparently, neither adding, stripping nor modifying tags that may be present.
- 1 Add a VLAN tag (including P bits) to upstream IGMP/MLD traffic. The VLAN is specified by the upstream IGMP/MLD TCI attribute.
- 2 Replace the entire TCI (VLAN ID plus P bits) on upstream IGMP/MLD traffic. The new tag is specified by the upstream IGMP/MLD TCI attribute. If the received IGMP/MLD traffic is untagged, an add operation is performed.
- 3 Replace only the VLAN ID on upstream IGMP/MLD traffic, retaining the original CFI and P bits. The new VLAN ID is specified by the VLAN ID field of the upstream IGMP/MLD TCI attribute. If the received IGMP/MLD traffic is untagged, an add operation is performed.

Others reserved

Upstream IGMP rate: This attribute limits the maximum rate of upstream IGMP/MLD traffic. Traffic in excess of this limit is silently discarded. The attribute value is specified in messages/second. The recommended default value 0 imposes no rate limit on this traffic. (R, W, Set-by-create) (optional) (4 bytes)

Dynamic access control list table: This attribute is a list that specifies one or more multicast group address ranges. Each list entry begins with a table control field:

Table control (2 bytes)

16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Set ctrl		Row part		Reserved			Row ID								

- VLAN ID (ANI). This field specifies the VLAN carrying the multicast group downstream. The VLAN ID resides in the 12 least significant bits; the remaining bits are set to 0 and not used. The value 0 designates an untagged downstream flow. (2 bytes)
- Imputed group bandwidth. Expressed in bytes per second, the imputed group bandwidth is used to decide whether or not to honor a join request in the presence of a max multicast bandwidth limit. The recommended default value 0 effectively allows this table entry to avoid max bandwidth limitations (4 bytes)
- Preview length. The maximum duration of each preview in seconds. The value 0 designates a group that is fully authorized by subscription and is not subject to preview restrictions. The remaining preview attributes in this row part are ignored. (2 bytes)
- Preview repeat time. The minimum time in seconds between two previews of a given multicast group. (2 bytes)
- Preview repeat count. The maximum number of times a given multicast group may be previewed. A value of zero allows an unlimited number of previews. (2 bytes)
- Preview reset time. The time at which the ONU resets the preview repeat counter. The value assignments are as follows: (2 bytes)
 - 0: Do not reset the preview repeat counter automatically. It is cleared only upon explicit action by the OLT.
 - 1...24: The integer clock time at which the ONU resets the preview repeat counter. For example, the value 2 resets the counter at 2:00 am. If the ONU does not have a time of day clock, the preview repeat counter is reset every 24 hours at an indeterminate time selected by the ONU.
 - 25...240: Reserved by ITU
 - 240...254: Reserved for vendor specific use
 - 255: Used by the OLT to explicitly reset the preview repeat counter. A set action with this value clears the preview repeat count to zero, but does not alter the pre-existing value of the field in the table row part.
- Reserved for vendor specific use. Set to zero by default. (4 bytes)
- Reserved for ITU use. Set to zero. (2 bytes)

A single multicast group may be specified by setting start and end destination IP addresses to the same value.

Row part 1 format:

- Table control (2 bytes)
- Multicast group destination IP address, start of range. May be either an IPv4 address (first twelve bytes 0) or an IPv6 address. (16 bytes)
- Reserved (12 bytes)

Row part 2 format:

- Table control (2 bytes)
- Multicast group destination IP address, end of range. May be either an IPv4 address (first twelve bytes 0) or an IPv6 address. (16 bytes)
- Reserved (12 bytes)

Row part 3 format:

- Table control (2 bytes)
- Reserved (28 bytes)

(R, W) (mandatory) (each row part: 30 bytes)

Static access control list table: This attribute is a list that specifies one or more multicast group address ranges. Groups defined in this list are multicast on the associated UNI(s) unconditionally, that is, without the need for an IGMP/MLD join. The bandwidth of static multicast groups is not included in the current multicast bandwidth measurement maintained by the multicast subscriber monitor managed entity. If a join message is always expected, this table may be empty. Table entries have the same format as those in the dynamic access control list table. (R, W) (mandatory) (each row part: 30 bytes)

Lost groups list table: This attribute is a list of groups from the dynamic access control list table for which there is an active join, but no downstream flow is present, possibly because of source failure, but also possibly because of misconfiguration somewhere upstream. After a join, the ONU should wait a reasonable time for upstream processing before declaring a group to be lost. Each entry is the destination IP address of the missing group. (R) (optional) (16N bytes)

Robustness: This attribute allows tuning for possible packet loss in the network.

The recommended default value 0 causes the ONU to follow the IETF recommendation to copy the robustness value from query messages originating further upstream. (R, W, Set-by-create) (optional) (1 byte)

Querier IP address: This attribute specifies the IP address to be used by a proxy querier. May be either an IPv4 address (first twelve bytes 0) or an IPv6 address. Although it is not a legitimate IPv4 address, the recommended default value 0 is legal in this case (SEE [b-IETF RFC 4541]). (R, W) (optional) (16 bytes)

Query interval: This attribute specifies the interval between general queries in seconds. The recommended default is 125 seconds. (R, W, Set-by-create) (optional) (4 bytes)

Query max response time: This attribute is the max response time added by the proxy into general query messages directed to UNIs. It is expressed in tenths of seconds, with a recommended default of 100 (10 seconds). (R, W, Set-by-create) (optional) (4 bytes)

Last member query interval: This attribute specifies the max response time inserted into group-specific queries sent to UNIs in response to group leave messages. It is also the repetition rate of [robustness] transmissions of the query. It is specified in tenths of seconds, with a default of 10 (1 second). (R, W) (optional) (4 bytes)

Unauthorized join request behavior: This boolean attribute specifies the ONU's behavior when it receives an IGMP/MLD join request for a group that is not authorized in the dynamic address control list table, or an IGMPv3/MLD membership report for groups, none of which are authorized in the dynamic ACL. The default value false specifies that the ONU silently discard the IGMP/MLD request; the value true specifies that the ONU forward the request upstream. The ONU does not attempt to honor the request for the unauthorized group(s) in either case. (R, W) (optional) (1 byte)

Downstream IGMP and multicast TCI: This attribute controls the downstream tagging of both the IGMP/MLD and multicast frames. If this attribute contains a value other than 0, a possible extended VLAN tagging operation ME is bypassed for downstream IGMP/MLD and multicast frames. (R, W, Set-by-create) (optional) (3 bytes)

The first byte defines the control type:

Value Meaning

0 Pass downstream IGMP/MLD and multicast traffic transparently, neither stripping nor modifying tags that may be present.

- 1 Strip the outer VLAN tag (including P bits) from downstream IGMP/MLD and multicast traffic.
- 2 Add a tag onto downstream IGMP/MLD and multicast traffic. The new tag is specified by the second and third bytes of this attribute.
- 3 Replace the tag on downstream IGMP/MLD and multicast traffic. The new tag is specified by the second and third bytes of this attribute.
- 4 Replace only the VID on downstream IGMP/MLD and multicast traffic, retaining the original DEI and P bits. The new VLAN ID is specified by the VLAN ID field of the second and third bytes of this attribute.
- 5 Add a tag onto downstream IGMP/MLD and multicast traffic. The new tag is specified by the VID (UNI) field of the multicast service package table row that is associated with this profile. If the VID (UNI) field specifies untagged traffic, the new tag is specified by the second and third bytes of this attribute.
- 6 Replace the tag on downstream IGMP/MLD and multicast traffic. The new tag is specified by the VID (UNI) field of the multicast service package table row that is associated with this profile. If the VID (UNI) field specifies untagged traffic, the outer VLAN tag (including P bits) is stripped from downstream IGMP/MLD and multicast traffic. If the value of the VID (UNI) is unspecified, the new tag is specified by the second and third bytes of this attribute.
- 7 Replace only the VID on downstream IGMP/MLD and multicast traffic, retaining the original DEI and P bits. The new VLAN ID is specified by the VID (UNI) field of the multicast service package table row that is associated with this profile. If the VID (UNI) field specifies untagged traffic, the outer VLAN tag (including P bits) is stripped from downstream IGMP/MLD and multicast traffic. If the value of the VID (UNI) is unspecified, the new tag is specified by the second and third bytes of this attribute.

Others reserved

The second and third bytes define the TCI (VLAN ID and P bits) to be applied on the downstream IGMP/MLD and multicast streams in case the replace or add option is selected.

Actions

Create, delete, get, get next, set

Set table (optional)

Notifications

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