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SERIES G: TRANSMISSION SYSTEMS AND MEDIA, DIGITAL SYSTEMS AND NETWORKS

Digital sections and digital line system – Optical line systems for local and access networks

Gigabit-capable Passive Optical Networks (G-PON): ONT management and control interface specification

ITU-T Recommendation G.984.4

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ITU-T Recommendation G.984.4

**Gigabit-capable Passive Optical Networks (G-PON):
ONT management and control interface specification**

Summary

This Recommendation provides the Optical Network Termination (ONT) Management and Control Interface (OMCI) specification for Gigabit-capable Passive Optical Network (G-PON) systems as defined in ITU-T Recs G.984.2 and G.984.3.

Firstly, it specifies the managed entities of a protocol-independent Management Information Base (MIB) that models the exchange of information between the Optical Line Termination (OLT) and the Optical Network Termination (ONT). In addition, it covers the ONT management and control channel, protocol and detailed messages.

FOREWORD

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ITU-T Recommendation G.984.4

Gigabit-capable Passive Optical Networks (G-PON): ONT management and control interface specification

1 Scope

This Recommendation specifies the ONT Management and Control Interface (OMCI) for the G-PON system defined in ITU-T Recs G.984.2 and G.984.3 to enable multi-vendor interoperability between the OLT and the ONT.

The OMCI specification addresses the ONT configuration management, fault management and performance management for G-PON system operation and for several services including:

- ATM adaptation layers 1, 2, and 5;
- GEM adaptation layers;
- circuit emulation service;
- Ethernet services, including MAC Bridged LAN;
- voice services;
- wavelength division multiplexing.

The focus of this OMCI specification is on FTTH and FTTBusiness ONTs; however, support for ONUs is addressed as well. This Recommendation defines a protocol necessary to support the capabilities identified for these ONTs. It also allows optional components and future extensions.

This Recommendation reuses much of ITU-T Rec. G.983.2; where appropriate, the reader is referred to the relevant sections of that Recommendation.

2 References[1]

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1]   ITU-T Recommendation I.363.5 (1996), *B-ISDN ATM Adaptation Layer specification: Type 5 AAL*.

[2]   ITU-T Recommendation I.751 (1996), *Asynchronous transfer mode management of the network element view*.

[3]   ITU-T Recommendation G.983.1 (1998), *Broadband optical access systems based on Passive Optical Networks (PON)*.

[4]   ITU-T Recommendation G.983.2 (2002), *ONT management and control interface specification for B-PON, plus Amendment 1*.

[5]   ITU-T Implementors' Guide to G.983.2 (2002).

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[1] References to Implementors' Guides in the text of this Recommendation do not give them the status of Recommendations.

[6]   ITU-T Recommendation G.983.5 (2002), *A broadband optical access system with enhanced survivability*.

[7]   ITU-T Recommendation G.983.6 (2002), *ONT management and control interface specifications for B-PON system with protection features*.

[8]   ITU-T Recommendation G.983.7 (2001), *ONT management and control interface specification for Dynamic Bandwidth Assignment (DBA) B-PON system*.

[9]   ITU-T Recommendation G.983.8 (2003), *B-PON OMCI support for IP, ISDN, video, VLAN tagging, VC cross-connections and other select functions*.

[10]   ITU-T Recommendation G.984.2 (2003), *Gigabit-capable Passive Optical Networks (G-PON): Physical Media Dependent (PMD) layer specification*.

[11]   ITU-T Recommendation G.984.3 (2004), *Gigabit-capable Passive Optical Networks (G-PON): Transmission convergence layer specification*.

[12]   ITU-T Recommendation G.983.9 (2004), *B-PON ONT Management and Control Interface (OMCI) support for Wireless Local Area Network interface*s.

[13]   ITU-T Recommendation G.983.10 (2004), *B-PON ONT Management and Control Interface (OMCI) support for Digital Subscriber Line interface*s.

3   Definitions

3.1   ONT and ONU

The terminology of ONT, which will be used throughout this Recommendation, is more broadly defined as an ONU used for the FTTH and FTTBusiness configuration. In general, the differences between FTTH and FTTBusiness are that FTTBusiness will serve more than one end user, have stricter availability requirements, and be able to afford for more features and functions than FTTH. When distinguishing ONT from ONU, the following definitions are used.

3.1.1   ONU: An Optical Network Unit provides (directly or remotely) the user-side interface of the OAN and is connected to the ODN. Since services for more than one customer premise can flow through the ONU, this device may be considered as part of the operator's network.

3.1.2   ONT: Optical Network Termination. This is an ONU which includes the user port function and can be considered as part of the customer premises equipment.

3.2   Upstream and downstream

The upstream is a traffic flow from ONU to OLT and the downstream is a traffic flow from OLT to ONU.

4   Abbreviations

This Recommendation uses the following abbreviations:

AAL   ATM Adaptation Layer

ABR   Available Bit Rate

ABT/DT   ATM Block Transfer Delayed Transmission

ABT/IT   ATM Block Transfer Immediate Transmission

ADSL   Asymmetric Digital Subscriber Line

AES   Advanced Encryption Standard

AIS   Alarm Indication Signal

AK	Acknowledgement
AN	Access Node
ANI	Access Node Interface
AR	Acknowledge Request
ATM	Asynchronous Transfer Mode
ATU-C	ADSL Transceiver Unit, Central office end
ATU-R	ADSL Transceiver Unit, Remote Terminal End
AVC	Attribute Value Change
B-BCC	Broadband Bearer Connection Control
B-PON	Broadband Passive Optical Network
CBR	Constant Bit Rate
CES	Circuit Emulation Service
CLEI	Common Language Equipment Identification
CPCS-SDU	Common Part Convergence Sublayer Service Data Unit
CPCS-UU	Common Part Convergence Sublayer User-to-User Indication
CPI	Common Part Indicator
CPS	Common Part Sublayer
CRC	Cyclic Redundancy Check
CTP	Connection Termination Point
DB	Destination Bit
DBA	Dynamic Bandwidth Assignment
DBR	Deterministic Bit Rate
DEMUX	De-multiplexing
DSSS	Direct-Sequence Spread Spectrum
EMF	Electromagnetic Field
FEC	Forward Error Correction
FHSS	Frequency-Hopping Spread Spectrum
FTTB	Fibre to the Building
FTTBusiness	Fibre to the Business
FTTC	Fibre to the Curb
FTTCab	Fibre to the Cabinet
FTTH	Fibre to the Home
GAL	GEM Adaptation Layer
GEM	G-PON Encapsulation Method
GFR	Guaranteed Frame Rate
G-PON	Gigabit Passive Optical Network
GTC	G-PON Transmission Convergence

HN	Home Network
HOL	Head of the Line
ICMP	Internet Control Message Protocol
ID	Identifier
IF	Interface
IP	Internet Protocol
IR	Infrared
ISDN	Integrated Services Digital Network
IW	Interworking
LAN	Local Area Network
LCT	Local Craft Terminal
LES	Loop Emulation Service
LIM	Line Interface Module
LMI	Layer Management Indication
LMIG	Layer Management Indication Generation
LMIR	Layer Management Indication Receiving
LT	Line Terminal
MAC	Media Access Control
ME	Managed Entity
MIB	Management Information Base
MLT	Mechanized Loop Testing
MT	Message Type
MUX	Multiplexing
NT	Network Terminal
OAN	Optical Access Network
ODN	Optical Distribution Network
OLT	Optical Line Terminal
OMCC	ONT Management and Control Channel
OMCI	ONT Management and Control Interface
ONT	Optical Network Terminal
ONU	Optical Network Unit
PHY	Physical Interface
PLOAM	Physical Layer Operations, Administration and Maintenance
PM	Protocol Monitoring
PON	Passive Optical Network
POTS	Plain Old Telephone Service
PPTP	Physical Path Termination Point

PSD	Power Spectral Density
PVC	Permanent Virtual Channel
RDI	Remote Defect Indication
RFI	Radio Frequency Interference
SAR	Segmentation and Reassembly
SBR	Statistical Bit Rate
SN	Service Node
SNI	Service Node Interface
SSCS	Service Specific Convergence Sublayer
TC	Transmission Convergence
TCA	Threshold Crossing Alert
T-CONT	Transmission Container
TDM	Time Division Multiplexing
TE	Terminal Equipment
TP	Termination Point
UBR	Unspecified Bit Rate
UNI	User Network Interface
UPC	Usage Parameter Control
VBR	Variable Bit Rate
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VDSL	Very High Speed Digital Subscriber Line
VP	Virtual Path
VPI	Virtual Path Identifier
VTU-O	VDSL Transceiver Unit, ONU end
VTU-R	VDSL Transceiver Unit, Remote Terminal end
WRR	Weighted Round Robin
xDSL	x Digital Subscriber Line

5 Conventions

In all bit vectors indicated in this Recommendation, the rightmost bit is bit 1. This represents the least significant bit, while bit 8 represents the most significant bit within a byte. If the bit vector is made up of more than one byte, then the numbering starts from the least significant byte onwards.

In all attribute descriptions that refer to the Boolean values "true" and "false", true will be coded as 0x01 in hexadecimal and false will be coded as 0x00.

In all attribute descriptions that refer to spaces, the value 0x20 must be used for the entire size of the attribute.

6   Reference model and terms

6.1   OMCI in ITU-T Rec. G.984.2

The network architecture reference model for G-PON is described in ITU-T Rec. G.984.2 and shown in Figure 1. The G-PON fits various access network architectures, i.e., FTTH, FTTB/C and FTTCab.

The OMCI specification fits into the overall ITU-T Rec. G.984.2 model for an access network system as illustrated in Figure 1. The dotted line shows a path for OMCI signals between an OLT and ONT. While this Recommendation provides some minimal modelling for ONUs with service interfaces, detailed OMCI support for ONUs with 802.11 and xDSL interfaces is described in ITU-T Recs G.983.9 and G.983.10.
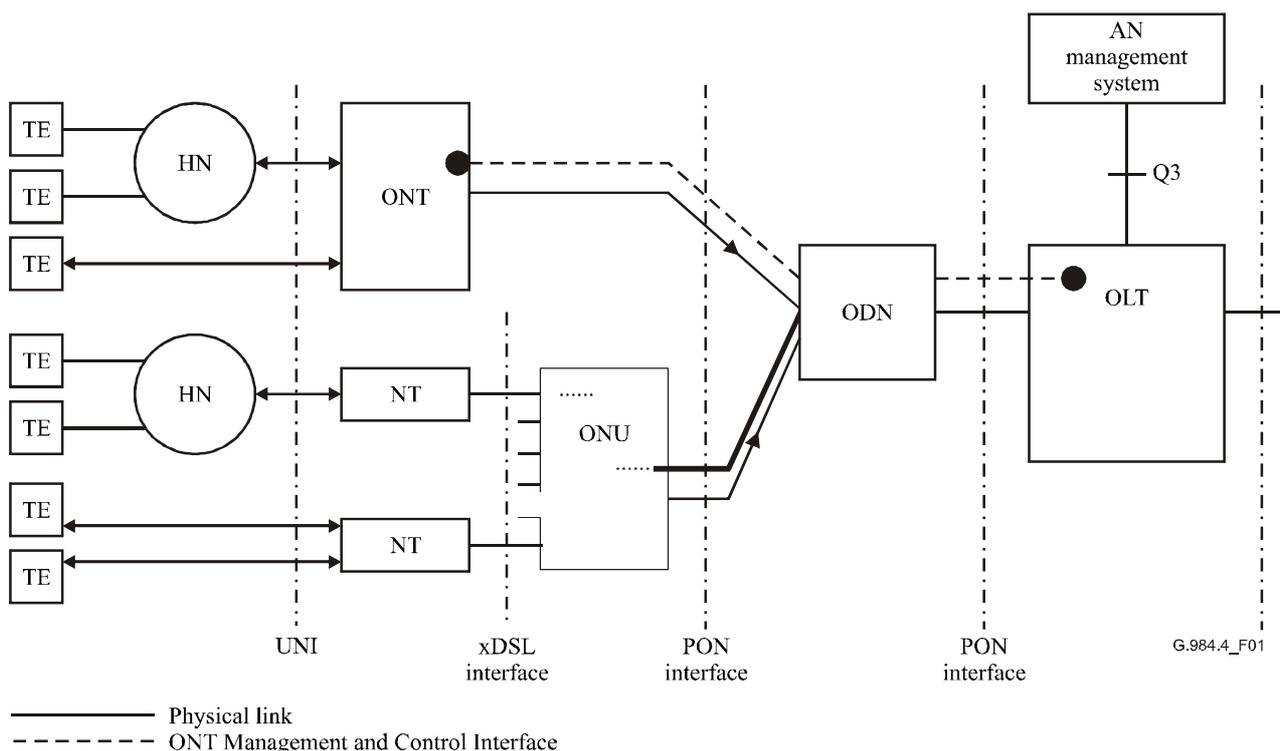
Figure 1/G.984.4 – Reference model

6.2   ONT/ONU functions

As shown in Figure 2, the functions of the ONT/ONU are:

a)   access network line termination function (AN-LT);

b)   user network interface line termination function (UNI-LT), noting that in the Fibre to the Business case the UNIs from one ONU may belong to different users;

c)   service multiplexing and de-multiplexing function (Service MUX and DEMUX).
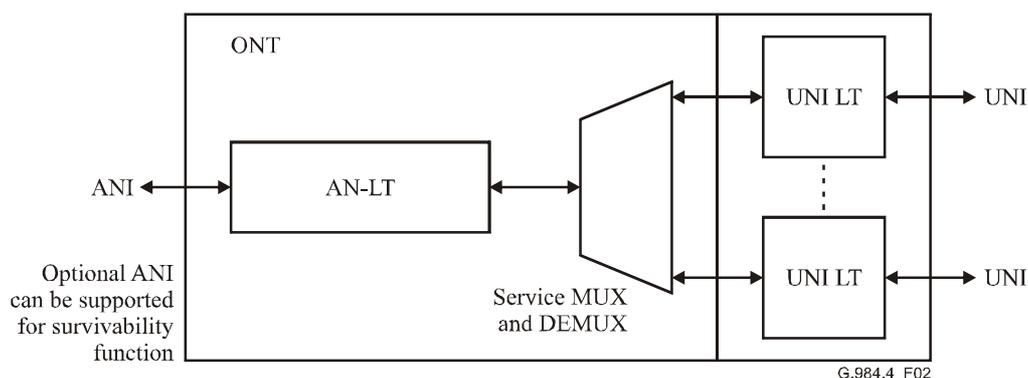
Figure 2/G.984.4 – ONT/ONU functional block diagram

6.3 VP/VC Mux functionality in the ONT

In ITU-T Rec. G.984.3, the end-to-end G-PON system (i.e., OLT, ODN and ONT) can function as an ATM VP or VC cross-connection with both provisioned and on-demand connectivity. The configuration of the ATM VP/VC cross-connection can be initiated by:

a)   the network element operations system via the management interface (e.g., Q3);

b)   the Service Node (SN) over a VB5.2 Broadband Bearer Connection Control (B-BCC) protocol.

The ONT, however, always acts as a provisioned ATM multiplexer for ATM connections. The OMCI itself does not distinguish between these two cases. The OLT can, however, assign different priorities to OMCI messages such that in case b) a fast response time of the OMCI is achieved.

6.4 Encapsulation in GEM frame

As the GEM is embedded in the PON section, it is independent of the types of UNIs. The UNI traffic is always encapsulated in GEM frames so that a cross-connect function is not needed in GEM service.

6.5 Support of Multicast connection

Multicast traffic can be supported in G-PON network. While a Port-ID is assigned to a T-CONT in a unicast connection, a Port-ID is shared by multiple T-CONTs in a multicast connection. The multicast connection set-up process is the same as the unicast connection set-up process. It is the responsibility of the OLT to manage the member of a multicast group and control the multicast connection in ONUs. The scheme for providing the multicast service (e.g., to manage the multicast group, maintain the security and so on) needs further study.

In the downstream, the multicast connection that is supported by a shared Port-ID is useful. On the other hand, in upstream, it is impossible to support the multicast connection by this methodology because the OLT cannot reassemble segmented GEM packets correctly when it receives several GEM packets with same Port-ID from different ONTs. Therefore, multicast Port-ID must be used when an OLT sends multicast traffic to ONTs. The direction of multicast Port-ID is indicated during multicast connection set-up.

7 Requirements of the management interface specification

The OMCI is used by the OLT to control an ONT. This protocol allows the OLT to:

a)   establish and release connections across the ONT;

b)   manage the UNIs at the ONT;

c)   request configuration information and performance statistics;

d)   autonomously inform the system operator of events such as link failures.

The OMCI protocol runs across either an ATM or GEM connection between the OLT controller and the ONT controller that is established at ONT initialization. The OMCI protocol is asymmetric: the controller in the OLT is the master and the one in the ONT is the slave. A single OLT controller using multiple instances of the protocol over separate control channels may control multiple ONTs.

The ONT management and control interface requirements given in this Recommendation are needed to manage the ONT in the following areas:

a)   configuration management;

b)   fault management;

c)   performance management;

d)   security management.

7.1   Configuration management

Configuration management provides functions to exercise control over, identify, collect data from and provide data to the ONT. This involves the following:

a)   Configuration of equipment;

b)   Configuration of the UNIs;

c)   Configuration of the VP Network CTP-Gs, ATM VP Cross-Connections, and GEM Port Network CTPs;

d)   Configuration of Interworking Termination Points;

e)   Configuration of the OAM flows;

f)   Configuration of the physical ports;

g)   Configuration of AAL profiles;

h)   Configuration of service profiles;

i)   Configuration of traffic descriptors;

j)   Configuration of GAL profiles.

For an ONT that supports ATM mode, the ONT handles ATM VP cross-connection in order to free VPI values on the UNI (the VPI value on the ANI is not free because the VPI values on the ANI are shared with all ONUs in the PON. VP cross-connection on the ONT resolves this limitation for the UNI). In the case of the OMCI, VC termination and interworking VCCTP are unified to the ATM Interworking VCC Termination Point ME. Figure 3 shows the termination model. For non-ATM LIMs, the aggregate of traffic parameters for the various VC terminations is represented by the Traffic Descriptor Profile Pointer associated with the VP Network CTP-G ME that contains the VC terminations.

Note – VC in the figure represents unification of VCCTP and Interworking VCCTP.
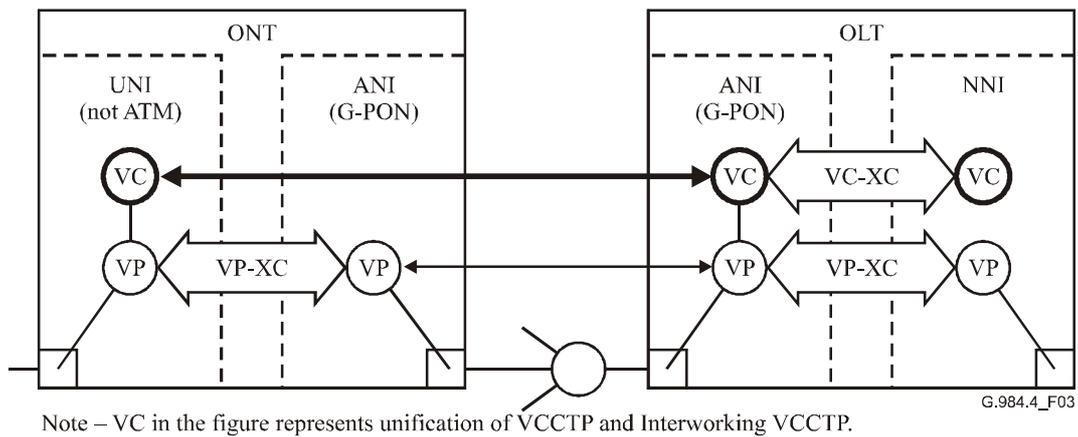
Figure 3/G.984.4 – ATM VP cross-connection termination model

For cases such as the support of ONUs with xDSL interfaces, it is necessary to implement VC cross-connections. VC cross-connection can be supported by the ONT/ONU, as indicated by the termination model shown in Figure 4.
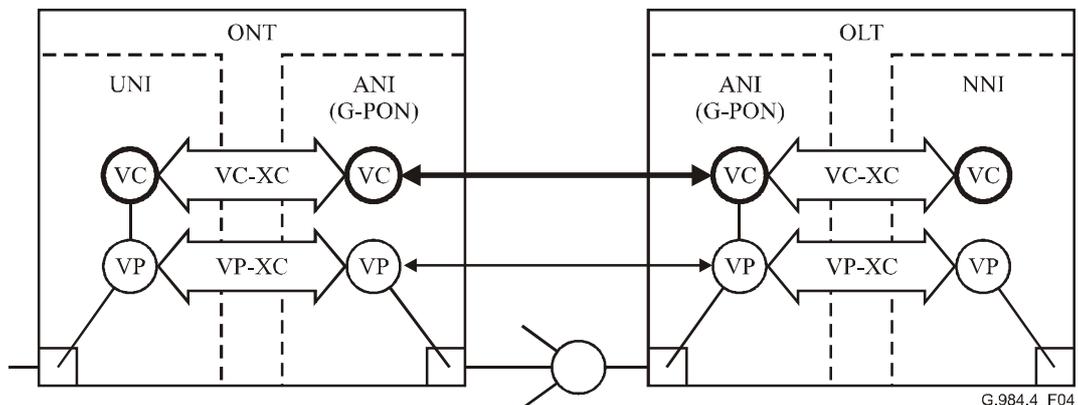
Figure 4/G.984.4 – ATM VC cross-connection termination model

7.2   Fault management

The ONT supports *limited* fault management only. Most of the operations are limited to failure indication. The OMCI supports failure reporting on the following managed entities that are described throughout clause 9, ITU-T Recs G.983.2 and G.983.8:

a)   ONT-G;

b)   Subscriber Line Cardholder;

c)   Subscriber Line Card;

d)   PON IF Line Card-G;

e)   Physical Path Termination Point ATM UNI;

f)   Physical Path Termination Point Ethernet UNI;

g)   Physical Path Termination Point CES UNI;

h)   Physical Path Termination Point ISDN UNI;

i)   Physical Path Termination Point POTS UNI;

j)   Physical Path Termination Point Video UNI;

k)   Physical Path Termination Point Video ANI;

l)   Physical Path Termination Point ADSL UNI;

m)   Physical Path Termination Point VDSL UNI;

n)   TC Adapter$_{B-PON}$;

o)   ATM Interworking VCC Termination Point;

p)   GEM Interworking Termination Point;

q)   VP Network CTP-G;

r)   VC Network CTP-G;

s)   GEM Port Network CTP;

t)   ONU-G.

An alarm table is defined for each of these entities.

The ONT also supports selective OAM cell loop-back testing at the UNI. The ONT diagnostics are limited to the ONT self test. The OLT or element manager will process the information from the ONT; for example, the OLT will determine the severity of each alarm when reporting it to the network operator. ATM management of continuity monitoring is not a part of this Recommendation (see af-nm-0020.001 (Bibliography) and ITU-T Rec. I.751).

7.3   Performance management

The ONT has only *limited* performance monitoring. The following are related managed entities:

a)   UPC Disagreement Monitoring History Data$_{B-PON}$;

b)   AAL1 Protocol Monitoring History Data$_{B-PON}$;

c)   AAL5 Protocol Monitoring History Data$_{B-PON}$;

d)   Ethernet Performance Monitoring History Data;

e)   Ethernet Performance Monitoring History Data 2;

f)   CES Physical Interface Monitoring History Data;

g)   TC Adapter Protocol Monitoring History Data;

h)   AAL 2 CPS Protocol Monitoring History Data $_{B-PON}$;

i)   AAL 2 SSCS Protocol Monitoring History Data $_{B-PON}$;

j)   Priority Queue-G;

k)   MAC Bridge PM History Data;

l)   MAC Bridge Port PM History Data;

m)   Voice PM History Data;

n)   VP PM History Data;

o)   VC PM History Data;

p)   ICMP PM History Data1;

q)   ICMP PM History Data2

r)   IP Router PM History Data1;

s)   IP Router PM History Data2;

t)   802.11 Counters;

u)   GEM Port Protocol Monitoring History Data;

v)   GAL TDM Protocol Monitoring History Data;

w)   GAL Ethernet Protocol Monitoring History Data;

x)   ADSL ATU-C Performance Monitoring History Data;

y)   ADSL ATU-R Performance Monitoring History Data;

z)   ADSL ATU-C Channel Performance Monitoring History Data;

aa)   ADSL ATU-R Channel Performance Monitoring History Data;

bb)   TC Adaptor Performance Monitoring History Data ADSL;

cc)   VDSL VTU-O Physical Interface Monitoring History Data;

dd)   VDSL VTU-R Physical Interface Monitoring History Data;

ee)   VDSL VTU-O Channel Performance Monitoring History Data;

ff)   VDSL VTU-R Channel Performance Monitoring History Data.

Note that it is not required to upload all the performance monitoring related managed entities during the MIB upload (see 7.1.2/G.983.2).

All the history data shall be maintained in the OLT. ATM management of performance monitoring is not a part of this Recommendation (see af-nm-0020.001 and ITU-T Rec. I.751).

7.4   Security management

ITU-T Rec. G.984.3 specifies some mechanisms from the viewpoint of security. That includes the downstream data encryption and password protection of ONT. The ONT2-G managed entity can enable/disable the downstream encryption function.

This Recommendation supports the protection function. The type C protection configuration that is defined in ITU-T Rec. G.983.5 is considered in this Recommendation. As the switching behaviour for PON protection will be done in TC layer, this Recommendation defines a managed entity to specify the protection capability. Though ITU-T Rec. G.983.6 specifies the OMCI for B-PON protection, a new scheme for G-PON protection is needed because G-PON has a different protocol stack from B-PON.

8   Protocol-independent MIB for the OMCI

The OMCI should be defined to allow vendors to offer modular, incremental capabilities to meet different levels of customer needs. This Recommendation first targets FTTH and FTTBusiness ONTs. It defines a protocol necessary to support capabilities identified by ITU-T Recs G.984.2 and G.984.3. It is important for early deployment and interoperability, yet it allows for optional components and future extensions.

A protocol-independent MIB is used to describe the exchange of information across the OMCI and forms the basis from which protocol-specific models (e.g., Simple Device Protocol for the ONT) are defined. This MIB has as much commonality as possible with the related generic MIB as defined in other ITU-T Recommendations. It is intended to make the OMCI relatively simple while maintaining consistency with the MIB used by the interface between the network-element manager and the OLT.

8.1   Managed entities

The protocol-independent MIB presented in this Recommendation has been defined in terms of *managed entities*. The managed entities are abstract representations of resources and services in an ONT.

This Recommendation uses three levels for indicating the degree of compliance necessary for specific functions and managed entities associated with the OMCI specification:

•   **Requirement (R)**: Entities necessary for operational compatibility;

•   **Conditional Requirements (CR)**: Entities necessary when the specified optional function is implemented;

•   **Option (O)**: Entities that may be useful and required by an operator but that are not necessary for operational compatibility.

The possible managed entities are listed in Table 1. This table also shows the Recommendations that define each ME.

In this table, G.983.2amd1 means ITU-T Rec. G.983.2 Amendment 1 and IGtoG.983.2 means Implementors' Guide to G.983.2.

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
AAL 1 Profile_{B-PON}	CR	Used when the ONT supports CES UNIs	G.983.2
AAL 1 Protocol Monitoring History Data_{B-PON}	O	Used when AAL1 layer performance monitoring is supported	G.983.2, G.983.2amd1, IGtoG.983.2
AAL 2 Profile_{B-PON}	CR	Used when the ONT supports AAL 2	G.983.2
AAL 2 CPS Protocol Monitoring History Data_{B-PON}	O	Used when AAL 2 layer performance monitoring is supported	G.983.2, G.983.2amd1, IGtoG.983.2
AAL 2 PVC Profile_{B-PON}	CR	Used when the ONT supports AAL 2 PVC	G.983.2
AAL 2 SSCS Parameter Profile 1	CR	Used when the ONT supports AAL 2 SSCS	G.983.2
AAL 2 SSCS Parameter Profile 2	CR	Used when the ONT supports AAL 2 SSCS	G.983.2
AAL 2 SSCS Protocol Monitoring History Data_{B-PON}	CR	Used when AAL 2 layer performance monitoring is supported	G.983.2, G.983.2amd1, IGtoG.983.2
AAL 5 Profile_{B-PON}	CR	Used when the ONT supports LAN UNIs	G.983.2
AAL 5 Protocol Monitoring History Data_{B-PON}	O	Used when AAL 5 layer performance monitoring is supported	G.983.2, G.983.2amd1, IGtoG.983.2
ADSL ATU-C Channel Performance Monitoring History Data	O	Performance monitoring data for an ADSL ATU-C channel	G.983.10
ADSL ATU-C Performance Monitoring History Data	O	Performance monitoring data for an ADSL ATU-C modem Path	G.983.10
ADSL ATU-R Channel Performance Monitoring History Data	O	Performance monitoring data for an ADSL ATU-R Channel	G.983.10
ADSL ATU-R Performance Monitoring History Data	O	Performance monitoring data for an ADSL ATU-R modem path	G.983.10

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
ADSL Channel Configuration Profile	CR	Contains Configuration for a Channel	G.983.10
ADSL Channel Downstream Status	CR	Contains status on the Downstream Channel	G.983.10
ADSL Channel Upstream Status	CR	Contains status on the Upstream Channel	G.983.10
ADSL Downstream PSD Mask Profile	CR	Contains Masking information for the Downstream PSD	G.983.10
ADSL Downstream RFI Bands Profile	CR	Contains information on the Downstream RFI Bands	G.983.10
ADSL Line Configuration Profile Part 1	CR	Contains the Line Parameters for an ADSL line	G.983.10
ADSL Line Configuration Profile Part 2	CR	Contains the Line Parameters for an ADSL line	G.983.10
ADSL Line Configuration Profile Part 3	CR	Contains the Line Parameters for an ADSL line	G.983.10
ADSL Line Inventory and Status Data Part 1	CR	Contains the inventory and status information on the ADSL Line	G.983.10
ADSL Line Inventory and Status Data Part 2	CR	Contains the inventory and status information on the ADSL Line	G.983.10
ADSL Subcarrier Masking Downstream Profile	CR	Contains masking information for the Downstream subcarriers	G.983.10
ADSL Subcarrier Masking Upstream Profile	CR	Contains masking information for the Upstream subcarriers	G.983.10
ANI-G	R	Used for ANI Management	G.984.4
ARP Configuration Data	CR	Used for IP Port supported by the ONT	G.983.8
ARP Service Profile	CR	Used for IP Port supported by the ONT	G.983.8
ATM Interworking VCC Termination Point	CR	Used for non-ATM UNIs and for ATM-based connections	G.984.4
ATM VC Cross-Connection	O	Used for VC multiplexing with VCI translation in the ONU	G.983.8
ATM VP Cross-Connection	CR	Used for VP multiplexing in the ONT	G.983.2
CES Service Profile$_{B-PON}$	CR	Used for CES services supported by the ONT	G.983.2
CES Physical Interface Monitoring History Data	O	Used for the CES interface performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2
Ethernet Performance Monitoring History Data	O	Used for Ethernet interface performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2
Ethernet Performance Monitoring History Data 2	O	Used for Ethernet performance monitoring	G.983.8
GAL TDM Profile	O	Used when the ONT supports GAL TDM	G.984.4

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
GAL Ethernet Profile	O	Used when the ONT supports GAL Ethernet	G.984.4
GAL TDM Protocol Monitoring History Data	O	Used when GAL TDM layer performance monitoring is supported	G.984.4
GAL Ethernet Protocol Monitoring History Data	O	Used when GAL Ethernet layer performance monitoring is supported	G.984.4
GAL TDM Traffic Descriptor	O	Used when the ONT supports GAL TDM	G.984.4
GAL Ethernet Frame Traffic Descriptor	O	Used when the ONT supports GAL Ethernet	G.984.4
GEM Interworking Termination Point	CR	Used for non-ATM UNIs and GEM-based connections	G.984.4
GEM Port Network CTP	CR	Used for GEM port termination	G.984.4
GEM port Protocol Monitoring History Data	O	Used for GEM Port performance monitoring	G.984.4
ICMP PM History Data1	O	Used for ICMP performance monitoring	G.983.8
ICMP PM History Data2	O	Used for ICMP performance monitoring	G.983.8
IP Port Configuration Data	CR	Used for IP Port supported by the ONT	G.983.8
IP Router Service Profile	CR	Used for IP Router supported by the ONT	G.983.8
IP Router Configuration Data	CR	Used for IP Router supported by the ONT	G.983.8
IP Router PM History Data1	O	Used for IP Router performance monitoring	G.983.8
IP Router PM History Data2	O	Used for IP Router performance monitoring	G.983.8
IP Route Table	CR	Used for IP Router supported by the ONT	G.983.8
IP Static Routes	CR	Used for IP Router supported by the ONT	G.983.8
LES Service Profile	CR	Used for LES services supported by the ONT	G.983.2
Logical N × 64 kbit/s Sub-port Connection Termination Point	CR	Used as logical interface for structured CES	G.983.2
MAC Bridge Configuration Data	CR	Used for MAC bridge supported by the ONT	G.983.2
MAC Bridge PM History Data	O	Used for MAC bridge performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2
MAC Bridge Port Configuration Data	CR	Used for MAC bridge supported by the ONT	G.983.2
MAC Bridge Port Designation Data	CR	Used for MAC bridge supported by the ONT	G.983.2
MAC Bridge Port Filter Table Data	CR	Used for MAC bridge supported by the ONT	G.983.2
MAC Bridge Port Filter Preassign Table	O	Used for Ethernet type filtering	G.983.8

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen-dation
MAC Bridge Port Bridge Table Data	CR	Used for MAC bridge supported by the ONT	G.983.2
MAC Bridge Port PM History Data	O	Used for MAC bridge port performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2
MAC Bridge Service Profile	CR	Used for MAC bridge supported by the ONT	G.983.2
ONT-G	R	Used for ONT equipment management	G.984.4
ONT2-G	R	Used for ONT equipment management	G.984.4
ONU-G	R	Used for ONU equipment management	G.984.4
ONU2-G	R	Used for ONU equipment management	G.984.4
ONT Data	R	Used for OMCI MIB management	G.983.2, G.983.8
Physical Path Termination Point ADSL UNI Part 1	CR	Used for the physical path termination point at an ADSL CO modem	G.983.10
Physical Path Termination Point ADSL UNI Part 2	CR	Used for the physical path termination point at an ADSL CO modem	G.983.10
Physical Path Termination Point ATM UNI	CR	Used for physical path termination point at the ATM UNI	G.983.2
Physical Path Termination Point CES UNI	CR	Used for physical path termination point at the CES UNI	G.983.2, G.983.2amd1, IGtoG.983.2
Physical Path Termination Point Ethernet UNI	CR	Used for physical path termination point at the Ethernet UNI	G.983.2, G.983.8, IGtoG.983.2
Physical Path Termination Point POTS UNI	CR	Used for physical path trail termination point at the POTS UNI	G.983.2, G.983.2amd1
Physical Path Termination Point ISDN UNI	O	Used for ISDN port supported by the ONT	G.983.8
Physical Path Termination Point Video UNI	O	Used for video port	G.983.8
Physical Path Termination Point Video ANI	O	Used for video input port	G.983.8
Physical Path Termination Point VDSL UNI	CR	Used for the physical path termination point at a VDSL connection	G.983.10
Physical Path Termination Point LCT UNI	O	Used for local craft terminal port	G.983.8
Physical Path Termination Point 802.11 UNI	CR	Used for 802.11 interface supported by the ONT	G.983.9
PON IF Line Card-G	R	Used for the PON line card	G.984.4
PON IF Line Cardholder	R	Used for the PON line cardholder	G.984.4

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
PON Physical Path Termination Point	R	Used for physical path at the ANI, descriptive purpose only, see clause 7.2/G.983.2 (ANI Management)	G.983.2
PON TC Adapter-G	R	Used for TC layer at PON interface	G.984.4
Priority Queue-G	CR	Used for ONTs that support priority queues to multiplex ATM or GEM traffic flows	G.984.4
Protection Data	CR	Used for PON protection	G.984.4
Software Image	R	Used for the software image of the ONT. Software image for the subscriber line cards is optional	G.983.2
Subscriber Line Card	R	Used for the UNI line card plug-in	G.983.2, G.983.2amd1, G.983.8, G.983.9
Subscriber Line Cardholder	R	Used for the UNI line card plug-in slot	G.983.2, G.984.4
TC Adapter$_{B\text{-}PON}$	CR	Used for TC layer at the UNI side for the ATM UNI	G.983.2
TC Adaptor Performance Monitoring History Data ADSL	O	Performance monitoring data for the ADSL ATM Data Path	G.983.10
TC Adapter Protocol Monitoring History Data	O	Used when TC layer performance monitoring is supported	G.983.2, G.983.2amd1, IGtoG.983.2
T-CONT	R	Used for DBA	G.984.4
Threshold Data 1	CR	Used for the set-up of threshold values	G.984.4
Threshold Data 2	CR	Used for the set-up of threshold values	G.984.4
Traffic Descriptors	CR	Used for the ONT that supports traffic shaper to specify ATM layer traffic characteristics in the case of accommodation of non-ATM UNI. Moreover, in the case of accommodation of ATM UNI, Traffic Descriptors may be used for the UPC function in the ONT, if it is required	G.983.2, G.983.2amd1, IGtoG.983.2, G.983.10
Traffic Scheduler-G	R	Used for DBA	G.984.4
UNI$_{B\text{-}PON}$	CR	Used for user network interface for ATM service	G.983.2
UNI-G	CR	Used for user network interface for GEM service	G.984.4
UPC Disagreement Monitoring History Data$_{B\text{-}PON}$	CR	Used for the ONT that supports UPC	G.983.2, G.983.2amd1, IGtoG.983.2
VDSL Band Plan Configuration Profile	CR	Parameters used to configure a VDSL Band Plan Configuration Profile	G.983.10

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
VDSL Channel Configuration Profile	CR	Parameters used to configure a VDSL Channel Configuration Profile	G.983.10
VDSL Channel Data	CR	Contains the Channel Parameters for VDSL Fast and Slow channels	G.983.10
VDSL Line Configuration Profile	CR	Parameters used to configure a VDSL Line Configuration Profile	G.983.10
VDSL VTU-O Channel Performance Monitoring History Data	O	Performance monitoring data for a VDSL VTU-O channel	G.983.10
VDSL VTU-O Physical Data	CR	Contains the Physical Layer Parameters for a VTU-O	G.983.10
VDSL VTU-O Physical Interface Monitoring History Data	O	Monitoring Data for a VDSL VTU-O Physical Interface	G.983.10
VDSL VTU-R Channel Performance Monitoring History Data	O	Performance monitoring data for a VDSL VTU-R channel	G.983.10
VDSL VTU-R Physical Data	CR	Contains the Physical Layer Parameters for a VTU-R	G.983.10
VDSL VTU-R Physical Interface Monitoring History Data	O	Monitoring Data for a VDSL VTU-R Physical Interface	G.983.10
VLAN Tagging Filter Data	O	Used for VLAN tagging	G.983.8
VLAN Tagging Operation Configuration Data	O	Used for VLAN tagging	G.983.8
VC Network CTP-G	CR	Used for VC link termination in the VC MUX	G.984.4
Voice Service Profile AAL	CR	Used for Voice over AAL 1/2 supported by the ONT	G.983.2, G.983.8
VC PM History Data	O	Used for VC performance monitoring	G.983.8
Voice CTP	CR	Used for Voice termination point supported by the ONT	G.983.2, G.983.8
Voice PM History Data	O	Used for voice performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2, G.983.8
VP Network CTP-G	CR	Used for VP link termination in the VP Mux	G.984.4
VP PM History Data	O	Used for VP performance monitoring	G.983.2, G.983.2amd1, IGtoG.983.2
802.11 Station Management data 1	CR	Used for 802.11 interface supported by the ONT	G.983.9
802.11 Station Management data 2	CR	Used for 802.11 interface supported by the ONT	G.983.9

Table 1/G.984.4 – Managed entities in the OMCI

Managed entity	Required/ Optional	Description	Recommen- dation
802.11 General Purpose Object	CR	Used for 802.11 interface supported by the ONT	G.983.9
802.11 MAC&PHY Operation and Antenna Data	CR	Used for 802.11 interface supported by the ONT	G.983.9
802.11 PHY FHSS DSSS IR Tables	CR	Used for 802.11 interface supported by the ONT	G.983.9
802.11 Counters	O	Used for 802.11 interface supported by the ONT	G.983.9

8.2 Managed entity relation diagrams

Clause 6.2/G.983.2 provides managed entity diagrams for B-PON that are also relevant for G-PON.

Figure 5 is a managed entity relation diagram from the viewpoint of ONT configuration. It resembles Figure 4/G.983.7.
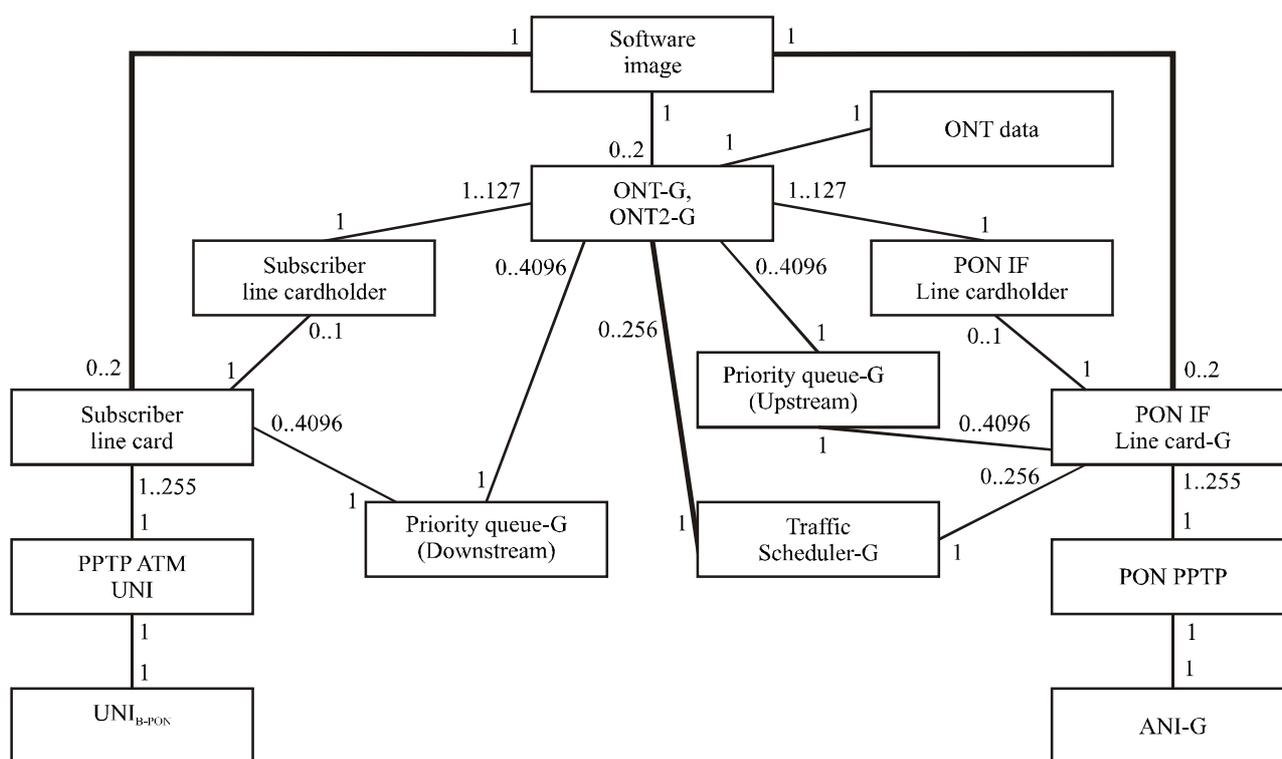
Figure 5/G.984.4 – ME relation diagram for ONT

Figure 6 is a managed entity relation diagram from the viewpoint of user traffic. In this figure, the CES/Ethernet UNI is connected to GEM T-CONT and ATM connection is connected to ATM T-CONT. The profile includes GAL Ethernet/TDM Profile and/or CES Service Profile$_{B-PON}$. The selection depends on the specific service.
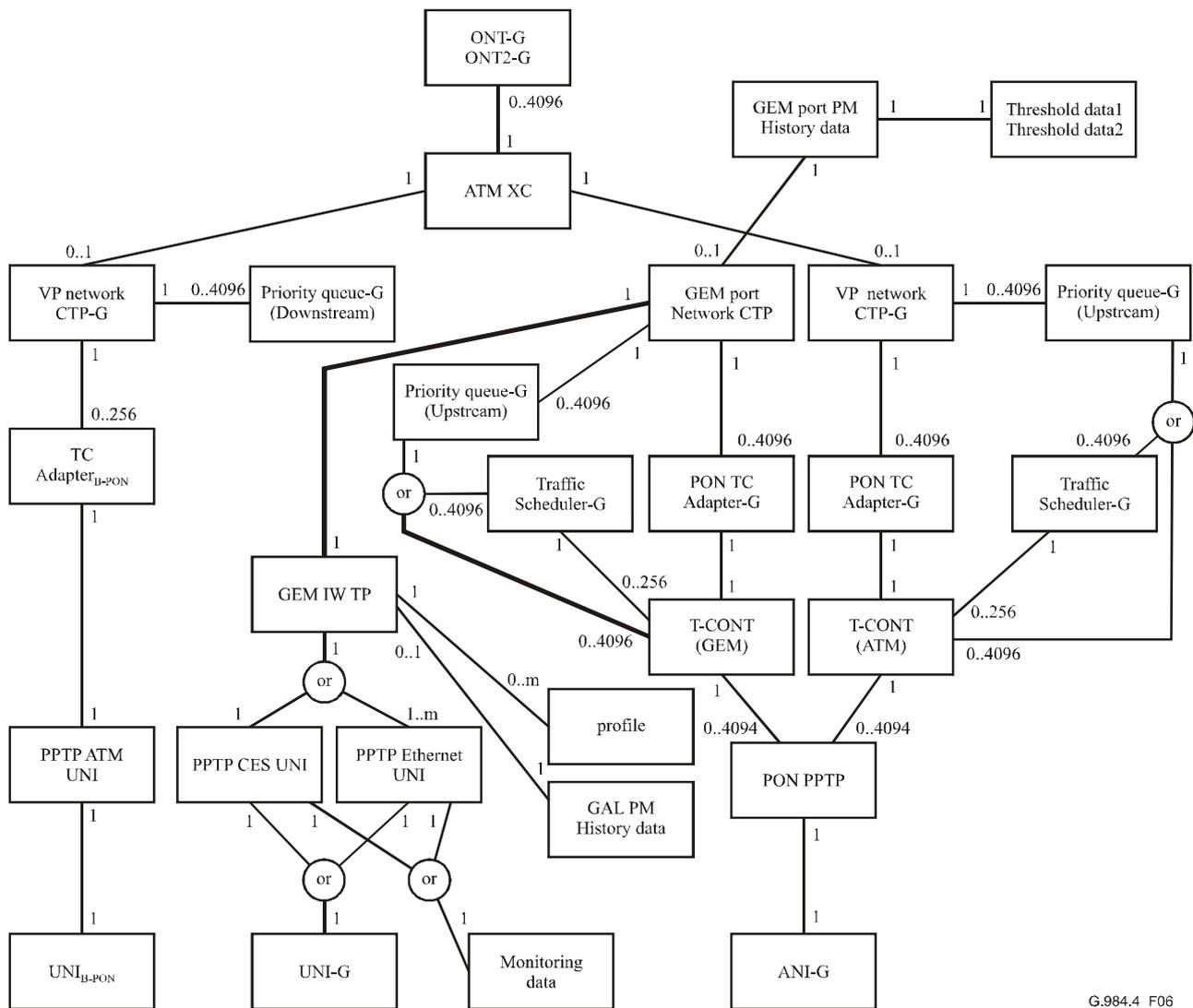
Figure 6/G.984.4 – ME relation diagram for user traffic

Figure 7 shows the Managed entity relation diagram in the case of MAC bridged LAN. Figure 8 shows the managed entity relation diagram in the case of structured CES.
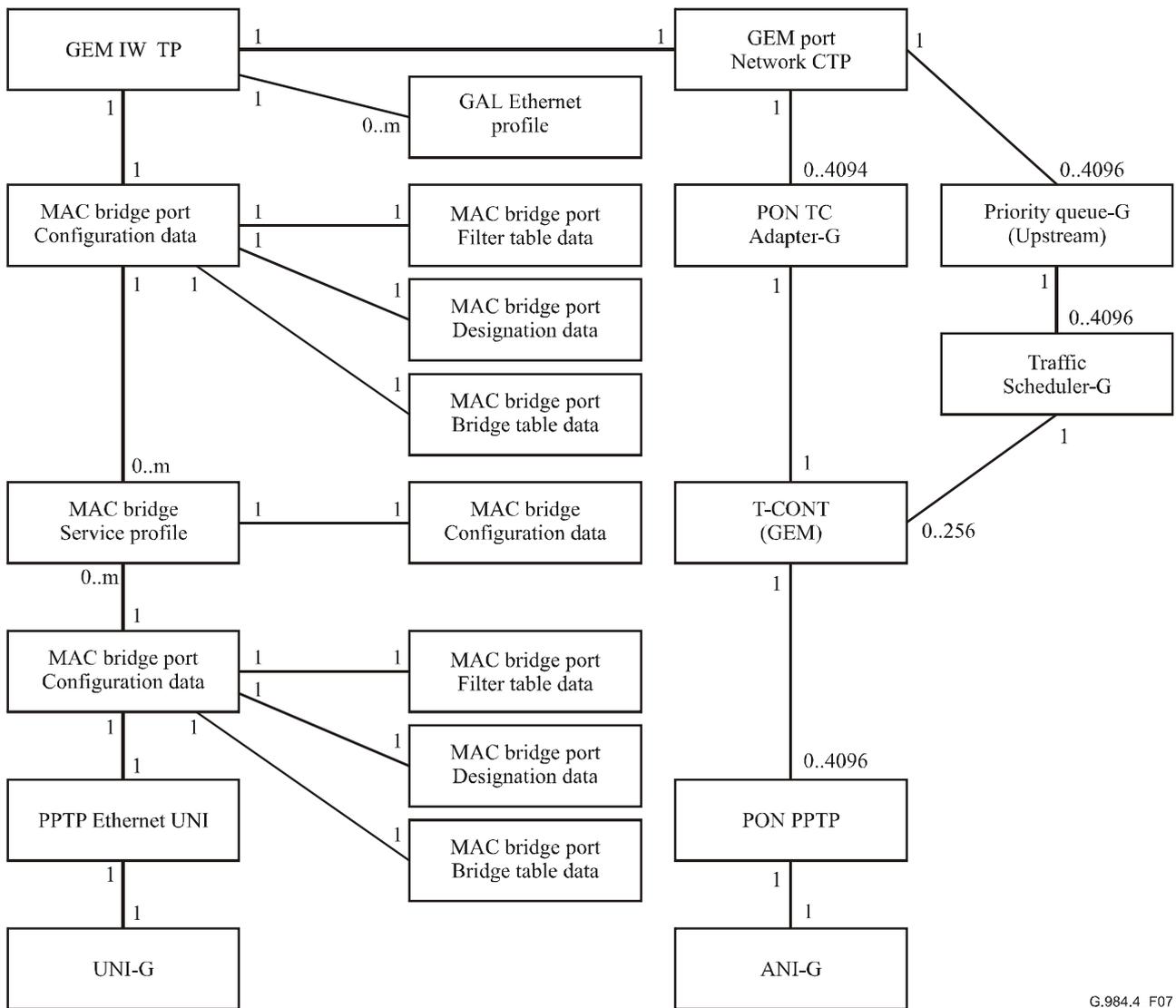
Figure 7/G.984.4 – ME relation diagram for MAC bridged LAN
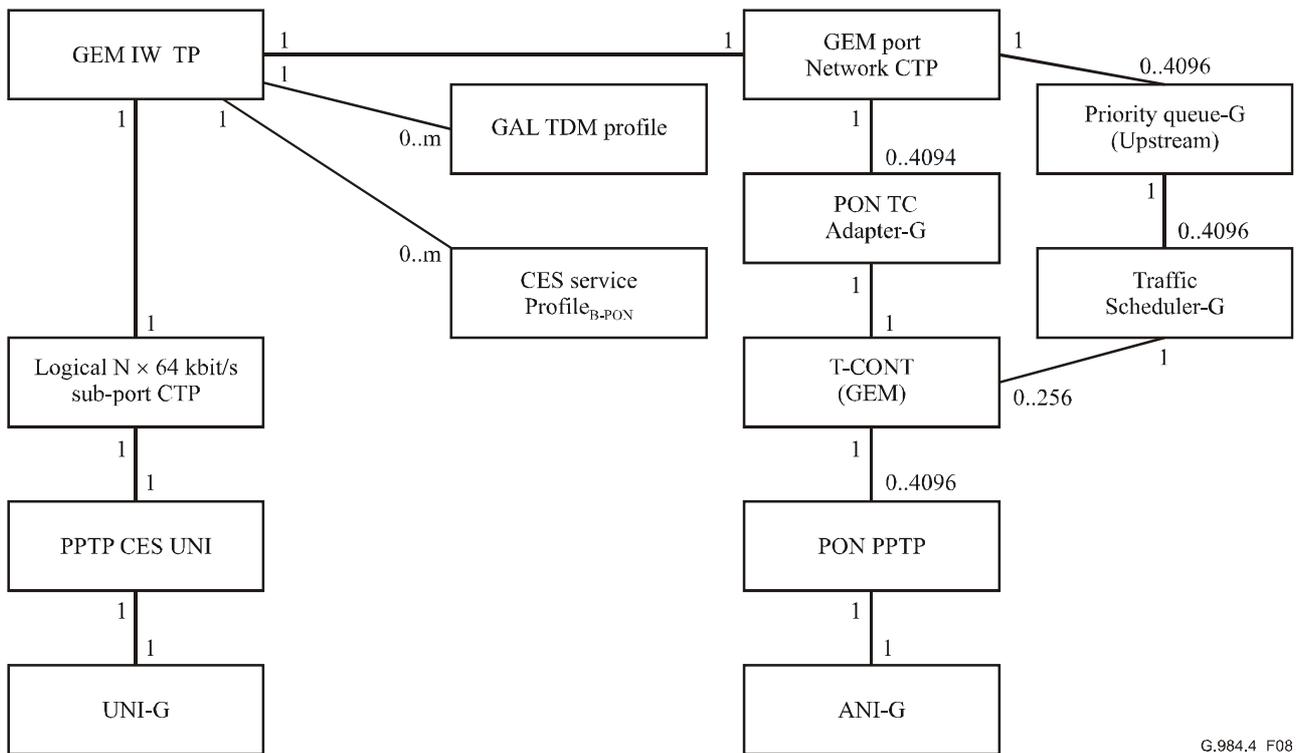
Figure 8/G.984.4 – ME relation diagram for structured CES

Figure 9 shows a part of ME relation diagram in that an ONT supports 1+1 protection function. In this figure, the dashed line means that the PON TC Adapter-G ME is implicitly associated with T-CONT ME in protection side. One instance of PON TC Adapter-G ME is associated with two instances of T-CONT ME by Protection Data ME.

To GEM interworking TP
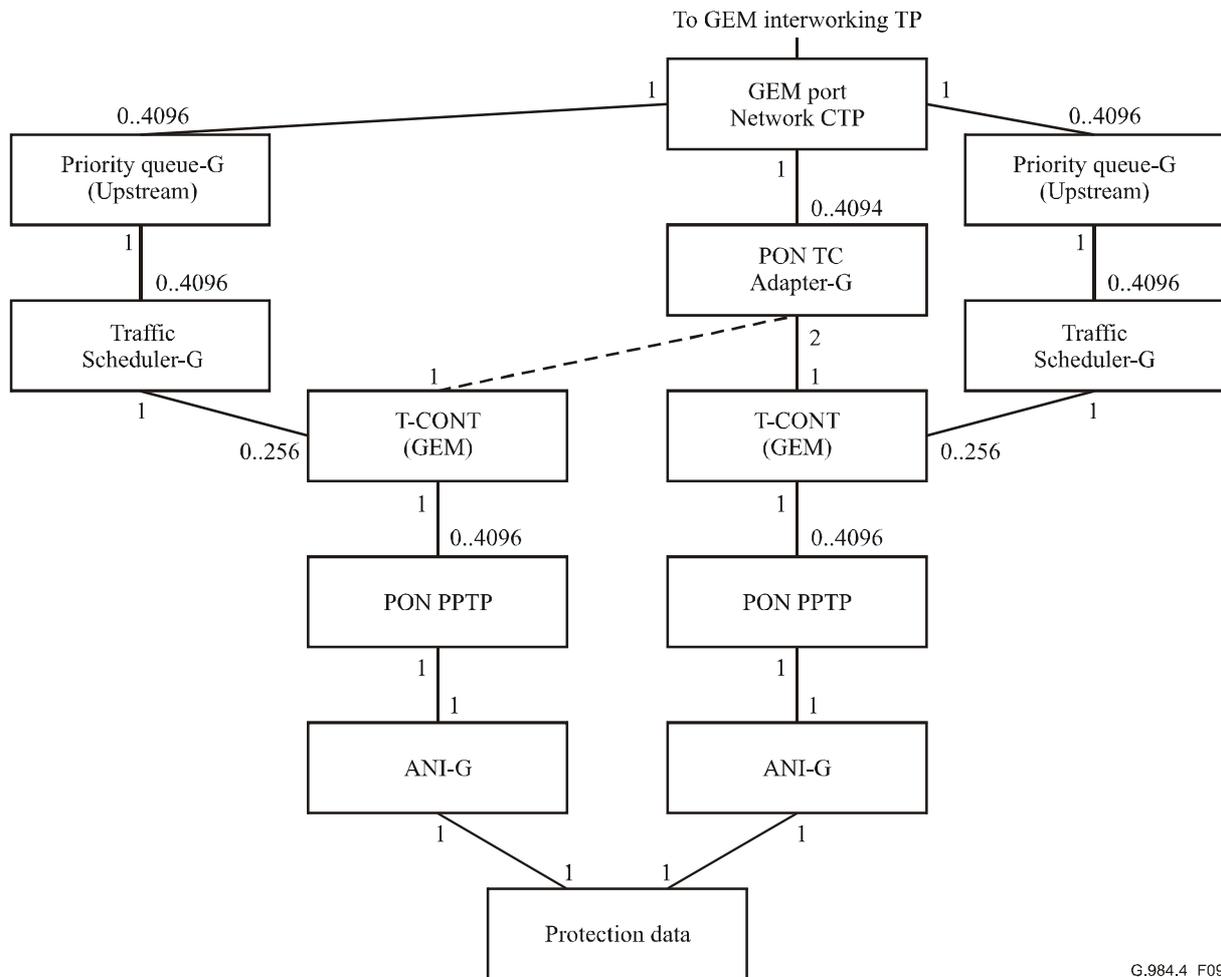
Figure 9/G.984.4 – Part of ME relation diagram for 1+1 protection

Figure 10 shows a part of ME relation diagram in that an ONT supports 1:1 protection function. In this figure, the dashed line means that the PON TC Adapter-G ME is implicitly associated with T-CONT ME in protection side by Protection Data ME. The PON TC Adapter-G ME for normal traffic is explicitly associated with T-CONT ME in working side. The PON TC Adapter-G ME for extra traffic is explicitly associated with T-CONT ME in protection side. Moreover, the PON TC Adapter-G ME for normal traffic is implicitly associated with T-CONT ME in protection side.
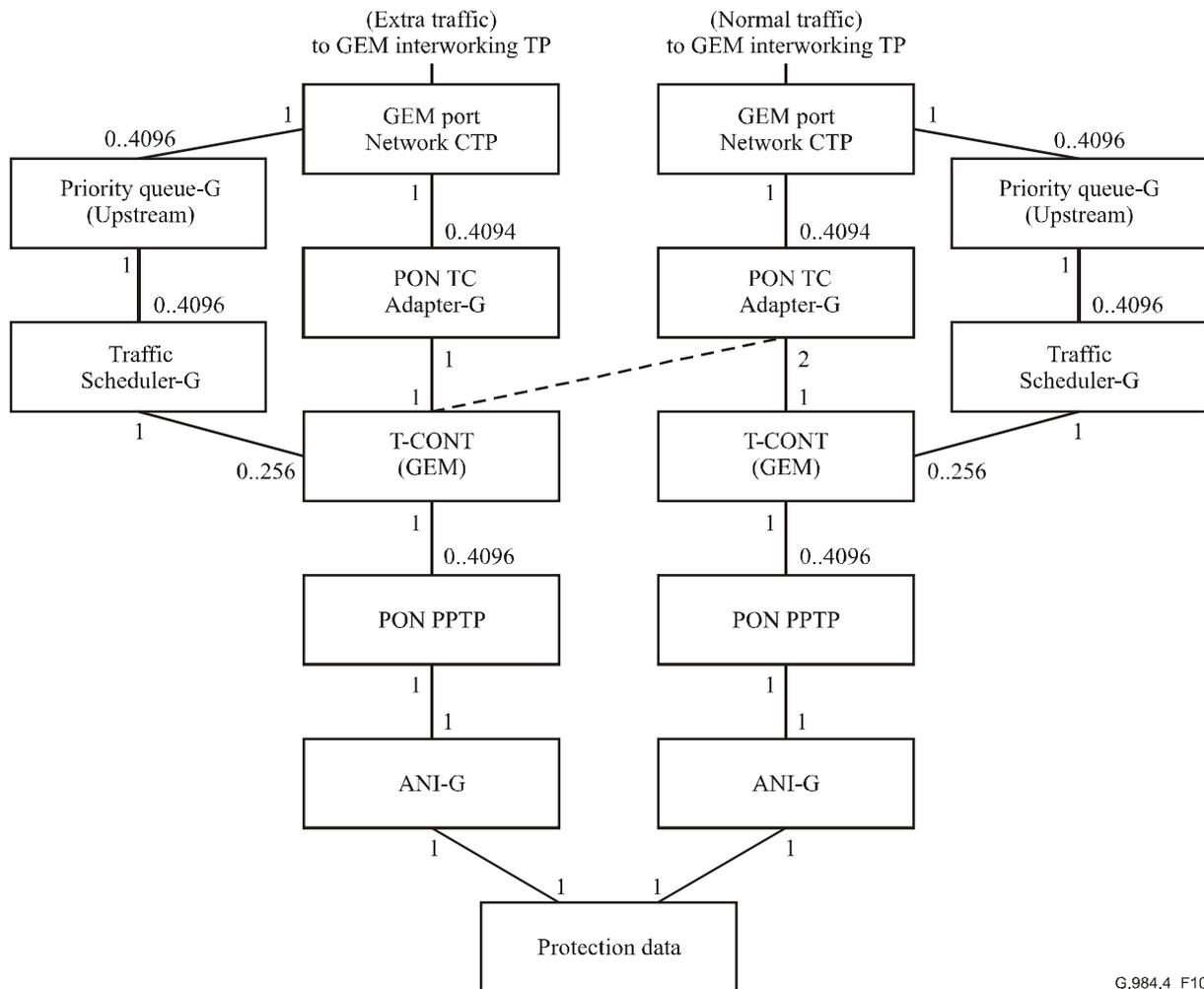
Figure 10/G.984.4 – Part of ME relation diagram for 1:1 protection

9 MIB description

As there is considerable overlap between the MIB required for B-PON and that required for G-PON, clause 7/G.983.2 provides a detailed description of many of the managed entities. Additional managed entity descriptions and details are provided in ITU-T Recs G.983.2 Amendment 1, G.983.8, G.983.9, G.983.10 and Implementors' Guide to G.983.2 (2002). Only managed entities in Table 1 specific to G-PON or that must be modified from ITU-T Recs G.983.2, G.983.2 Amendment 1, G.983.8, G.983.9, G.983.10, or Implementors' Guide to G.983.2 (2002) are provided here. The descriptions include:

a)   the purpose of the entity;

b)   the relationship(s) that the entity supports with other managed entities;

c)   the attributes of the entity;

d)   the management operations that may be performed on the entity;

e)   the notifications generated by the managed entity.

These clauses are organized as follows:

a)   ONT equipment management;

b)   ANI (i.e., PON IF) management;

c)   UNI management;

d)   connection management;

e)   traffic management.

A managed entity can be instantiated by the ONT autonomously or on explicit request of the OLT via a create command.

Attributes of a managed entity for which no create action exists (i.e., a managed entity which is auto-instantiated by the ONT) can be (R), (W), or (R, W). On the other hand, attributes of a managed entity for which a create action exists (i.e., a managed entity which is instantiated on explicit request by the OLT) can be either (R), (W), (R, W), (R, Set-by-create), (W, Set-by-create), or (R, W, Set-by-create). For attributes that are not "Set-by-create", a default value will be specified in this Recommendation which will be assigned to the attribute on instantiation of the managed entity.

The following gives a more detailed explanation for each of the possible cases:

(R):   On instantiation of the managed entity (either autonomously or on request of the OLT via a create action), the ONT sets the attribute to a default value. The OLT can only read the value of the attribute. In case of an autonomous attribute value change, the ONT will send an attribute value change notification to the OLT.

(W):   On instantiation of the managed entity (either autonomously or on request of the OLT via a create action), the ONT sets the attribute to a default value. The OLT can only write the value of the attribute. In case of an autonomous attribute value change, the ONT will NOT send an attribute value change notification to the OLT.

(R, W):   On instantiation of the managed entity (either autonomously or on request of the OLT via a create action), the ONT sets the attribute to a default value. The OLT can both read and write the value of the attribute. In case of an autonomous attribute value change, the ONT will send an attribute value change notification to the OLT.

(R, Set-by-create): On instantiation of the managed entity (by necessity on request of the OLT via a create action), the ONT sets the attribute to the value specified in the create command. Subsequently, the OLT can only read the value of the attribute. In case of an autonomous attribute value change, the ONT will send an attribute value change notification to the OLT.

(W, Set-by-create): On instantiation of the managed entity (by necessity on request of the OLT via a create action), the ONT sets the attribute to the value specified in the create command. Subsequently, the OLT can only write the value of the attribute. In case of an autonomous attribute value change, the ONT will NOT send an attribute value change notification to the OLT.

(R, W, Set-by-create): On instantiation of the managed entity (by necessity on request of the OLT via a create action), the ONT sets the attribute to the value specified in the create command. Subsequently, the OLT can both read and write the value of the attribute. In case of an autonomous attribute value change, the ONT will send an attribute value change notification to the OLT.

The notifications generated by a managed entity stem from the following events: Alarms, Attribute Value Changes (AVCs), Threshold Crossing Alerts (TCAs), and Test results. Alarms, TCAs, and failures of autonomous self tests are all reported via "Alarm" messages. AVCs are reported via "Attribute Value Change" messages. Test results are reported:

a)   via a "Test result" message if the test is invoked by a "Test" command from the OLT; or

b)   via an "Alarm" message in the case of failure of an autonomous self test (in start-up phase).

Details about these messages and the related coding are in Appendix II.

9.1   ONT equipment management

9.1.1   ONT-G

This managed entity represents the ONT as equipment.

An instance of this managed entity is automatically created by the ONT after initialization. After the creation of this managed entity, the associated attributes are updated according to the data within the ONT itself.

Relationships

All other managed entities in this Recommendation are related directly or indirectly to the ONT-G entity.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. There is only one instance and it has the number 0x0000. (R) (mandatory) (2 bytes)

Vendor id: This attribute identifies the vendor of the ONT. Upon autonomous instantiation, this attribute consists of all spaces. (R) (mandatory) (4 bytes)

Version: This attribute identifies the version of the ONT as defined by the vendor. The printable value of "0" is used when version information is not available or applicable to the ONT being represented. Upon autonomous instantiation, this attribute consists of all spaces. (R) (mandatory) (14 bytes)

Serial Number: The serial number is unique for each ONT. Note that the serial number of the ONT is already defined in ITU-T Rec. G.983.1 and contains the vendor id and/or the version number. Upon autonomous instantiation, this attribute consists of all spaces. (R) (mandatory) (8 bytes)

Traffic Management Option: This attribute identifies the upstream traffic management function implemented in the ONT. There are two options:

1) "Priority controlled and flexibly scheduled upstream traffic" (0x00): The traffic scheduler and priority queue mechanism are used for the upstream traffic.

2) "Cell rate controlled upstream traffic" (0x01): The maximum upstream traffic of each individual connection is guaranteed. For more clarification, see Appendix IV/G.983.2.

Note that the Traffic management option will not apply to downstream traffic. In other words, there is no need for a traffic descriptor for the downstream direction and downstream priority queues can be used. Upon autonomous instantiation, this attribute is set to 0x00. (R) (mandatory) (1 byte)

VP/VC Cross-connection Function Option: This attribute identifies the support of ATM VP or VC cross-connection management functions for the interworking connections to non-ATM UNIs. The value is set to 0x00 if no cross-connection management functions are modelled. The value is set to 0x01 if ATM VP cross-connection management functions are modelled. The value is set to 0x02 if ATM VP and VC cross-connection management functions are modelled. The default value of this attribute is 0x01. (R) (mandatory for ONTs that support ATM mode) (1 byte)

Battery Backup: This attribute provides a Boolean indication of whether or not the ONT/NT supports battery backup. False will indicate that no battery is provisioned; true

indicates that a battery is provisioned. Upon autonomous instantiation, this attribute is set to false. (R, W) (mandatory) (1 byte)

Administrative State: This attribute is used to activate (unlock: value 0x00) and deactivate (lock: value 0x01) the functions performed by instances of this managed entity. Selection of a default value for this attribute is outside the scope of this Recommendation as it is normally handled through supplier-operator negotiations. (R, W) (mandatory) (1 byte)

Operational State: This attribute indicates whether or not a managed entity is capable of performing its task. Valid values are enabled (0x00) and disabled (0x01). (R) (optional) (1 byte)

Actions

Get: Get one or more attributes.

Set: Set one or more attributes.

Reboot: Reboot the ONT.

Test: This action is used to initiate an ONT self test. Test outcome is "Pass" or "Fail".

Synchronize Time: This action is used to synchronize the start time of all Monitoring managed entities of the ONT with the reference time of the OLT and to reset the registers of the Monitoring managed entities. The effect of this action is that all counters of all Monitoring managed entities are set to 0x00 and restart counting. Also, the value of the Interval End Time attribute of the Monitoring managed entities is set to 0x00 and restarts counting.

Note that no other OMCI action has the same effect: synchronization of the start time is not guaranteed at start-up or after a MIB reset command (optional).

Notifications

Attribute value change: This notification is used to report autonomous changes to the attributes of this managed entity. The attribute value change notification should identify the attribute changed and its new value. The list of AVCs for this managed entity is given in Table 2a.

Alarm: This notification is used to notify the managed system when a failure has been detected or cleared. Both ONT and OLT should know the alarm list used by this entity. For the "Test result" event, notification is sent to the OLT via an alarm if the ME fails the autonomous self test. The alarm list for this entity is given in Table 2b.

Test result: Test results are reported via a "Test result" message if the test is invoked by a "Test" command from the OLT.

Table 2a/G.984.4 – AVC list for ONT-G

Number	Attribute value change	Description
1	Vendor ID	Vendor identification
2	Version	Version of ONT as defined by vendor
3	Serial Number	Serial number of ONT
4-7	N/A	
8	OpState	Operational state of ONT-G
9-16	N/A	

Table 2b/G.984.4 – Alarm list for ONT-G

Number	Event	Description
	Alarm	
0	EquipmentAlarm	A functional failure on an internal interface
1	PoweringAlarm	Loss of external power
2	BatteryMissing	Battery is provisioned but missing
3	BatteryFailure	Battery is provisioned and present but cannot recharge
4	BatteryLow	Battery is provisioned and present but its voltage is too low
5	PhysicalIntrusionAlarm	Applies if the ONT is supported with detection such as door or box open
6	ONTSelfTestFailure	ONT has failed autonomous self test
7-223	Reserved	

9.1.2 ONT2-G

This managed entity provides additional attributes that are associated with the G-PON ONT.

An instance of this managed entity is automatically created by the ONT after initialization. After the creation of this managed entity, the associated attributes are updated according to the data within the ONT itself.

Relationships

This managed entity is related directly to the ONT-G entity.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. There is only one instance and it has the number 0x0000. (R) (mandatory) (2 bytes)

Equipment id: This attribute may be used to identify the specific type of ONT. In North America, this may be used for the equipment CLEI code. (R) (optional) (20 bytes)

OMCC Version: This attribute is used to identify the specific version of the OMCC protocol being used by the ONT. This is used to allow the OLT to manage a network with ONTs that support different OMCC versions. The only valid value at this time is 0x80 (2002 version of G.983.2, G.983.2 Amendment 1, G.983.8, G.983.9, G.983.10, and 2004 version of G.984.4). Future versions will be added sequentially. Upon autonomous instantiation, this attribute consists of the value 0x80. (R) (mandatory) (1 byte)

Vendor Product Code: This attribute is used to provide a vendor-specific product code for the ONT. (R) (optional) (2 bytes)

Security Capability: This attribute is used to advertise the advanced security modes of the ONT. The following codepoints are defined:

0: Reserved for future use;

1: AES encryption of the downstream payload is supported;

2..255: Reserved for future use.

(R) (mandatory) (1 byte)

Security Mode: This attribute is used to select the advanced security mode for the ONT. Note that all secure VPs/VCs or GEM ports in an ONT must use the same security mode at any time. The following codepoints are defined:

0: Reserved for future use;

1: AES algorithm for unicast traffic will be used;

2..255: Reserved for future use.

Upon autonomous instantiation this attribute consists of the value 0x01. (R, W) (mandatory) (1 byte)

Total Priority Queue Number: This attribute provides a total number of priority queues which are not associated with the PON IF line card. Maximum value is 0x0FFF. (R) (mandatory) (2 bytes)

Total Traffic Scheduler Number: This attribute provides a total number of Traffic Schedulers which are not associated with the PON IF line card. The ONT supports NULL function, HOL scheduling and WRR from the priority control and guarantee of minimum rate control points of view, respectively. If the ONT does not have any Traffic Scheduler, this attribute should be 0x00. (R) (mandatory) (1 byte)

Mode: This attribute identifies whether the ONT can operate in ATM-only mode (0x00), GEM-only mode (0x01), or dual (both ATM and GEM) mode (0x02). (R) (mandatory) (1 byte)

Actions

Get: Get one or more attributes.

Set: Set one or more attributes.

Notifications

Attribute value change: This notification is used to report autonomous changes to the attributes of this managed entity. The attribute value change notification should identify the attribute changed and its new value. The list of AVCs for this managed entity is given in Table 3.

<p align="center">Table 3/G.984.4 – AVC list for ONT2-G</p>

Number	Attribute value change	Description
1	N/A	
2	OMCC Version	OMCC Version supported in the ONT
3-8	N/A	
9-16	Reserved	

9.1.3 ONU-G

This managed entity represents the ONU as equipment.

An instance of this managed entity is automatically created by the ONU after initialization. After the creation of this managed entity, the associated attributes are updated according to the data within the ONU itself.

The specifications of attributes, actions and notifications are the same as ONT-G ME. The difference between ONT-G and ONU-G is based on the difference of ONU from ONT. Please refer to 3.1 for the definition of ONU and ONT.

Relationships

>All other managed entities in this Recommendation are related directly or indirectly to the ONU-G entity.

9.1.4   ONU2-G

This managed entity provides additional attributes that are associated with the G-PON ONU.

An instance of this managed entity is automatically created by the ONU after initialization. After the creation of this managed entity, the associated attributes are updated according to the data within the ONU itself.

The specifications of attributes, actions and notifications are the same as ONT2-G ME. The difference between ONT2-G and ONU2-G is based on the difference of ONU from ONT. Please refer to 3.1 for the definition of ONU and ONT.

Relationships

>This managed entity is related directly to the ONU-G entity.

9.1.5   Subscriber Line Cardholder

Some subscriber line card types are no longer valid. The Managed Entity id attribute value of 0x0000 is removed since it is no longer needed (it was included in the revised version of ITU-T Rec. G.983.2 for purposes of backwards-compatibility).

9.1.6   PON IF Line Cardholder

This managed entity is modified slightly from that given in 7.1.5/G.983.2. These modifications are to allow the modelling of integrated PON IF line cardholders.

This managed entity represents slots of the ONT that are capable of holding a network card on the ANI side. An instance of this managed entity exists for each slot. Instances of this managed entity are created automatically by an ONT that supports PON IF plug-in after the ONT initialization.

Relationships

>An instance of the PON IF Line Cardholder may contain an instance of the PON IF Line Card managed entity to model the containment of PON IF Line Cards within slots of the ONT.

Attributes

>**Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. The first byte of this two-byte identifier is always 0x00. The second byte of this identifier is the slot id.

>To accommodate a universal code of the ONT slot id for both PON and UNI interfaces, one must interpret the least significant 7 bits of the slot id as the actual physical slot number with the most significant bit serving as an interface type (UNI/ANI) indicator. Therefore, the coding of the PON IF Line Card slot id for non-integrated interfaces is in the range of 0x81-0xFF (129-255). The code 0x81 (129) is used for the leftmost lower slot of the ONT when looking at the side where the PON IF Line Cards are plugged in, 0x82 (130) is used for the next slot just to the right of the previous one, and so forth; numbering on the next higher shelf continues at its left edge. The coding of the PON IF Line Card slot id for integrated interfaces is 0x80. Accordingly, the full two-byte managed entity id value is in the range 0x0080-0x00FF. (R) (mandatory) (2 bytes)

>NOTE – Only up to 127 slots are supported.

Actions

      Get: Get one or more attributes.

Notifications

      None.

9.1.7 PON IF Line Card-G

This managed entity is modified slightly from that given in 7.1.2/G.983.7; these modifications are related to the increased number of T-CONTs supported by G-PON and the support of integrated PON IF line cards.

This managed entity is used to model a field-replaceable PON IF Line Card contained within an ONT. An instance of this managed entity is automatically created by the ONT.

Relationships

      One instance of this managed entity is contained by an instance of the PON IF Line Cardholder.

Attributes

      Managed Entity id: This attribute provides a unique number for each instance of this managed entity. The number used is the same as the instance number used for the PON IF Line Cardholder managed entity instance containing this PON IF Line Card instance. (R) (mandatory) (2 bytes)

      Serial Number: The serial number is unique for each PON IF Line Card. Upon autonomous instantiation, this attribute consists of all spaces. (R) (mandatory) (8 bytes)

      Version: This attribute identifies the version of the PON IF Line Card as defined by the vendor. Upon autonomous instantiation, this attribute consists of all spaces. (R) (mandatory) (14 bytes)

      Vendor id: This attribute identifies the vendor of the PON IF Line Card. Upon autonomous instantiation, this attribute consists of all spaces. (R) (optional) (4 bytes)

      Equipment id: This attribute may be used to identify the vendor's specific type of PON interface card. This attribute applies only to PON interface cards that do not have integrated interfaces. In North America, this may be used for the equipment CLEI code. (R) (optional) (20 bytes).

      Total Priority Queue Number: This attribute provides a total number of priority queues which are associated with the PON IF line card. Maximum value is 0x0FFF. (R) (mandatory) (2 bytes)

      Total Traffic Scheduler Number: This attribute provides a total number of Traffic Schedulers, which are associated with the PON IF line card. The ONT can support NULL function, HOL scheduling and WRR from the priority control and guarantee of minimum rate control points of view, respectively. If the PON IF line card does not have any Traffic Scheduler, this attribute should be 0x00. (R) (mandatory) (1 byte)

Actions

      Get: Get one or more attributes.

      Reboot: Reboot the PON IF line card.

      Test: Test the PON IF line card (this action is optional).

Notifications

Attribute Value Change: This notification is used to report autonomous changes to the attributes of this managed entity. The notification should identify the attribute that changed and its new value. The list of AVCs for this managed entity is given in Table 4a.

Alarm: Alarms on the PON IF are transmitted to the OLT by PLOAM messages (see ITU-T Recs G.983.1 and G.984.3). Alarms for redundant PON IFs are also transmitted to the OLT by PLOAM messages (see ITU-T Recs G.983.5 and G.984.3). This managed entity defines some alarms that are not defined in the TC layer. Both ONT and OLT should know the alarm list used by this entity. For the "Test result" event, notification is sent to the OLT via an alarm if the ME fails the autonomous self test. The alarm list for this entity is given in Table 4b.

Test result: Test results are reported via a "Test result" message if the test is invoked by a "Test" command from the OLT.

Table 4a/G.984.4 – AVC list for PON IF Line Card-G

Number	Attribute value change	Description
1	Serial Number	Serial Number of this PON IF Line Card
2	Version	Version supported in this PON Line Card
3	Vendor id	Vendor id supported in this PON Line Card
4	N/A	
5	Total Priority Queue Number	Total number of priority queues supported in this PON Line Card
6	Total Traffic Number	Total number of traffic scheduler supported in this PON Line Card
7-16	Reserved	

Table 4b/G.984.4 – Alarm list for PON IF Line Card-G

Number	Event	Description
	Alarm	
0	EquipmentAlarm	A functional failure on an internal interface
1	SelfTestFailure	Failure of PON IF Line Card autonomous self test
2-223	Reserved	

9.1.8 Threshold Data 1

An instance of this managed entity together with an instance of the Threshold Data 2 ME contains threshold values for the performance monitoring parameters maintained in one or more instances of other managed entities.

Instances of this managed entity are created and deleted by request of the OLT.

Threshold Data 1 ME includes the attributes Threshold Value 1 through Threshold Value 7. Threshold Data 2 ME includes the attributes Threshold Value 8 through Threshold Value 14. This will keep the total number of bytes below the 32-byte limit for the message contents of the "Create" message for each managed entity. In order to link the related instances of Threshold Data 1 ME and Threshold Data 2 ME together, an instance of Threshold Data 2 ME has the same ME ID as for the related instance of Threshold Data 1 ME.

Relationships

> Zero or more instances of this managed entity can be contained in the ONT-G managed entity.

> This managed entity may be related to multiple instances of History Data type managed entities, which have a Threshold Data1/2 id attribute that points to an instance of this managed entity. For managed entities that are defined in ITU-T Recs G.983.2 and G.983.8, the Threshold Data$_{B-PON}$ id attribute should be interpreted as having the same functionality as the Threshold Data 1/2 id attribute. The Related Managed Entities are listed in 7.3.

Attributes

> **Managed Entity id**: This attribute provides a unique number for the instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

> **Threshold Value 1**: This attribute provides the associated threshold value for the 1st thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 2**: This attribute provides the associated threshold value for the 2nd thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 3**: This attribute provides the associated threshold value for the 3rd thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 4**: This attribute provides the associated threshold value for the 4th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 5**: This attribute provides the associated threshold value for the 5th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 6**: This attribute provides the associated threshold value for the 6th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

> **Threshold Value 7**: This attribute provides the associated threshold value for the 7th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Actions

> **Create**: Create an instance of this managed entity.

> **Delete**: Delete an instance of this managed entity.

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> None

9.1.9 Threshold Data 2

An instance of this managed entity together with an instance of the Threshold Data 1 ME contains threshold values for the performance monitoring parameters maintained in one or more instances of other managed entities.

Instances of this managed entity are created and deleted by request of the OLT.

Relationships

Please refer to the relationships of Threshold Data 1 ME.

Attributes

Managed Entity id: This attribute provides a unique number for the instance of this managed entity. This ME id shall be the same as the related instance of Threshold Data 1 ME. (R, Set-by-create) (mandatory) (2 bytes)

Threshold Value 8: This attribute provides the associated threshold value for the 8th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 9: This attribute provides the associated threshold value for the 9th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 10: This attribute provides the associated threshold value for the 10th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 11: This attribute provides the associated threshold value for the 11th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 12: This attribute provides the associated threshold value for the 12th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 13: This attribute provides the associated threshold value for the 13th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Threshold Value 14: This attribute provides the associated threshold value for the 14th thresholded counter in the History Data type managed entity. (R, W, Set-by-create) (mandatory) (4 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Set: Set one or more attributes.

Notifications

None

9.1.10 Protection Data

This managed entity is used for the ONT that supports the PON protection function. An instance of this managed entity represents the capability and parameters for protection function.

An instance of this managed entity is automatically created by ONT after initialization when this ONT supports PON protection function.

Relationships

> One instance of this managed entity is associated with two instances of ANI-G managed entity. One instance of ANI-G managed entity represents a working side and the other instance represents a protection side.

Attributes

> Managed Entity id: This attribute provides a unique number for the instance of this managed entity. This ME id shall be numbered by the ONT itself. It is numbered in ascending order from 0x0000. (R) (mandatory) (2 bytes)

> **Working ANI-G Pointer**: This attribute provides the ME id of the ANI-G managed entity that represents a working side of PON protection. (R) (mandatory) (2 bytes)

> **Protection ANI-G Pointer**: This attribute provides the ME id of the ANI-G managed entity that represents a protection side of PON protection. (R) (mandatory) (2 bytes)

> **Protection Type**: This attribute provides the behaviour of PON protection. The valid values are as follows:

> 0x00: 1+1 Protection,

> 0x01: 1:1 Protection without Extra traffic,

> 0x02: 1:1 Protection with capability to support Extra traffic.

> (R) (mandatory) (1 byte)

> **Revertive Ind**: This attribute indicates whether the protection scheme uses revertive mode (= TRUE, value 0x01) or non-revertive mode (= FALSE, value 0x00). (R) (mandatory) (1 byte)

> **Wait To Restore Time**: This attribute specifies the amount of time, in units of seconds, to wait during the time from a fault clear to switching over the trail/connection/line to the working side. Upon autonomous instantiation this attribute consists of the value 0x03. (R, W) (mandatory) (2 bytes)

> **Switching Guard Time**: This attribute specifies the amount of time, in units of milliseconds, to wait during the interval from the detection of a fault to the time when a protection trail/connection/line can be used to transport the normal traffic signal and/or to select the normal traffic signal. Selection of a default value for this attribute is outside the scope of this Recommendation as it is normally handled through supplier-operator negotiations. (R, W) (optional) (2 bytes)

Actions

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> None.

9.2 ANI management

Although the OLT can maintain the PON interface related managed entities and attributes via PLOAM messages, there is some information to be negotiated in OMCC. Therefore, the ONT will autonomously create one instance of each of the managed entities "PON Physical Path Termination Point", "ANI-G", "T-CONT" and "PON TC Adapter-G" upon creation of the ONT-G or ONU-G managed entity. These ANI management MEs are uploaded in the MIB upload.

9.2.1 ANI-G

This managed entity is modified from that given in 7.2.1/G.983.7.

This managed entity is used to organize data associated with the Access Network Interface supported by the ONT. One instance of this managed entity exists for each PON physical port.

An instance of this managed entity is automatically created by the ONT after initialization.

Relationships

> One or more instances of this managed entity are contained in an instance of the PON IF Line Card-G managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. This 2-byte number is directly associated with the physical position of the PON IF. The assigned number is the same as the id of the PON Physical Path Termination Point with which this ANI is associated. (R) (mandatory) (2 bytes)

> **SR Indication**: This Boolean attribute indicates the capability of status reporting. The value TRUE means that the status reporting is available for all T-CONTs which are associated with the ANI. (R) (mandatory) (1 byte)

> **Total T-CONT Number**: This attribute provides the total number of T-CONTs that are able to be supported in this ANI port. (R) (mandatory) (2 bytes)

> **GEM Block Length**: This attribute indicates the reporting block size for GEM mode in units of bytes. The value which the OLT sets is used by all T-CONTs in this ANI. Upon autonomous instantiation this attribute consists of the value 0x0030. (R,W) (mandatory) (2 bytes)

> **Piggyback DBA Reporting**: This attribute provides a special code that indicates the piggyback DBA reporting format capabilities of this ONT. ITU-T Rec. G.984.3 defines three possible piggyback reporting mode formats. For reporting mode 0, the single field is the entire report. For reporting mode 1, the DBA report is two fields in length. For reporting mode 2, the DBA report is four fields in length. More explanation is provided in ITU-T Rec. G.984.3. Support of mode 0 is mandatory for ONTs that utilize the piggyback DBA reporting method. Support of modes 1 and/or 2 is optional. The following coding is used to indicate the ONT's piggyback DBA reporting mode capabilities:

0x00: supports mode 0 only;

0x01: supports modes 0 and 1;

0x02: supports modes 0 and 2;

0x03: supports modes 0, 1, and 2;

0x04: piggyback DBA reporting not supported.

(R) (mandatory) (1 byte)

> **Whole ONU DBA Reporting**: This attribute indicates whether or not whole ONU DBA reporting as specified in ITU-T Rec. G.984.3 is supported by the ONU/ONT.

> Valid values are 0x00 (whole ONU DBA reporting is not supported) and 0x01 (whole ONU DBA reporting is supported).

> (R) (mandatory) (1 byte)

Actions

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> **Attribute value change**: This notification is used to report autonomous changes of attributes of this managed entity. The notification should identify the attribute and its new value. The list of AVCs for this managed entity is given in Table 5.

Table 5/G.984.4 – AVC list for ANI-G

Number	Attribute value change	Description
1	SR Indication	Indicates status reporting capability of ONT
2	Total T-CONT number	Maximum number of T-CONTs supported by ANI
3	N/A	
4	Piggyback DBA reporting	Indicates modes of piggyback DBA reporting supported by ONT
5	Whole ONU DBA reporting	Indicates whether whole ONU DBA reporting is supported by ONT
6-16	Reserved	

9.2.2 PON TC Adapter-G

This managed entity is modified slightly from that given in 7.2.3/G.983.2.

An instance of this managed entity represents a point in the ONT where the adaptation of the GEM or ATM layer to the underlying physical infrastructure (i.e., the G-PON TC layer) takes place.

An instance of this managed entity is automatically created after creation of a T-CONT.

Relationships

> One instance of this managed entity will exist for each T-CONT managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. The assigned number is the same as the id of the T-CONT ME with which this PON TC Adapter-G is associated. (R) (mandatory) (2 bytes)

Actions

> **Get**: Get one or more attributes.

Notifications

> None.

9.2.3 T-CONT

An instance of this managed entity represents a logical connection group that is associated with the Alloc-id. A T-CONT can accommodate ATM cells or GEM packets in priority queues or Traffic Schedulers that exist in the ATM or GEM layer.

Instances of this ME are autonomously created by the ONT after the initialization. OLT can know the number of instances of T-CONT ME via ANI-G ME. Each instance id can be found because of the generation rule of this instance.

Relationships

> One or more instances of this managed entity are contained in an instance of the PON IF Line Card-G managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. This 2-byte number is associated with the physical capability that realizes the T-CONT. It is represented as 0xSSBB, where SS indicates the slot id that contains this T-CONT and BB is the T-CONT id that is numbered by the ONT itself. The range of SS is 0x80-0xFF (T-CONT is ANI side only). The T-CONT id is numbered in ascending order with the range of 0x00 to 0xFF in each slot. (R) (mandatory) (2 bytes)

> **Alloc-id**: This attribute represents the Alloc-id that is assigned by the OLT with Assign_AllocID PLOAM message. When created autonomously, this attribute has a default value of 0x00FF. As the ONT does not know the relationship between the Alloc-id and T-CONT ME, OLT sets the correct value. This attribute has a value from 0x0000 to 0x0FFF. Once a value has been written to this attribute, the ONT holds that value. If OLT changes the Alloc-id for this T-CONT, the OLT should overwrite this attribute with a new value in order to align the OMCI condition with TC layer condition. (R, W) (mandatory) (2 bytes)

> **Mode Indicator**: This attribute indicates whether this T-CONT operates in ATM-mode (0x00) or GEM mode (0x01). (R) (mandatory) (1 byte)

> **Policy**: This attribute represents scheduling policy. Valid values include but are not limited to "Null" (value 0x00), "HOL" (value 0x01) or "WRR" (value 0x02). Upon autonomous instantiation, this attribute consists of the 0x01. (R) (mandatory) (1 byte)

Actions

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> **Attribute value change**: This notification is used to report autonomous changes of attributes of this managed entity. The notification should identify the attribute and its new value. The list of AVCs for this managed entity is given in Table 6.

Table 6/G.984.4 – AVC list for T-CONT

Number	Attribute value change	Description
1	N/A	
2	Mode Indicator	Indicate ATM mode or GEM mode
3	N/A	
4-16	Reserved	

9.3 UNI Management

9.3.1 UNI-G

This managed entity is used to organize data associated with the User Network Interfaces (UNIs) supported by the GEM services. For ATM UNIs and non-ATM UNIs that are supported by the ATM services, UNI$_{B-PON}$ is used. One instance of this managed entity exists for each UNI supported by the ONT.

Instances of this managed entity are automatically created/deleted by the ONT immediately following the creation/deletion of a Subscriber Line Card managed entity. After the creation of an instance of this managed entity, the associated attributes are updated according to the data within the Subscriber Line Card (if present) or within the ONT for the case of integrated interfaces on the UNI side.

Relationships

> One or more instances of the UNI-G managed entity may be contained in an instance of a Subscriber Line Card managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. This 2-byte number is directly associated with the physical position of the UNI. The assigned number is the same as the id of the Physical Path Termination Point with which this UNI is associated. (R) (mandatory) (2 bytes)

> **Configuration Option Status**: This attribute holds the UNI Configuration Code field. Its bits are assigned as described in Table 7. (R, W) (mandatory) (2 bytes)

> **Administrative State**: This attribute is used to "unlock" (value 0x00) and "lock" (value 0x01) the functions performed by the UNI. When the Administrative State attribute is set to "lock", all user traffic to and from this UNI is blocked and alarms for this UNI and all associated managed entities are no longer generated. Selection of a default value for this attribute is outside the scope of this Recommendation as it is normally handled through supplier-operator negotiations. (R, W) (mandatory) (1 byte)

Table 7/G.984.4 – Coding of the Configuration Option Status attribute

Bit	Name	Setting
1	n/a	
2	ServerTrailFaultPropagation TC layer	0: All TC layer alarm reporting through the OMCC is inhibited 1: All TC layer alarm reporting through the OMCC is not inhibited
3	ServerTrailFaultPropagation PHY layer	0: All PHY layer alarm reporting through the OMCC is inhibited 1: All PHY layer alarm reporting through the OMCC is not inhibited
4	ServerTrailFaultPropagation GAL layer	0: All GAL layer alarm reporting through the OMCC is inhibited 1: All GAL layer alarm reporting through the OMCC is not inhibited
5-16	Reserved	

Actions

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> None.

9.3.2   ATM Interworking VCC Termination Point

This managed entity is modified slightly from the Interworking VCC Termination Point managed entity given in 7.3.7/G.983.2. An instance of this managed entity represents a point in the ONT where the interworking of a service (e.g., CES, IP) or underlying physical infrastructure (e.g., nxDS0/DS1/DS3/E3/Ethernet) to ATM layer takes place. At this point, ATM cells are generated from a bit stream (e.g., nxDS0/DS1/DS3/E3/Frame Relay/Ethernet) or a bit stream is re-constructed from ATM cells.

Instances of this managed entity are created and deleted by the ONT on request of the OLT.

Establishment of a "CES interworking connection"

Since it is more complicated to introduce the "pointer list" as an attribute, the following mechanism will be used to create a CES interworking connection:

• for structured service: Create first a VP Network CTP-G or VC Network CTP-G instance *and* a Logical N × 64 kbit/s Sub-port Connection Termination Point instance, and then create an ATM Interworking VCC Termination Point; the latter would contain a reference to the VP Network CTP-G or VC Network CTP-G instance on one hand and the Logical N × 64 kbit/s Sub-port Connection Termination Point instance on the other hand; or

• for unstructured service: Create first a VP Network CTP-G or VC Network CTP-G instance, and then create an ATM Interworking VCC Termination Point; the latter would contain a reference to the VP Network CTP-G or VC Network CTP-G instance on one hand and to the Physical Path Termination Point CES UNI instance on the other hand.

Establishment of an "Ethernet interworking connection"

Create first a VP Network CTP-G or VC Network CTP-G instance, and then create an ATM Interworking VCC Termination Point. The latter would contain a reference to the VP Network CTP-G or VC Network CTP-G instance, on one hand and, to the Physical Path Termination Point Ethernet UNI instance on the other hand.

Relationships

One instance of this managed entity exists for each occurrence of transformation of a data stream into ATM cells and vice versa. Note that the attributes "AAL Profile pointer" and "Service Profile pointer" imply relationships to these managed entities.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

VCI Value: This attribute identifies the VCI value associated with this ATM Interworking VCC Termination Point. (R, Set-by-create) (mandatory) (2 bytes)

VPNetworkCTP Connectivity Pointer: This attribute provides an instance identifier of the VP Network CTP-G that is associated with this ATM Interworking VCC Termination Point. This attribute is only valid for VP cross-connections (R, Set-by-create) (mandatory for VP cross-connections) (2 bytes)

Interworking Option: This attribute identifies the type of non-ATM function that is being interworked; the option can be CES (0x00), MAC Bridge LAN (0x01), or Voice (0x02) service. (R, Set-by-create) (mandatory) (1 byte)

Service Profile Pointer: This attribute provides the service profile type and a pointer to the instance of a service profile, such as the CES Service Profile$_{B\text{-}PON}$ (if the interworking option = 0x00), MAC Bridge Service Profile (if the interworking option = 0x01), or Voice Service Profile AAL (if the interworking option = 0x02). (R, Set-by-create) (mandatory) (2 bytes)

AAL Profile Pointer: This attribute provides the AAL profile type and a pointer to an instance of AAL Profile such as AAL 1 Profile$_{B\text{-}PON}$ if the interworking option = 0x00, AAL 1 Profile$_{B\text{-}PON}$ or AAL 2 Profile$_{B\text{-}PON}$ if the interworking option = 0x02, or AAL 5 Profile$_{B\text{-}PON}$ if the interworking option = 0x01. (R, Set-by-create) (mandatory) (2 bytes)

Interworking Termination Point Pointer: This attribute provides a pointer to the associated instance(s) of the following managed entities (depending on the service provided):

• Physical Path Termination Point Ethernet UNI.

• Physical Path Termination Point POTS UNI.

• Physical Path Termination Point CES UNI.

• Logical N × 64 kbit/s sub-port Connection Termination Point.

• Physical Path Termination Point ISDN UNI.

• Physical Path Termination Point 802.11 UNI.

NOTE – For the case utilizing the multiplexing function of AAL 2, this attribute is assigned a special value:

• 0x00XX will be used for pseudo slotIDs;

• 0xXX00 will be used for pseudo portIDs.

Therefore, 0x0000 will be used only if the integrated interfaces (integrated type of ONT) support AAL 2 multiple functions. (R, Set-by-create) (mandatory) (2 bytes)

AAL Loopback Configuration: This attribute is used to set the loopback configuration: No loopback (value 0x00), Loopback 1 (value 0x01, loopback of downstream traffic before FEC of AAL 1), Loopback 2 (value 0x02, loopback of downstream traffic after FEC of AAL 1), loopback after AAL (value 0x03, loopback of downstream traffic after any AAL). Loopback after AAL is depicted in Figure 11. Upon autonomous instantiation, the value 0x00 is used. (R, W) (mandatory) (1 byte)

PPTP Counter: This attribute represents the number of instances of PPTP managed entities associated with this instance of the ATM Interworking VCC Termination Point managed entity. If only one instance of a PPTP managed entity is associated with this instance of the ATM Interworking VCC Termination Point managed entity, this attribute is set to 0x01. If multiple instances of PPTP managed entities are associated with this instance of the ATM Interworking VCC Termination Point managed entity (i.e., in case of AAL 2 multiplexing), this attribute is set to 0xZZ, where ZZ represents the number of associated PPTP instances. (R) (optional) (1 byte)

Operational State: This attribute indicates whether or not this managed entity is capable of performing its task. The operational state reflects the perceived ability to receive or to generate a valid signal. Valid values are enabled (0x00) and disabled (0x01). (R) (optional) (1 byte)

VCNetworkCTP Connectivity Pointer: This attribute provides an instance identifier of the VC Network CTP-G that is associated with this ATM Interworking VCC Termination Point. This attribute is only valid for VC cross-connections. (R, Set-by-create) (mandatory for VC cross-connections) (2 bytes)
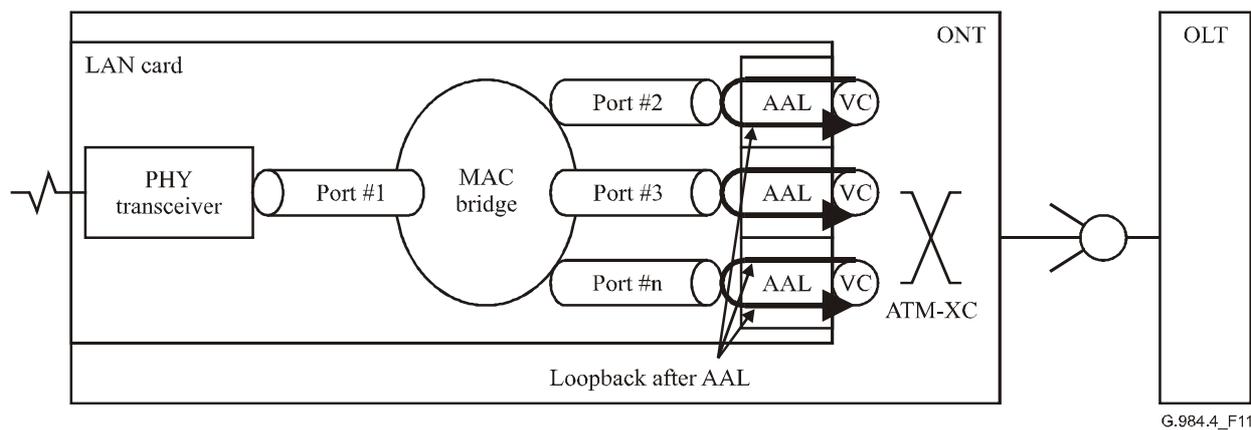
Figure 11/G.984.4 − Schematic diagram of loopback after AAL

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Set: Set one or more attributes.

Notifications

Attribute value change: This notification is used to report autonomous changes of attributes of this managed entity. The notification should identify the attribute and its new value. The list of AVCs for this managed entity is given in Table 8a.

Alarm: This notification is used to notify the management system when a failure has been detected or cleared. Both ONT and OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 8b. See also Appendix III/G.983.2.

Table 8a/G.984.4 − AVC list for ATM Interworking VCC Termination Point

Number	Attribute value change	Description
1-8	N/A	
9	OpState	Operational state of ATM Interworking VCC Termination Point
10	N/A	
11-16	Reserved	

Table 8b/G.984.4 – Alarm list for ATM Interworking VCC Termination Point

Number	Alarm	Description
0	End-to-end VC-AIS-LMIR	End-to-end VC-AIS receiving indication (optional)
1	End-to-end VC-RDI-LMIR	End-to-end VC-RDI receiving indication (optional)
2	End-to-end VC-AIS-LMIG	End-to-end VC-AIS generation indication (optional)
3	End-to-end VC-RDI-LMIG	End-to-end VC-RDI generation indication (optional)
4	Segment Loss of Continuity	Loss of continuity is detected when the ATM Interworking VCC Termination Point is a segment end point (optional)
5	End-to-End Loss of Continuity	Loss of continuity is detected at the ATM Interworking VCC Termination Point (optional)
6	CSA	Cell starvation alarm
7-223	Reserved	

9.3.3   GEM Interworking Termination Point

An instance of this managed entity represents a point in the ONT where the interworking of a service (e.g., CES, IP) or underlying physical infrastructure (e.g., nxDS0/DS1/DS3/E3/Ethernet) to GEM layer takes place. At this point, GEM packets are generated from a bit stream (e.g., nxDS0/DS1/DS3/E3/Frame Relay/Ethernet) or a bit stream is re-constructed from GEM packets.

Instances of this managed entity are created and deleted by the ONT on request of the OLT.

Establishment of a "CES interworking connection"

Since it is more complicated to introduce the "pointer list" as an attribute, the following mechanism will be used to create a CES interworking connection:

• for structured service: Create first a GEM Port Network CTP instance *and* a Logical N × 64 kbit/s Sub-port Connection Termination Point instance, and then create a GEM Interworking Termination Point; the latter would contain a reference to the GEM Port Network CTP instance, on one hand, and the Logical N × 64 kbit/s Sub-port Connection Termination Point instance on the other hand; or

• for unstructured service: Create first a GEM Port Network CTP instance, and then create a GEM Interworking Termination Point; the latter would contain a reference to the GEM Port Network CTP instance, on one hand, and to the Physical Path Termination Point CES UNI instance on the other hand.

Establishment of an "Ethernet interworking connection"

Create first a GEM Port Network CTP instance, and then create a GEM Interworking Termination Point. The latter would contain a reference to the GEM Port Network CTP instance, on one hand, and to the Physical Path Termination Point Ethernet UNI instance on the other hand.

Relationships

One instance of this managed entity exists for each occurrence of transformation of a data stream into GEM packets and vice versa. Note that the attributes "GEM Profile pointer", and "Service Profile pointer" imply relationships to these managed entities.

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

GEM Port Network CTP Connectivity Pointer: This attribute provides an instance identifier of the GEM Port Network CTP that is associated with this GEM Interworking Termination Point. (R, Set-by-create) (mandatory) (2 bytes)

Interworking Option: This attribute identifies the type of non-GEM function that is being interworked; the option can be CES (0x00) or MAC Bridge LAN (0x01). (R, Set-by-create) (mandatory) (1 byte)

Service Profile Pointer: This attribute provides the service profile type and a pointer to the instance of a service profile, such as the CES Service Profile$_{B-PON}$ (if the interworking option = 0x00) or MAC Bridge Service Profile (if the interworking option = 0x01), (R, Set-by-create) (mandatory) (2 bytes)

Interworking Termination Point Pointer: This attribute provides a pointer to the associated instance(s) of the following managed entities (depending on the service provided):

• Physical Path Termination Point Ethernet UNI.

• Physical Path Termination Point POTS UNI.

• Physical Path Termination Point CES UNI.

• Logical N × 64 kbit/s sub-port Connection Termination Point.

• Physical Path Termination Point ISDN UNI.

• Physical Path Termination Point 802.11 UNI.

(R, Set-by-create) (mandatory) (2 bytes)

PPTP Counter: This attribute represents the number of instances of PPTP managed entities associated with this instance of the GEM Interworking Termination Point managed entity. If only one instance of a PPTP managed entity is associated with this instance of the GEM Interworking Termination Point managed entity, this attribute is set to 0x01. If multiple instances of PPTP managed entities are associated with this instance of the GEM Interworking Termination Point managed entity, this attribute is set to 0xZZ, where ZZ represents the number of associated PPTP instances. (R) (optional) (1 byte)

Operational State: This attribute indicates whether or not this managed entity is capable of performing its task. The operational state reflects the perceived ability to receive or to generate a valid signal. Valid values are enabled (0x00) and disabled (0x01). (R) (optional) (1 byte)

GAL Profile Pointer: For GEM mode, this attribute provides the GAL profile type and a pointer to an instance of a GAL Profile such as GAL TDM Profile if the interworking option = 0x00 or GAL Ethernet Profile if the interworking option = 0x01. (R, Set-by-create) (mandatory) (2 bytes)

GAL Loopback Configuration: This attribute is used to set the loopback configuration when using GEM mode: No loopback (value 0x00), Loopback of downstream traffic after GAL (value 0x01). Upon autonomous instantiation, the value 0x00 is used. (R, W) (mandatory) (1 byte)

Actions

> **Create**: Create an instance of this managed entity.
>
> **Delete**: Delete an instance of this managed entity.
>
> **Get**: Get one or more attributes.
>
> **Set**: Set one or more attributes.

Notifications

> **Attribute value change**: This notification is used to report autonomous changes of attributes of this managed entity. The notification should identify the attribute and its new value. The list of AVCs for this managed entity is given in Table 9a.
>
> **Alarm**: This notification is used to notify the management system when a failure has been detected or cleared. Both ONT and OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 9b.

Table 9a/G.984.4 – AVC list for GEM Interworking Termination Point

Number	Attribute value change	Description
1-5	N/A	
6	OpState	Operational state of GEM Interworking Termination Point
7-8	N/A	
9-16	Reserved	

Table 9b/G.984.4 – Alarm list for GEM Interworking Termination Point

Number	Alarm	Description
0	GFSA	GEM frame starvation alarm
1-223	Reserved	

9.3.4 GAL TDM profile

This managed entity organizes data that describes the GTC Adaptation layer processing functions of the ONT for TDM services. ITU-T Rec. G.984.3 explains that GEM adaptation layer generates a GEM frame that accommodates TDM traffic once a frame (every 125 µs). The length of the GEM frame depends on the UNI bit rate. The clock recovery function and structured data transfer function are not necessary because the GEM is terminated in the PON section.

The receiver of GEM adaptation layer should check the loss of GEM frame once a frame (every 125 µs).

It is used with the GEM Interworking Termination Point managed entity. In an GEM environment, GAL TDM configuration parameters are associated with a GEM Interworking Termination Point managed entity through a pointer relationship. Each instance of this managed entity defines a combination of parameter values that may be associated with multiple instances of GEM Interworking Termination Point ME.

This managed entity is instantiated/deleted on request of the OLT.

One instance of this managed entity exists for each combination of GAL TDM profile parameter values used within an ONT and may be associated with zero or more instances of the GEM Interworking Termination Point managed entity.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

GEM Frame Loss Integration Period: This attribute represents the duration in milliseconds of the GEM frame loss integration period. If the GEM frame loss persists for such a period, the GEM Interworking Termination Point managed entity associated with this entity will generate a GEM frame starvation alarm. (R, Set-by-create) (mandatory) (2 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Notifications

None.

9.3.5 GAL Ethernet Profile

This managed entity organizes data that describes the GTC Adaptation layer processing functions of the ONT for Ethernet services. It is used with the GEM Interworking Termination Point managed entity.

In a GEM environment, GAL Ethernet configuration parameters are associated with a GEM Interworking Termination Point managed entity through a pointer relationship. Each instance of this managed entity defines a combination of parameter values that may be associated with multiple instances of GEM Interworking Termination Point ME.

This managed entity is instantiated/deleted on request of the OLT.

Relationships

One instance of this managed entity exists for each combination of GAL Ethernet profile parameter values used within an ONT and may be associated with zero or more instances of the GEM Interworking Termination Point managed entity.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

Maximum GEM Payload Size: This attribute represents a maximum payload size that is generated in the associated GEM Interworking Termination Point managed entity. (R, Set-by-create) (mandatory) (2 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Notifications

> None.

9.3.6   GAL TDM protocol monitoring history data

This managed entity contains the last completed 15-minute interval performance monitoring data collected as a result of performing Segmentation and Reassembly (SAR) Level and Convergence Sublayer (CS) protocol monitoring. All the attribute counters are only updated at the end of each period. Instances of this managed entity are created on request of the OLT whenever an instance of the GEM Interworking Termination Point managed entity is created that represents GAL TDM functions. Instances of this managed entity are deleted on request of the OLT.

Relationships

> One instance of this managed entity can exist for each instance of the GEM Interworking Termination Point managed entity that represents GAL TDM functions.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. The assigned number is the same as the Managed Entity id of the corresponding GEM Interworking Termination Point. (R, Set-by-create) (mandatory) (2 bytes)

> **Interval End Time**: This attribute identifies the most recently finished 15-minute interval. It is a cyclic counter (modulo 0x0100 (256)) that is incremented each time a new interval is finished and the attribute counters are updated. The value of this attribute is 0x00 during the first 15-minute interval that starts with the reception of the "synchronize time" action. The value is 0x01 during the first period after this, and so on. If this managed entity is created after the reception of the "synchronize time" action, the value of this attribute is set equal to the number of the last completed interval. The actual counters of this managed entity start counting directly. The attribute counters are updated at the end of the interval. (R) (mandatory) (1 byte)

> **Threshold Data 1/2 id**: This attribute provides a pointer to instances of the Threshold Data 1 and 2 managed entities that contain the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

> **GEM frame Loss**: This attribute represents a count of the number of lost GEM frames. This counter records the number of GEM frames detected as lost in the network prior to the destination interworking function GTC adaptation layer processing. If the actual counter saturates, it remains on its maximum value. Default value is 0x00. (R) (mandatory) (4 bytes)

> **Buffer Underflows**: This attribute represents a count of the number of times the reassembly buffer underflows. In the case of a continuous underflow caused by a loss of GEM frame flow, a single buffer underflow should be counted. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer underflow will cause this count to be incremented. If the actual counter saturates, it remains on its maximum value. Default value is 0x00. (R) (mandatory) (4 bytes)

> **Buffer Overflows**: This attribute represents a count of the number of times the reassembly buffer overflows. If the interworking function is implemented with multiple buffers, such as a cell level buffer and a bit level buffer, then either buffer overflow will cause this count to be incremented. If the actual counter saturates, it remains on its maximum value. Default value is 0x00. (R) (mandatory) (4 bytes)

Actions

> **Create**: Create an instance of this managed entity.

> **Delete**: Delete an instance of this managed entity.

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

> **Get current data**: This action returns the current value of one or more actual counters associated with performance monitoring attributes and the value of the Interval End Time attribute representing the interval in which the request is made. The values in the specific counters are reset at the end of the interval. Support of this action is optional.

> NOTE – "Get" returns the statistical data stored in the attribute values; "Get current data" returns the real-time value of the actual counters associated with those attributes.

Notifications

> **Threshold Crossing Alert**: This notification is used to notify the management system when a Threshold Crossing Alert (TCA) has been detected or cleared. The TCA change notification "on" will be sent at the crossing of the threshold by the actual counter; the TCA change notification "off" will be sent at the end of the 15-minute period since that is when the actual counters are reset to 0x00. The event list for this entity is given in Table 10.

Table 10/G.984.4 – Alarm list for GAL TDM protocol monitoring history data

Number	Event	Description	Threshold data counter # (Note)
	Threshold Crossing Alert		
0	GEM frame loss	GEM frame loss threshold crossing	1
1	Buffer Underflows	Buffer Underflows threshold crossing	2
2	Buffer Overflows	Buffer Overflows threshold crossing	3
3-13	Reserved		
NOTE – This numbering is used with the associated Threshold Data 1/2 managed entities. Threshold Data counter 1 indicates the 1st thresholded counter that is associated with Threshold Value 1 attribute of Threshold Data 1 managed entity. Threshold Data counters 1 to 7 are associated with Threshold Value 1 to 7 attributes of Threshold Data 1 managed entity and Threshold Data counter 8 to 14 are associated with Threshold Value 8 to 14 attributes of Threshold Data 2 managed entity.			

9.3.7 GAL Ethernet protocol monitoring history data

This managed entity is used to collect and report performance monitoring data associated with a GEM Interworking Termination Point managed entity for the last completed 15-minute interval when GEM layer provides Ethernet service. The instances of this managed entity are created and deleted on request of the OLT.

Relationships

> Zero or one instance of this managed entity may exist for each instance of the GEM Interworking Termination Point managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. The assigned number is the same as the Managed Entity id of the corresponding GEM Interworking TP. (R, Set-by-create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recently finished 15-minute interval. It is a cyclic counter (modulo 0x100 (256)) that is incremented each time a new interval is finished and the actual counters are updated. The value of this attribute is 0x00 during the first 15-minute interval that starts with the reception of the "synchronize time" action. The value is 0x01 during the first period after this, and so on. If this managed entity is created after the reception of the "synchronize time" action, the value of this attribute is set equal to the number of the last completed interval. The actual counters of this managed entity start counting directly. (R) (mandatory) (1 byte)

Threshold Data 1/2 id: This attribute provides a pointer to instances of the Threshold Data 1 and 2 managed entities that contain the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Discarded Frames: This attribute represents a count of the number of downstream frames that are discarded for any reason. (Erroneous FCS, too long length, buffer overflow, and so on.) The unit of this counter is GEM frame. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (4 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Set: Set one or more attributes.

Get current data: This action returns the current value of one or more actual counters associated with performance monitoring attributes and the value of the Interval End Time attribute representing the interval in which the request is made. The values in the specific counters are reset at the end of the interval. Support of this action is optional.

NOTE – "Get" returns the statistical data stored in the attribute values; "Get current data" returns the real-time value of the actual counters associated with those attributes.

Notifications

Threshold Crossing Alert: This notification is used to notify the management system when a threshold crossing alert (TCA) is detected or cleared. The TCA change notification "on" will be sent at the crossing of the threshold; the TCA change notification "off" will be sent at the end of the 15-minute period since that is when the counters are reset to 0x00. Both ONT and OLT should know the event list used by this entity, given in Table 11.

Table 11/G.984.4 – Alarm list for GAL Ethernet protocol monitoring history data

Number	Event	Description	Threshold data counter # (Note)
	Threshold Crossing Alert		
0	Discarded Frames	Exceeds threshold	1
1-13	Reserved		
NOTE – This numbering is used with the associated Threshold Data 1/2 managed entities. Threshold Data counter 1 indicates the 1st thresholded counter that is associated with Threshold Value 1 attribute of Threshold Data 1 managed entity. Threshold Data counters 1 to 7 are associated with Threshold Value 1 to 7 attributes of Threshold Data 1 managed entity and Threshold Data counter 8 to 14 are associated with Threshold Value 8 to 14 attributes of Threshold Data 2 managed entity.			

9.4   Connection Management

9.4.1   GEM Port Network CTP

This managed entity is used to represent the termination of GEM ports on an ONT.

Instances of the GEM Port Network CTP managed entity will be created on demand of the OLT as a consequence of action "create" on the GEM Port Network CTP managed entity.

Instances of the GEM Port Network CTP managed entity will be deleted on demand of the OLT as a consequence of action "delete" on the GEM Port Network CTP managed entity.

Notice that an instance of GEM Port Network CTP can be deleted only when no GEM Interworking Termination Point nor GEM Port PM History Data is associated with it. It is the responsibility of the OLT to make sure that the instance of GEM Port Network CTP meets this condition at the time when the OLT requests to delete it.

Note that this managed entity aggregates connectivity functionality from the network view and alarms from the network element view as well as artefacts from trails.

Relationships

> One or more instances of the GEM Port Network CTP managed entity exists for each instance of the PON TC Adapter-G and GEM Interworking Termination Point managed entity.

> Relationship to Priority Queue-G/Traffic Descriptor Profile Pointer: see attribute definition.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

> **PortID Value**: This attribute identifies the PortID associated with the GEM port being terminated. (R, Set-by-create) (mandatory) (2 bytes)

> **PON TC Adapter-G Pointer**: This attribute associates the GEM Port Network CTP ME with the PON TC Adapter-G ME. It points to the connected PON TC Adapter-G instance id. (R, Set-by-create) (mandatory) (2 bytes)

> **Direction**: This attribute specifies whether the GEM port is used for UNI-to-ANI (value 0x01), ANI-to-UNI (value 0x02), or bidirectional (value 0x03) connection. (R, W, Set-by-create) (mandatory) (1 byte)

> **Priority Queue Pointer for Upstream**: This attribute points to the instance of the Priority Queue-G ME used for this GEM Port Network CTP ME in the upstream direction. It is used when the **Traffic Management Option** attribute in ONT-G ME is 0x00; this pointer is null otherwise. (R, Set-by-create) (mandatory) (2 bytes)

> **Traffic Descriptor Profile Pointer**: This attribute serves as a pointer to the instance of the Traffic Descriptor Profile managed entity that contains the traffic parameters used for this GEM Port Network CTP ME. This attribute is used when the **Traffic Management Option** attribute in ONT-G ME is 0x01.

> When traffic shaping is used, it applies to the ANI side GEM Port Network CTP ME. In this case, this pointer points to a Traffic Descriptor Profile managed entity and the **Priority Queue Pointer for the upstream** attribute is null. (R, Set-by-create) (optional) (2 bytes)

> **UNI Counter**: This attribute represents the number of instances of UNI-G managed entity associated with an instance of the GEM Port Network CTP managed entity. If only one instance of a UNI-G managed entity is associated with an instance of the GEM Port Network CTP managed entity, this attribute is set to 0x01. If multiple instances of UNI-G

managed entity are associated with an instance of the GEM Port Network CTP managed entity, this attribute is set to 0xZZ, where ZZ represents the number of associated UNI-G instances. (R) (optional) (1 byte)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes of this managed entity.

Set: Set one or more attributes of this managed entity.

Notifications

Alarm: This notification is used to notify the management system when an alarm has been detected or cleared. The OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 12.

Table 12/G.984.4 – Alarm list for GEM port network CTP

Number	Alarm	Description
0-4	Reserved	
5	End-to-End Loss of Continuity	Loss of continuity can be detected when the GEM Port Network CTP supports a GEM Interworking Termination Point (optional).
6-223	Reserved	

9.4.2 GEM port protocol monitoring history data

This managed entity is used to collect and report performance monitoring data associated with a GEM Port Network CTP for the last completed 15-minute interval. The instances of this managed entity are created and deleted on request of the OLT.

Relationships

Zero or one instance of this managed entity may exist for each instance of the GEM Port Network CTP managed entity.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. The assigned number is the same as the Managed Entity id of the corresponding GEM Port Network CTP. (R, Set-by-create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recently finished 15-minute interval. It is a cyclic counter (modulo 0x100 (256)) that is incremented each time a new interval is finished and the actual counters are updated. The value of this attribute is 0x00 during the first 15-minute interval that starts with the reception of the "synchronize time" action. The value is 0x01 during the first period after this, and so on. If this managed entity is created after the reception of the "synchronize time" action, the value of this attribute is set equal to the number of the last completed interval. The actual counters of this managed entity start counting directly. (R) (mandatory) (1 byte)

Threshold Data 1/2 id: This attribute provides a pointer to instances of the Threshold Data 1 and 2 managed entities that contain the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Lost Packets: This attribute measures background packet loss. It cannot distinguish between packets lost because of header bit errors or buffer overflows. It records only loss of information. The unit of this counter is GEM frame. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (4 bytes)

Misinserted Packets: This attribute is used to measure occurrences of when a packet is misrouted to an active GEM port that is being monitored. The unit of this counter is GEM frame. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (4 bytes)

Received Packets: This attribute provides a count of all packets that are correctly received at the monitored GEM port. The unit of this counter is GEM frame. (R) (mandatory) (5 bytes)

Received Blocks: This attribute provides a count of all blocks that are correctly received at the monitored GEM port. The unit of this counter is GEM block length. (R) (mandatory) (5 bytes)

Transmitted Blocks: This attribute provides a count of all blocks that are originated at a monitored connection by the transmitting end point (i.e., backward reporting is assumed). The unit of this counter is GEM block length. (R) (mandatory) (5 bytes)

Impaired Block: This severely errored data block counter will be incremented whenever one of the following events takes place: the number of misinserted packets exceeds $M_{misinserted}$, the number of bipolar violations exceeds $M_{errored}$, or the number of lost packets exceeds M_{lost}. The values for $M_{misinserted}$, $M_{errored}$, and M_{lost} are set based on vendor-operator negotiation. (R) (mandatory) (4 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes.

Set: Set one or more attributes.

Get current data: This action returns the current value of one or more actual counters associated with performance monitoring attributes and the value of the Interval End Time attribute representing the interval in which the request is made. The values in the specific counters are reset at the end of the interval. Support of this action is optional.

NOTE – "Get" returns the statistical data stored in the attribute values; "Get current data" returns the real-time value of the actual counters associated with those attributes.

Notifications

Threshold Crossing Alert: This notification is used to notify the management system when a threshold crossing alert (TCA) is detected or cleared. The TCA change notification "on" will be sent at the crossing of the threshold; the TCA change notification "off" will be sent at the end of the 15-minute period since that is when the counters are reset to 0x00. Both ONT and OLT should know the event list used by this entity, given in Table 13.

Table 13/G.984.4 – Alarm list for GEM Port PM History Data

Number	Event	Description	Threshold data counter # (Note)
	Threshold Crossing Alert		
0	Lost packets	Exceeds threshold	1
1	Misinserted packets	Exceeds threshold	2
2	Impaired Blocks	Exceeds threshold	3
3-13	Reserved		
NOTE – This numbering is used with the associated Threshold Data 1/2 managed entities. Threshold Data counter 1 indicates the 1st thresholded counter that is associated with Threshold Value 1 attribute of Threshold Data 1 managed entity. Threshold Data counters 1 to 7 are associated with Threshold Value 1 to 7 attributes of Threshold Data 1 managed entity and Threshold Data counter 8 to 14 are associated with Threshold Value 8 to 14 attributes of Threshold Data 2 managed entity.			

9.4.3   VP Network CTP-G

This managed entity is used to represent the termination of VP links on an ONT. As the G-PON ONT has multiple T-CONTs in an ANI, ANI Pointer attribute in VP Network CTP$_{B-PON}$ is not sufficient to indicate which T-CONT includes the termination point. Therefore, a new ME is defined.

An instance of the ATM VP Cross-Connection (i.e., VP MUX in ONT) managed entity may be used to relate two instances of the VP Network CTP-G managed entity for point-to-point cross-connection.

Instances of the VP Network CTP-G managed entity will be created on demand of the OLT:

•   as a consequence of action "create" on the VP Network CTP-G managed entity; or

•   as a consequence of action "create complete connection" on the ATM VP Cross-Connection managed entity.

Instances of the VP Network CTP-G managed entity will be deleted on demand of the OLT:

•   as a consequence of action "delete" on the VP Network CTP-G managed entity; or

•   as a consequence of action "delete complete connection" on the ATM VP Cross-Connection managed entity.

Notice that an instance of VP Network CTP-G managed entity can be deleted only when no ATM VP Cross-Connection or ATM Interworking VCC Termination Point is associated with it. It is the responsibility of the OLT to make sure that the instance of VP Network CTP-G meets this condition at the time when the OLT requests to delete it.

Note that this managed entity aggregates connectivity functionality from the network view and alarms from the network element view as well as artefacts from trails.

Relationships

Zero or more instances of the VP Network CTP-G managed entity exist for each instance of the TC Adapter$_{B-PON}$, PON TC Adapter-G or ATM Interworking VCC Termination Point managed entity.

Relationship to Priority Queue-G/Traffic Descriptor Profile Pointer: see attribute definition.

Relationship to UPC Disagreement Monitoring History Data$_{B-PON}$: one or zero implied in the managed entity id of UPC Disagreement Monitoring History Data$_{B-PON}$.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

VPI Value: This attribute identifies the VPI value associated with the VP link being terminated. (R, Set-by-create) (mandatory) (2 bytes)

UNI/PON TC Adapter-G Pointer: This attribute associates the VP Network CTP-G with the PON TC Adapter-G (ANI side) or UNI-G/UNI$_{B-PON}$ (UNI side). It points to the connected PON TC Adapter-G instance id or UNI-G/UNI$_{B-PON}$ instance id.

NOTE – For the case using the multiplexing function of AAL2 (i.e., multiple instances of UNI are associated with a VP Network CTP-G instance), this attribute is assigned a special value:

– 	0x00XX will be used for pseudo slotIDs;

– 	0xXX00 will be used for pseudo portIDs.

Therefore, 0x0000 will be used only for integrated interfaces (integrated type of ONT) that support multiple AAL2 functions. (R, Set-by-create) (mandatory) (2 bytes)

Direction: This attribute specifies whether the VP link is used for UNI-to-ANI (value 0x01), ANI-to-UNI (value 0x02), or bidirectional (value 0x03) connection. (R, W, Set-by-create) (mandatory) (1 byte)

Priority Queue Pointer for Downstream: This attribute points to the instance of the Priority Queue-G ME used for this VP Network CTP-G ME in the downstream direction. Note that the value of this pointer is null when the VP Network CTP-G ME is at the ANI side. (R, Set-by-create) (mandatory) (2 bytes)

Priority Queue Pointer for Upstream: This attribute points to the instance of the Priority Queue-G ME used for this VP Network CTP-G ME in the upstream direction. It is used when the UNI/PON TC Adapter-G pointer attribute indicates a PON TC Adapter-G instance id and the **Traffic Management Option** attribute in ONT-G ME is 0x00; this pointer is null otherwise. (R, Set-by-create) (mandatory) (2 bytes)

Traffic Descriptor Profile Pointer: This attribute serves as a pointer to the instance of the Traffic Descriptor Profile managed entity that contains the traffic parameters used for this VP Network CTP-G ME. This attribute is used when the **Traffic Management Option** attribute in ONT-G ME is 0x01.

When traffic shaping is used, it applies to the ANI side VP Network CTP-G ME. In this case, this pointer points to a Traffic Descriptor Profile managed entity and the **Priority Queue Pointer for upstream** attribute is null. (R, Set-by-create) (optional) (2 bytes)

See also Appendix IV/G.983.2.

UNI Counter: This attribute represents the number of instances of UNI-G managed entity associated with an instance of the VP Network CTP-G managed entity. If only one instance of a UNI-G managed entity is associated with an instance of the VP Network CTP-G managed entity, this attribute is set to 0x01. If multiple instances of UNI-G managed entity are associated with an instance of the VP Network CTP-G managed entity (i.e., in case of AAL2 multiplexing), this attribute is set to 0xZZ, where ZZ represents the number of associated UNI-G instances. (R) (optional) (1 byte)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes of this managed entity.

Set: Set one or more attributes of this managed entity.

Notifications

Alarm: This notification is used to notify the management system for the ATM Layer Management Indication (LMI) when an alarm has been detected or cleared. The OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 14.

Table 14/G.984.4 – Alarm list for VP Network CTP-G

Number	Alarm	Description
0	VP-AIS-LMIR	VP-AIS receiving indication (optional)
1	VP-RDI-LMIR	VP-RDI receiving indication (optional)
2	VP-AIS-LMIG	VP-AIS generation indication (optional)
3	VP-RDI-LMIG	VP-RDI generation indication (optional)
4	Segment Loss of Continuity	Loss of continuity is detected when the VP Network CTP-G is a segment end point (optional)
5	End-to-End Loss of Continuity	Loss of continuity can be detected when the VP Network CTP-G supports an ATM Interworking VCC Termination Point (optional).
6-223	Reserved	

9.4.4 VC Network CTP-G

This managed entity is used to represent the termination of VC links on an ONT. As the G-PON ONT has multiple T-CONTs in an ANI, ANI Pointer attribute in VC Network CTP_{B-PON} is not sufficient to indicate which T-CONT includes the termination point. Therefore, a new ME is defined.

An instance of the ATM VC Cross-Connection (i.e., VC MUX in ONT) managed entity may be used to relate two instances of the VC Network CTP-G managed entity for point-to-point cross-connection.

Instances of the VC Network CTP-G managed entity will be created on demand of the OLT:

• as a consequence of action "create" on the VC Network CTP-G managed entity; or

• as a consequence of action "create complete connection" on the ATM VC Cross-Connection managed entity.

Instances of the VC Network CTP-G managed entity will be deleted on demand of the OLT:

• as a consequence of action "delete" on the VC Network CTP-G managed entity; or

• as a consequence of action "delete complete connection" on the ATM VC Cross-Connection managed entity.

Notice that an instance of VC Network CTP-G managed entity can be deleted only when no ATM VC Cross-Connection or ATM Interworking VCC Termination Point is associated with it. It is the responsibility of the OLT to make sure that the instance of VC Network CTP-G meets this condition at the time when the OLT requests to delete it.

Note that this managed entity aggregates connectivity functionality from the network view and alarms from the network element view as well as artefacts from trails.

Relationships

> Zero or more instances of the VC Network CTP-G managed entity exist for each instance of the TC Adapter$_{B-PON}$, PON TC Adapter-G or ATM Interworking VCC Termination Point managed entity.

> Relationship to Priority Queue-G/Traffic Descriptor Profile Pointer: see attribute definition.

> Relationship to UPC Disagreement Monitoring History Data$_{B-PON}$: one or zero implied in the managed entity id of UPC Disagreement Monitoring History Data$_{B-PON}$.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)

> **VPI Value**: This attribute identifies the VPI value associated with the VC link being terminated. (R, Set-by-create) (mandatory) (2 bytes)

> **VCI Value**: This attribute identifies the VCI value associated with the VC link being terminated. (R, Set-by-create) (mandatory) (2 bytes)

> **UNI/PON TC Adapter-G Pointer**: This attribute associates the VC Network CTP-G with the PON TC Adapter-G (ANI side) or UNI-G/UNI$_{B-PON}$ (UNI side). It points to the connected PON TC Adapter-G instance id or UNI-G/UNI$_{B-PON}$ instance id.

> NOTE – For the case using the multiplexing function of AAL2 (i.e., multiple instances of UNI are associated with a VC Network CTP-G instance), this attribute is assigned a special value:

> – 0x00XX will be used for pseudo slotIDs;

> – 0xXX00 will be used for pseudo portIDs.

> Therefore, 0x0000 will be used only for integrated interfaces (integrated type of ONT) that support multiple AAL2 functions. (R, Set-by-create) (mandatory) (2 bytes)

> **Direction**: This attribute specifies whether the VC link is used for UNI-to-ANI (value 0x01), ANI-to-UNI (value 0x02), or bidirectional (value 0x03) connection. (R, W, Set-by-create) (mandatory) (1 byte)

> **Priority Queue Pointer for Downstream**: This attribute points to the instance of the Priority Queue-G ME used for this VC Network CTP-G ME in the downstream direction. Note that the value of this pointer is null when the VC Network CTP-G ME is at the ANI side. (R, Set-by-create) (mandatory) (2 bytes)

> **Priority Queue Pointer for Upstream**: This attribute points to the instance of the Priority Queue-G ME used for this VC Network CTP-G ME in the upstream direction. It is used when the UNI/PON TC Adapter-G pointer attribute indicates a PON TC Adapter-G instance id and the **Traffic Management Option** attribute in ONT-G ME is 0x00; this pointer is null otherwise. (R, Set-by-create) (mandatory) (2 bytes)

> **Traffic Descriptor Profile Pointer**: This attribute serves as a pointer to the instance of the Traffic Descriptor Profile managed entity that contains the traffic parameters used for this VC Network CTP-G ME. This attribute is used when the **Traffic Management Option** attribute in ONT-G ME is 0x01.

> When traffic shaping is used, it applies to the ANI side VC Network CTP-G ME. In this case, this pointer points to a Traffic Descriptor Profile managed entity and the **Priority Queue Pointer for upstream** attribute is null. (R, Set-by-create) (optional) (2 bytes)

See also Appendix IV/G.983.2.

UNI Counter: This attribute represents the number of instances of UNI-G managed entity associated with an instance of the VC Network CTP-G managed entity. If only one instance of a UNI-G managed entity is associated with an instance of the VC Network CTP-G managed entity, this attribute is set to 0x01. If multiple instances of UNI-G managed entity are associated with an instance of the VC Network CTP-G managed entity (i.e., in case of AAL2 multiplexing), this attribute is set to 0xZZ, where ZZ represents the number of associated UNI-G instances. (R) (optional) (1 byte)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Get: Get one or more attributes of this managed entity.

Set: Set one or more attributes of this managed entity.

Notifications

Alarm: This notification is used to notify the management system for the ATM Layer Management Indication (LMI) when an alarm has been detected or cleared. The OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 15.

Table 15/G.984.4 – Alarm list for VC Network CTP-G

Number	Alarm	Description
0	VC-AIS-LMIR	VC-AIS receiving indication (optional)
1	VC-RDI-LMIR	VC-RDI receiving indication (optional)
2	VC-AIS-LMIG	VC-AIS generation indication (optional)
3	VC-RDI-LMIG	VC-RDI generation indication (optional)
4	Segment Loss of Continuity	Loss of continuity is detected when the VC Network CTP-G is a segment end point (optional)
5	End-to-End Loss of Continuity	Loss of continuity can be detected when the VC Network CTP-G supports an ATM Interworking VCC Termination Point (optional).
6-223	Reserved	

9.5 Traffic management

9.5.1 Priority Queue-G

This managed entity specifies the priority queue in the ONT that is used for the VP Network CTP-G or GEM Port Network CTP.

If *N* priority queues reside in the ONT, the Subscriber Line Card, ONT core or PON IF Line Card, *N* instances of Priority Queue-G management entity will be automatically created by the ONT following the creation of the Subscriber Line Card or T-CONT ME. In ANI side, the Priority Queue-G ME is related to T-CONT ME. After instances of T-CONT ME are created, instances of Priority Queue-G ME should be created autonomously.

Note that the OLT will find all the queues by reading the Priority Queue-G managed entity instances. If the OLT tries to retrieve a non-existing priority queue, this will be indicated in the response from the ONT to the OLT.

See also Appendix IV/G.983.2.

Upstream priority queues can be added to the ONT. Moreover, priority queues can exist in the ONT core and subscriber line cards as well as PON IF Line Cards.

In order to configure the optional Traffic Scheduler, the Weight attribute is included.

Several attributes are included that support back pressure operation. Back pressure is defined as a mechanism for backward flow control. The back pressure signal is sent backward and causes the customer terminal to temporarily suspend sending data.

Relationships

> One or more instances of this managed entity are contained in the ONT-G managed entity to model the upstream priority queues if the Traffic Management Option attribute in ONT-G ME is 0x00. One or more instances of this managed entity are associated with the Subscriber Line Card managed entity as downstream priority queues. For the ONT that has one or more fixed user interfaces, one or more instances are contained in the ONT-G managed entity for the downstream priority queues.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. The most significant bit represents the direction (0b1: Upstream, 0b0: Downstream). The 15 least significant bits represent a queue id. The queue id is numbered in ascending order by the ONT itself. The range of the downstream queue id is 0x0000 to 0x7FFF and the range of upstream queue id is 0x8000 to 0xFFFF in an ONT. (R) (mandatory) (2 bytes)

> **Queue Configuration Option**: This attribute identifies the buffer-partitioning policy. The value of 0x01 means that all the queues share one buffer size of Maximum Queue Size and the value 0x00 means that each queue uses its individual buffer size of Maximum Queue Size. (R) (mandatory) (1 byte)

> **Maximum Queue Size**: This attribute specifies the maximum size of the queue. Units are cells for ATM mode and "GEM block lengths" for GEM mode. (R) (mandatory) (2 bytes)

> **Allocated Queue Size**: This attribute identifies the allocated size of this queue. Units are cells for ATM mode and "GEM block lengths" for GEM mode. (R, W) (mandatory) (2 bytes)

> **Discard-cell/block-counter Reset Interval**: This attribute represents the interval in milliseconds at which the counter resets itself. (R, W) (optional) (2 bytes)

> **Threshold Value for Discarded Cells or Blocks due to Buffer Overflow**: The threshold for the number of cells or GEM block lengths discarded on this queue due to buffer overflow. (R, W) (optional) (2 bytes)

> **Related Port**: This attribute represents the slot, port/T-CONT and priority information that is associated with the instance of Priority Queue-G ME. This attribute consists of four bytes. The first byte represents the slot id where the traffic that is stored in the queue is outgoing. The second byte represents the ME id of T-CONT ME (in the case of upstream) or port id (in the case of downstream) where the traffic that is stored in the queue is outgoing. The last two bytes represent the priority of this queue. The range of the priority is 0x0000 to 0x0FFF. The value 0x0000 indicates the highest priority and the value 0x0FFF indicates the lowest priority. (R) (mandatory) (4 bytes)

Traffic Scheduler-G Pointer: This attribute represents the Traffic Scheduler-G ME instance that is directly associated with this priority queue. Upon autonomous instantiation, this attribute is null (0x0000). This pointer is used when this priority queue is connected with a Traffic Scheduler. Default value is 0x0000. (R, W) (mandatory) (2 bytes)

Weight: This attribute represents weight for WRR. This weight is used by the Traffic Scheduler or T-CONT (whose Policy is WRR) indicated by the Traffic Scheduler-G pointer attribute or Related Port attribute. Upon autonomous instantiation, this attribute consists of the value 0x01. (R, W) (mandatory) (1 byte)

Back Pressure Operation: This attribute is used to activate (enable: value 0x00) or deactivate (disable: value 0x01) the functions of Back Pressure operation. Default value is 0x00. (R, W) (mandatory) (2 bytes)

Back Pressure Time: This attribute indicates the time duration in which the customer terminal temporarily suspends sending data. This attribute presents the duration in microseconds. This attribute can be used as a pause time for Ethernet UNI. Values: 0x00000000 to 0xFFFFFFFF. Upon autonomous instantiation, the value 0x00000000 is used. (R, W) (mandatory) (4 bytes)

Back Pressure Occur Queue Threshold: This attribute identifies the threshold size of this queue to start sending Back Pressure signal. (R, W) (mandatory) (2 bytes)

Back Pressure Clear Queue Threshold: This attribute identifies the threshold size of this queue to stop sending Back Pressure signal. (R, W) (mandatory) (2 bytes)

Actions

Get: Get one or more attributes.

Set: Set one or more attributes.

Notifications

Threshold Crossing Alert: This notification is used to notify the management system when a threshold crossing alert (TCA) has been detected or cleared. Both ONT and OLT should know the event coding used by this entity. The event list for this entity is given in Table 16.

Table 16/G.984.4 – Alarm list for Priority Queue-G

Number	Alarm	Description
	Threshold Crossing Alert	
0	Cell/block loss	Exceeds threshold
1-223	Reserved	

9.5.2   Traffic Scheduler-G

This managed entity is modified slightly from that given in 7.3.2/G.983.7.

An instance of this managed entity represents a logical object of some Traffic Scheduler to control upstream ATM cells or GEM packets. A Traffic Scheduler can accommodate ATM cells or GEM packets after priority queue or other Traffic Scheduler and transfer ATM cells or GEM packets toward the next Traffic Scheduler or T-CONT.

The Traffic Scheduler-G ME is related to T-CONT ME. It has a T-CONT Pointer attribute. After instances of T-CONT ME are created, instances of Traffic Scheduler-G ME should be created autonomously.

Relationships

> Zero or more instances of this managed entity are contained in an instance of the ONT-G managed entity.

Attributes

> **Managed Entity id**: This attribute provides a unique number for each instance of this managed entity. This 2-byte number is associated with the physical capability that realizes the Traffic Scheduler. The first byte is the slot id of the PON IF card with which this Traffic Scheduler is associated. For integrated PON IF interfaces, this byte can be associated with "pseudo" slot id 0x80 (128). If the ONT has Traffic Schedulers that are not associated with the PON IF card at the creation of this instance, the first byte of this Traffic Scheduler is 0xFF. The second byte is the Traffic Scheduler id that is numbered by the ONT itself. The Traffic Scheduler id is numbered in ascending order with the range of 0x00 to 0xFF. (R) (mandatory) (2 bytes)

> **T-CONT Pointer**: This attribute represents the T-CONT ME instance that is directly associated with this Traffic Scheduler. This pointer is used when this Traffic Scheduler is connected to the T-CONT directly, it is null (0x0000) otherwise. (R) (mandatory) (2 bytes)

> **Traffic Scheduler Pointer**: This attribute represents the Traffic Scheduler-G ME instance that serves this Traffic Scheduler. Upon autonomous instantiation this attribute is null (0x0000). This pointer is used when this Traffic Scheduler is connected to another Traffic Scheduler, it is null otherwise. The default value is 0x0000. (R) (mandatory) (2 bytes)

> **Policy**: This attribute represents scheduling policy. Valid values include but are not limited to "Null" (value 0x00), "HOL" (value 0x01) or "WRR" (value 0x02). Upon autonomous instantiation, this attribute consists of the value 0x00. (R) (mandatory) (1 byte)

> **Priority/Weight**: This attribute represents priority for HOL scheduling or the weight for WRR scheduling. This value is used by the T-CONT or Traffic Scheduler indicated by the T-CONT Pointer attribute or Traffic Scheduler Pointer attribute. If the indicated pointer has Policy = HOL, then this value is interpreted as a priority (0x00 indicates the highest priority, and 0xFF (255) the lowest). If the indicated pointer has Policy = WRR, then this value is interpreted as a weight. Upon autonomous instantiation, this attribute consists of the value 0x00. (R, W) (mandatory) (1 byte)

Actions

> **Get**: Get one or more attributes.

> **Set**: Set one or more attributes.

Notifications

> None.

9.5.3 GEM traffic descriptors

Traffic descriptor in OMCI represents the upstream GEM frame behaviour. In order to accommodate TDM traffic and Ethernet frame traffic, the following traffic descriptors are introduced to OMCI.

9.5.3.1 GEM TDM traffic descriptor

For Further Study.

9.5.3.2 GEM Ethernet frame traffic descriptor

For further study.

10 ONT Management and Control Channel (OMCC)

An ATM or GEM connection shall be provisioned for the OMCC. ITU-T Rec. G.984.3 specifies a PLOAM message that activates either a VPI/VCI pair (ATM mode) or a PortID (GEM mode) between the OLT and ONT processors. The VPI/VCI or PortID value for the management channel of each ONT is programmed by the OLT using this message. A grant flow must be allocated by the MAC layer of the OLT for upstream OMCC traffic of each ONT.

The following performance requirements related to the OMCC are considered with input from operators:

a) The cells carrying ONT management messages should be sent with cell loss priority CLP = 0 (for ATM connection).

b) The upstream traffic on each OMCC should not exceed x bandwidth, where x is based on the operator's requirement.

c) An upstream OMCC cell or packet should always be put in the high priority queue or be modelled with the CBR service category; the constraints on the downstream OMCC cells or packets are out of the scope of this Recommendation as this is completely under control of the OLT.

d) Message Response Time: The system should support response times that do not exceed 1 s for the high priority protocol handling messages and 3 s for the low priority protocol handling messages.

11 ONT management and control protocol

11.1 ONT management and control protocol cell/packet format

11.1.1 Introduction

In ATM mode, each ONT Management and Control Protocol packet is encapsulated directly in a single 53-byte ATM cell. The cell format is shown in Figure 12. The following clauses discuss the details.

ATM header (5 bytes)	Transaction correlation identifier (2 bytes)	Message type (1 byte)	Device identifier (1 byte)	Message identifier (4 bytes)	Message contents (32 bytes)	OMCI trailer (8 bytes)

Figure 12/G.984.4 – ONT management and control protocol cell format

In GEM mode, each ONT Management and Control Protocol packet is encapsulated directly in a GEM packet. The packet format is shown in Figure 13. For simplicity, the packet contents are equivalent to those used in ATM mode, and only the header is changed. The OMCI trailer is retained and used for its CRC. The following clauses discuss the details.

GEM header (5 bytes)	Transaction correlation identifier (2 bytes)	Message type (1 byte)	Device identifier (1 byte)	Message identifier (4 bytes)	Message contents (32 bytes)	OMCI trailer (8 bytes)

Figure 13/G.984.4 – ONT management and control protocol packet format

11.1.2 ATM header or GEM header

The header contains the VPI/VCI value (ATM mode) or the PortID (GEM mode) of the OMCC for the addressed ONT (see clause 10).

11.1.3 Transaction correlation identifier

The Transaction Correlation Identifier is used to associate a request message with its response message. For request messages, the OLT selects any transaction identifier. A response message carries the transaction identifier of the message to which it is responding. The transaction identifier of event messages is 0x0000.

As explained in 9.2/G.983.2, the most significant bit of the Transaction Correlation Identifier is used to indicate the priority of the message. The following coding will be used: 0 = low priority, 1 = high priority. The OLT decides whether a command should be executed with low or high priority.

The mechanism that the OLT uses to assign the rest of the bits of the Transaction Correlation Identifier in an acknowledged command is not standardized and is left to the implementers.

However, since the Transaction Correlation Identifier is used to match a command from the OLT to the ONT with a response from the ONT to the OLT, some care is required in the choice of the Transaction Correlation Identifier. The OLT must assign the Transaction Correlation Identifier in such a way that, whenever it sends a command with a Transaction Correlation Identifier that has been used before in another command to the same ONT, it is guaranteed with sufficiently high probability that no response for the first command will be received.

11.1.4 Message Type

The Message Type field is subdivided into four parts. These are given in Figure 14.

8	7	6	5				1
DB	AR	AK	MT				
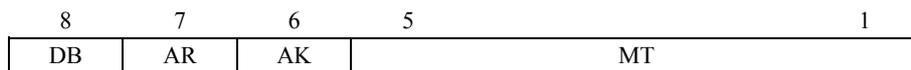
Figure 14/G.984.4 – Message type field subdivision

The most significant bit, bit 8, is reserved for the destination bit (DB). In the OMCI this bit is always 0.

Bit 7, Acknowledge Request (AR), is used to indicate whether or not the message requires an acknowledgement. If an acknowledgement is expected, this bit is set to "1". If no acknowledgement is expected, the coding of this bit is "0". Note that "acknowledge" means a response to an action request, not an acknowledgement at the link layer.

Bit 6, Acknowledgement (AK), is used to indicate whether or not this message is an acknowledgement to an action request. If a message is an acknowledgement, this bit is set to "1". If the message is not a response, this bit is set to "0".

Bit 5 to bit 1, Message Type (MT), are used to indicate the message type. Codes 0 to 3 and 29 to 31 are reserved for future use. Codes 4 to 28 are used by this specification. Table 17 lists the message types that are defined.

Table 17/G.984.4 – OMCI message types

MT	Type	Purpose	AK	Inc MIB data sync.
4	Create	Create a managed entity instance with its attributes	yes	yes
5	Create complete connection	Create an instance of ATM VP/VC Cross-Connection ME and two associated instances of VP Network CTP-G or VC Network CTP-G ME.	yes	yes
6	Delete	Delete a managed entity instance	yes	yes
7	Delete complete connection	Delete an instance of ATM VP/VC Cross-Connection ME and two associated instances of VP Network CTP-G or VC Network CTP-G ME	yes	yes
8	Set	Set one or more attributes of a managed entity	yes	yes
9	Get	Get one or more attributes of a managed entity	yes	no
10	Get complete connection	Get all attributes of an instance of ATM VP/VC Cross-Connection ME and the attributes of the associated instances of VP Network CTP-G or VC Network CTP-G	yes	no
11	Get all alarms	Latch the alarm statuses of all managed entities and reset the alarm message counter	yes	no
12	Get all alarms next	Get the active alarm status of the next managed entity	yes	no
13	MIB upload	Latch the MIB	yes	no
14	MIB upload next	Get latched attributes of a managed entity instance	yes	no
15	MIB reset	Clear the MIB and re-initialize it to its default and reset the MIB data sync counter to 0	yes	no
16	Alarm	Notification of an alarm	no	no
17	Attribute value change	Notification of an autonomous attribute value change	no	no
18	Test	Request a test on a specific managed entity	yes	no
19	Start software download	Start a software download action	yes	yes
20	Download section	Download a section of a software image	yes/no	no
21	End software download	End of a software download action	yes	yes
22	Activate software	Activate the downloaded software image	yes	yes
23	Commit software	Commit the downloaded software image	yes	yes
24	Synchronize Time	Synchronize the time between OLT and ONT	yes	no
25	Reboot	Reboot ONT, Subscriber Line Card or PON IF Line Card	yes	no
26	Get next	Get the latched attribute values of the managed entity within the current snapshot	yes	no
27	Test result	Notification of test result that is initiated by "Test"	no	no
28	Get current data	Get current counter value associated with one or more attributes of a managed entity	yes	no
NOTE – The "Download section" action is only acknowledged for the last section within a window. See Appendix I.2.15/G.983.2.				

11.1.5 Device identifier

For systems based on ITU-T Rec. G.984.3, this field is defined as 0x0A.

11.1.6 Message identifier

The message identifier consists of four bytes. The first, most significant, 2 bytes of the message identifier field are used to indicate which managed entity is the target of the action specified in the message type. The maximum number of possible managed entities is thus 65535. The least significant two bytes of this message identifier field are used to identify the managed entity instance. The number of bytes for each managed entity instance is defined in clause 9. The summation of the number of bytes in message identifier field and the number of bytes available in the message contents field shall be 36 bytes because the ONT management and control protocol cell format is 53 bytes long.

Table 18 gives the managed entities and their class values in the OMCI. Depending on the managed entity, there will be only one (e.g., ONT-G) or several (e.g., VP Network CTP-G) instances.

Table 18/G.984.4 – Managed entity identifiers

Managed entity class value	Managed entity
1	-------------------------(intentionally left blank)
2	ONT Data
3	PON IF Line Cardholder
4	-------------------------(intentionally left blank)
5	Subscriber Line Cardholder
6	Subscriber Line Card
7	Software Image
8	UNI$_{B-PON}$
9	TC Adapter$_{B-PON}$
10	Physical Path Termination Point ATM UNI
11	Physical Path Termination Point Ethernet UNI
12	Physical Path Termination Point CES UNI
13	Logical N $\times$ 64 kbit/s Sub-port Connection Termination Point
14	-------------------------(intentionally left blank)
15	AAL1 Profile$_{B-PON}$
16	AAL5 Profile$_{B-PON}$
17	AAL1 Protocol Monitoring History Data$_{B-PON}$
18	AAL5 Protocol Monitoring History Data$_{B-PON}$
19	AAL2 Profile
20	-------------------------(intentionally left blank)
21	CES Service Profile $_{B-PON}$
22	(Reserved)
23	CES Physical Interface Monitoring History Data
24	Ethernet Performance Monitoring History Data
25	-------------------------(intentionally left blank)

Table 18/G.984.4 – Managed entity identifiers

Managed entity class value	Managed entity
26	ATM VP Cross-Connection
27	-------------------------(intentionally left blank)
28	DBR/CBR Traffic Descriptor
29	UBR Traffic Descriptor
30	SBR1/VBR1 Traffic Descriptor
31	SBR2/VBR2 Traffic Descriptor
32	SBR3/VBR3 Traffic Descriptor
33	ABR Traffic Descriptor
34	GFR Traffic Descriptor
35	ABT/DT/IT Traffic Descriptor
36	UPC Disagreement Monitoring History Data$_{\text{B-PON}}$
37	-------------------------(intentionally left blank)
38	-------------------------(intentionally left blank)
39	-------------------------(intentionally left blank)
40	PON Physical Path Termination Point
41	TC Adapter Protocol Monitoring History Data
42	-------------------------(intentionally left blank)
43	Operator Specific
44	Vendor Specific
45	MAC Bridge Service Profile
46	MAC Bridge Configuration Data
47	MAC Bridge Port Configuration Data
48	MAC Bridge Port Designation Data
49	MAC Bridge Port Filter Table Data
50	MAC Bridge Port Bridge Table Data
51	MAC Bridge PM History Data
52	MAC Bridge Port PM History Data
53	Physical Path Termination Point POTS UNI
54	Voice CTP
55	Voice PM History Data
56	AAL2 PVC Profile$_{\text{B-PON}}$
57	AAL2 CPS Protocol Monitoring History Data$_{\text{B-PON}}$
58	Voice Service Profile AAL
59	LES Service Profile
60	AAL2 SSCS Parameter Profile1
61	AAL2 SSCS Parameter Profile2
62	VP PM History Data

Table 18/G.984.4 – Managed entity identifiers

Managed entity class value	Managed entity
63	-------------------------(intentionally left blank)
64	-------------------------(intentionally left blank)
65	UBR+ Traffic Descriptor
66	AAL2 SSCS Protocol Monitoring History Data$_{B-PON}$
67	IP Port Configuration Data
68	IP Router Service Profile
69	IP Router Configuration Data
70	IP Router PM History Data 1
71	IP Router PM History Data 2
72	ICMP PM History Data1
73	ICMP PM History Data 2
74	IP Route Table
75	IP Static Routes
76	ARP Service Profile
77	ARP Configuration Data
78	VLAN Tagging Operation Configuration Data
79	MAC Bridge Port Filter Pre-assign Table
80	Physical Path Termination Point ISDN UNI
81	(Reserved)
82	Physical Path Termination Point Video UNI
83	Physical Path Termination Point LCT UNI
84	VLAN Tagging Filter Data
85	-------------------------(intentionally left blank)
86	ATM VC Cross-Connection
87	-------------------------(intentionally left blank)
88	VC PM History Data
89	Ethernet Performance Monitoring History Data 2
90	Physical Path Termination Point Video ANI
91	Physical Path Termination Point 802.11 UNI
92	802.11 Station Management data 1
93	802.11 Station Management data 2
94	802.11 General Purpose Object
95	802.11 MAC&PHY Operation and Antenna Data
96	802.11 Counters
97	802.11 PHY FHSS DSSS IR Tables
98	Physical Path Termination Point ADSL UNI Part 1

Table 18/G.984.4 – Managed entity identifiers

Managed entity class value	Managed entity
99	Physical Path Termination Point ADSL UNI Part 2
100	ADSL Line Inventory and Status Data Part 1
101	ADSL Line Inventory and Status Data Part 2
102	ADSL Channel Downstream Status Data
103	ADSL Channel Upstream Status Data
104	ADSL Line Configuration Profile Part 1
105	ADSL Line Configuration Profile Part 2
106	ADSL Line Configuration Profile Part 3
107	ADSL Channel Configuration Profile
108	ADSL Subcarrier Mask Downstream Profile
109	ADSL Subcarrier Mask Upstream Profile
110	ADSL Downstream PSD Mask Profile
111	ADSL Downstream RFI Bands Profile
112	ADSL ATU-C Performance Monitoring History Data
113	ADSL ATU-R Performance Monitoring History Data
114	ADSL ATU-C Channel Performance Monitoring History Data
115	ADSL ATU-R Channel Performance Monitoring History Data
116	TC Adaptor Performance Monitoring History Data ADSL
117	Physical Path Termination Point VDSL UNI
118	VDSL VTU-O Physical Data
119	VDSL VTU-R Physical Data
120	VDSL Channel Data
121	VDSL Line Configuration Profile
122	VDSL Channel Configuration Profile
123	VDSL Band Plan Configuration Profile
124	VDSL VTU-O Physical Interface Monitoring History Data
125	VDSL VTU-R Physical Interface Monitoring History Data
126	VDSL VTU-O Channel Performance Monitoring History Data
127	VDSL VTU-R Channel Performance Monitoring History Data
128..255	Reserved for future B-PON managed entities
256	ONT-G
257	ONT2-G
258	ONU-G
259	ONU2-G
260	PON IF Line Card-G
261	PON TC Adapter-G
262	T-CONT

Table 18/G.984.4 – Managed entity identifiers

Managed entity class value	Managed entity
263	ANI-G
264	UNI-G
265	ATM Interworking VCC Termination Point
266	GEM Interworking Termination Point
267	GEM Port Protocol Monitoring History Data
268	GEM Port Network CTP
269	VP Network CTP-G
270	VC Network CTP-G
271	GAL TDM Profile
272	GAL Ethernet Profile
273	Threshold Data1
274	Threshold Data2
275	GAL TDM Protocol Monitoring History Data
276	GAL Ethernet Protocol Monitoring History Data
277	Priority Queue-G
278	Traffic Scheduler-G
279	Protection Data
280..65535	Reserved

11.1.7 Message contents

The layout of the message contents field is message specific. The detailed layout of all messages is given in Appendix II.

11.1.8 OMCI trailer

AAL5 trailer is reused in this field. The eight bytes of this field are used as follows:

a)   The first two bytes are set to 0x0000 at the transmitter and ignored at the receiver. (They correspond to CPCS-UU and CPI.)

b)   The length of the CPCS-SDU field is set to 0x0028.

c)   The 32-bit CRC is as specified in ITU-T Rec. I.363.5.

11.2   Message flow control and error recovery

See 9.2/G.983.2.

11.3   OMCI handling within the ONT

11.3.1   Prioritized protocol entities

This clause specifies the behaviour of the ONT more precisely than in the preceding clause with respect to the prioritized request mechanism of the OMCC.

Conceptually, the way the ONT handles the OMCC requests can be illustrated by referring to the dual priority level implementation example shown in Figure 15.

When the ONT receives an ATM cell or GEM packet via the VCC or GEM port associated with the management channel, it shall calculate the CRC and compare it with the value found in the OMCI trailer. If the values do not match, the ONT shall discard the message. It is recommended that this event be logged by the ONT and possibly communicated to the OLT by some out-of-band mechanism but, as far as the protocol is concerned, the message is discarded silently.

Messages with a correct CRC are then placed into either of two distinct incoming FIFO-based message queues, according to the priority level (i.e., high or low) of the associated command. Note that the priority level of a given command is encoded using the most significant bit of the transaction correlation Identifier field. If the associated incoming message queue is already full, the ONT must simply discard the message. It is recommended that this event be logged by the ONT and possibly communicated to the OLT by some out-of-band mechanism but, as far as the protocol is concerned, the message is discarded silently.

There are two distinct incoming command processing protocol entities (one associated with each priority level) that are used to service messages sequentially from an independently associated incoming FIFO queue. Each of these protocol entities can execute concurrently. If a message is a one-way command (i.e., an unacknowledged command), the protocol entity will simply have the command executed. If a message is an acknowledged command, the protocol entity must first look at the Transaction Correlation Identifier. If it is not equal to the Transaction Correlation Identifier of the last executed command with the same priority level, the protocol entity will have the command executed and place the response/acknowledgement (with identical Transaction Correlation Identifier) in the outgoing FIFO queue of the same priority level. If the Transaction Correlation Identifier is equal to that of the last executed command with the same priority level (i.e., the case where the controller retransmits a command due to lack of proper acknowledgement), the protocol entity will not actually have the command executed but simply will place the response from the last execution of that command in the outgoing FIFO queue (i.e., re-send the previous acknowledgement response). It is assumed that in both cases the command processing protocol entity for a given priority level will block until there is room in the associated outgoing FIFO queue for the response message.

In the other direction, requests by the applications to send autonomous event notifications will simply result in the corresponding messages being directed to an event notification protocol entity for transmission to the OLT. The event notification protocol entity will forward these event notification messages to the low priority outgoing FIFO queue. In this case as well, the event notification protocol entity will block until there is room in the low priority outgoing FIFO queue to hold the notification message. The CRC generator will remove messages from the outgoing FIFO queues using a strict priority discipline (i.e., the low-priority queue will only be serviced when the high-priority queue is empty), generate a CRC, append a properly-formatted OMCI trailer to the cell/packet payload, and transmit the message to the OLT.
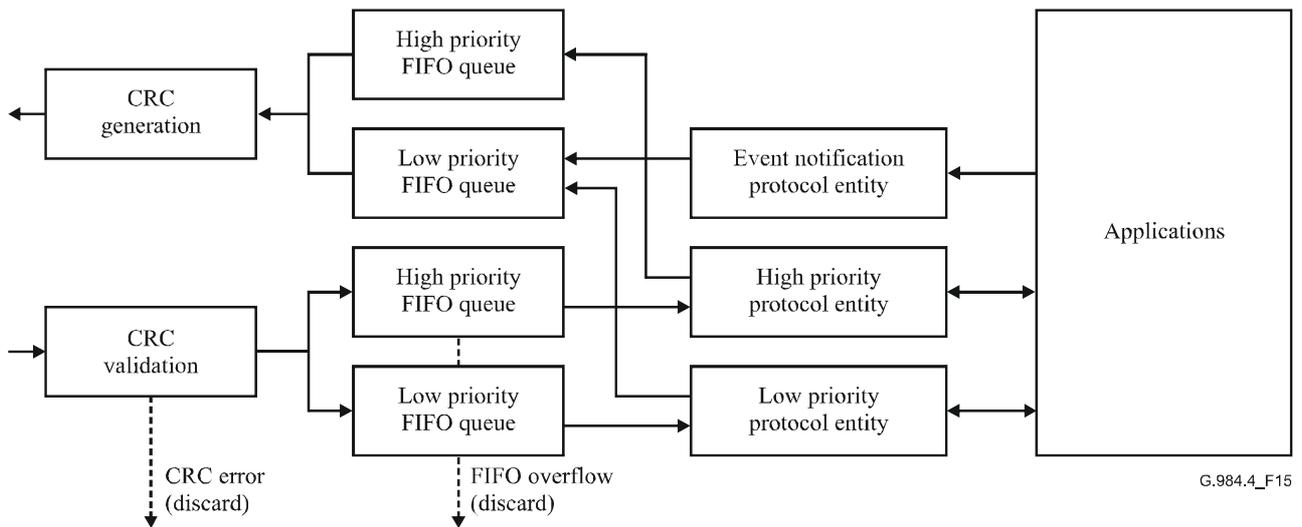
Figure 15/G.984.4 – Protocol entities within the ONT

11.3.2 Restrictions on the actions in relation to the protocol entities

To reduce the complexity and the amount of memory necessary in the ONT, the OLT is not allowed to issue a MIB Upload or a Software Download of a certain priority level while a similar action in the other priority level is in progress.

Appendix I

OMCI common mechanisms and services

This appendix describes the common mechanisms of the OMCI, e.g., the MIB resynchronization, and the OMCI services, e.g., the equipment management or connection management.

I.1 Common mechanisms

See Appendix I.1/G.983.2.

I.2 Common services

The common services consist of:

a)   Start-up phase of ONT;

b)   on demand subscriber line card provisioning;

c)   on demand subscriber line card de-provisioning;

d)   plug-and-play subscriber line card provisioning;

e)   plug-and-play subscriber line card de-provisioning;

f)   ATM VP Cross-Connection set-up;

g)   ATM VP Cross-Connection tear-down;

h)   structured/unstructured CES service connection set-up (ATM mode);

i)   structured/unstructured CES service connection tear-down (ATM mode);

j)   Ethernet connection set-up;

k)   Ethernet connection tear-down;

l)   software image download;

m)   software image changes;

n)   MAC bridge service connection set-up (ATM mode);

o)   MAC bridge service connection tear-down (ATM mode);

p)   addition of entries to MAC Filter Table;

q)   removal of entries from MAC Filter Table;

r)   voice service connection set-up;

s)   voice service connection tear-down;

t)   IP Router service connection set-up;

u)   IP Router service connection tear-down;

v)   addition of entries to IP Static Routes;

w)   removal of entries from IP Static Routes;

x)   MAC bridge service connection set-up (GEM mode);

y)   MAC bridge service connection tear-down (GEM mode);

z)   structured CES service connection set-up (GEM mode); and

aa)   structured CES service connection tear-down (GEM mode).

Services a) – w) are described in Appendix I.2/G.983.2 and Appendix I.1/G.983.8. These services are also used in G-PON. Please note that the managed entities are the ones defined in this Recommendation even though the sequences are referred to ITU-T Rec. G.983.2.

I.2.1 MAC bridge service connection set-up (GEM mode)

Figures I.1 and I.2 show the scenario for MAC bridge service connection set-up for an ONT. Note that the GAL Ethernet Profile can be shared among multiple instances of GEM Interworking Termination Point ME. No creation of the profile is needed if a new GEM Interworking Termination Point is associated with an existing profile. Also, the OLT may want to create corresponding History Data managed entities for the connection.
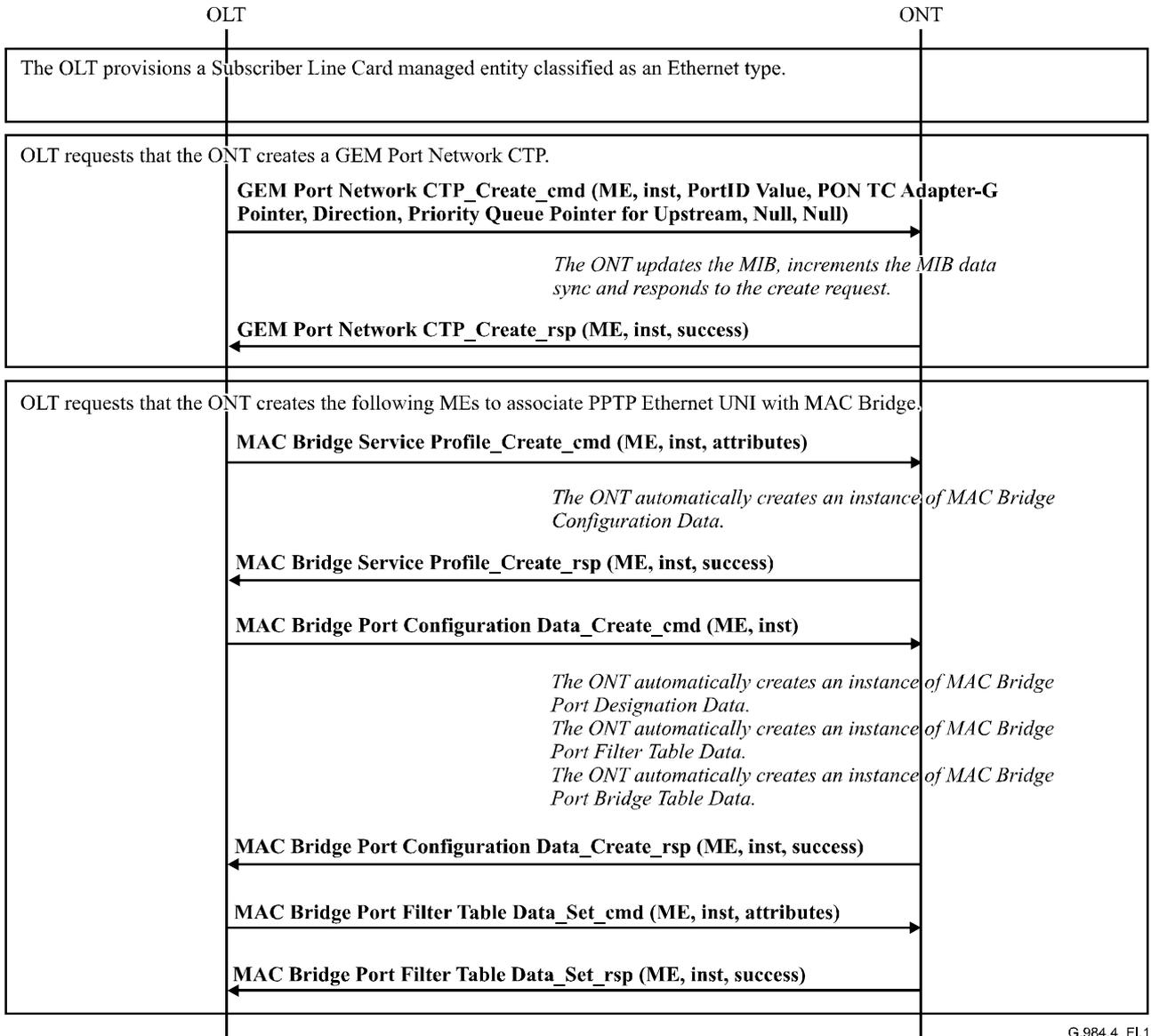
Figure I.1/G.984.4 – Connection set-up for MAC bridge service

OLT   ONT

OLT requests that the ONT creates the following MEs to associate GEM IW VCC TP with MAC Bridge.

MAC Bridge Port Configuration Data_Create_cmd (ME, inst)

The ONT automatically creates an instance of MAC Bridge Port Designation Data.
The ONT automatically creates an instance of MAC Bridge Port Filter Table Data.
The ONT automatically creates an instance of MAC Bridge Port Bridge Table Data.

MAC Bridge Port Configuration Data_Create_rsp (ME, inst, success)

MAC Bridge Port Filter Table Data_Set_cmd (ME, inst, attributes)

MAC Bridge Port Filter Table Data_Set_rsp (ME, inst, success)

GAL Ethernet Profile_Create_cmd (ME, inst, attributes)

GAL Ethernet Profile_Create_rsp (ME, inst, success)

GEM IW TP_Create_cmd (ME, inst, attributes)

GEM IW TP_Create_rsp (ME, inst, success)

G.984.4_FI.2

Figure I.2/G.984.4 – Connection set-up for MAC bridge service (continued)

I.2.2   MAC bridge service connection tear-down (GEM mode)

Figure I.3 shows the scenario of the MAC bridge service connection tear-down. If applicable, the OLT must delete the corresponding History Data managed entities as well. Note that the GAL Ethernet Profile instances can be shared among multiple GEM Interworking Termination Point instances. If there are more GEM Interworking Termination Point instances associated with this profile managed entity instances, the OLT may not request to delete it.
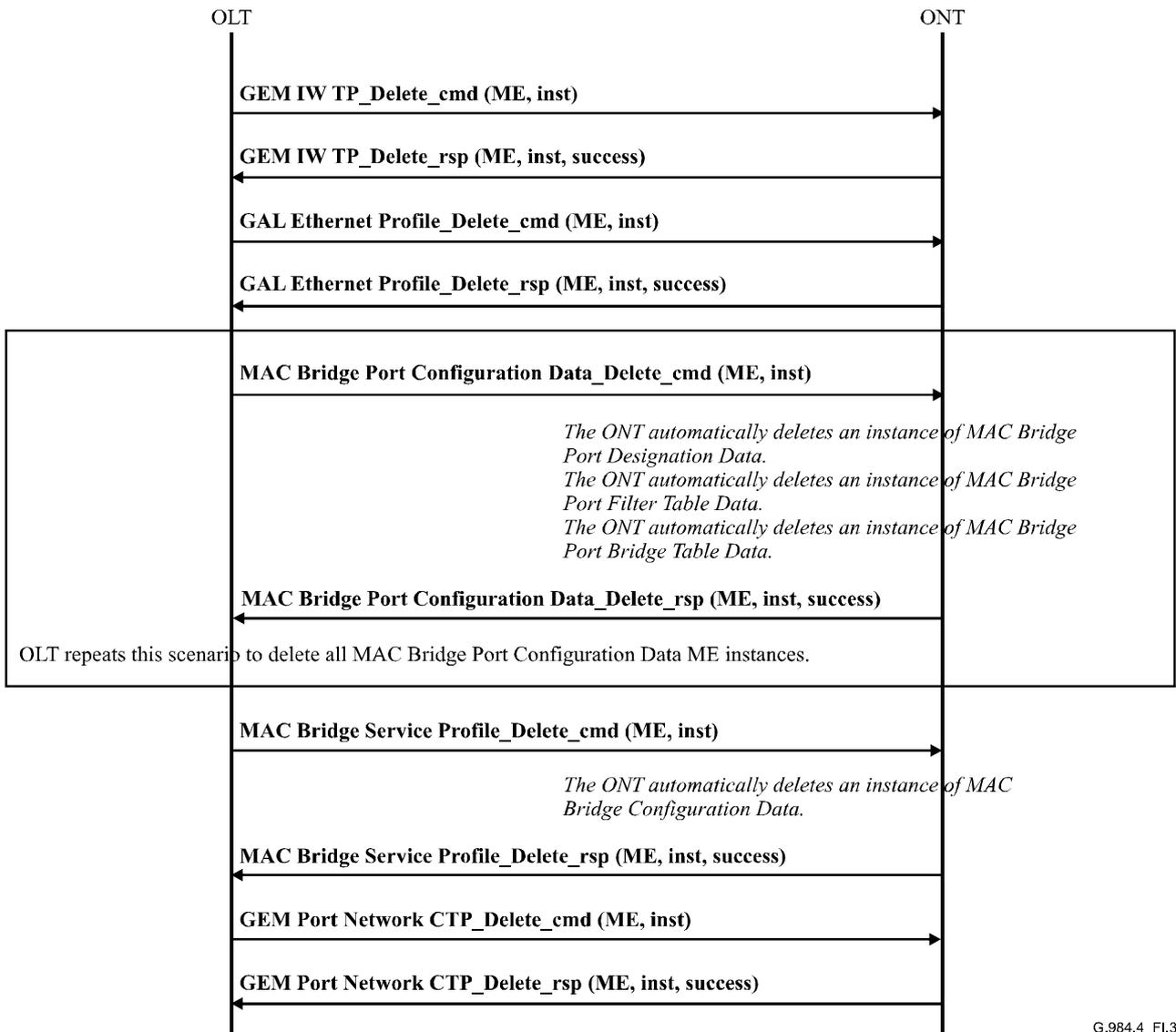
Figure I.3/G.984.4 – Connection tear-down for MAC bridge service

I.2.3   Structured CES service connection set-up (GEM mode)

Figure I.4 shows the scenario for the connection set-up of a structured CES service. Note that CES Service Profile$_{\text{B-PON}}$ and GAL TDM Profile can be shared among multiple GEM Interworking Termination Point instances. No creation of those profiles is needed if the GEM Interworking Termination Point is pointing to an existing profile.

Also, the OLT might want to create corresponding History Data managed entities for the connection.

OLT   ONT

The OLT provisions a Subscriber Line Card managed entity classified as a CES type.

OLT requests that the ONT creates a GEM Port Network CTP.

GEM Port Network CTP_Create_cmd (ME, inst, PortID Value, PON TC Adapter-G Pointer, Direction, Priority Queue Pointer for Upstream, Null, Null)

The ONT updates the MIB, increments the MIB data sync and responds to the create request.

GEM Port Network CTP_Create_rsp (ME, inst, success)

OLT requests that the ONT creates the following MEs to associate PPTP CES UNI with GEM Port Interworking VCC Termination Point.

Logical N × 64 kbit/s Sub-Port CTP_Create_cmd (ME, inst, attributes)

Logical N × 64 kbit/s Sub-Port CTP_Create_ rsp (ME, inst, success)

CES Service profile$_{B-PON}$_Create_cmd (ME, inst, attributes)

CES Service profile$_{B-PON}$_Create_ rsp (ME, inst, success)

GAL TDM Profile_Create_cmd (ME, inst, attributes)

GAL TDM Profile_Create_rsp (ME, inst, success)

GEM Interworking TP_Create_cmd (ME, inst, attributes)

GEM Interworking TP_Create_rsp (ME, inst, success)

G.984.4_FI.4

Figure I.4/G.984.4 − Connection set-up of a structured CES

I.2.4   Structured CES service connection tear-down (GEM mode)

Figure I.5 shows the scenario of the structured CES service connection tear-down. If applicable, the OLT must delete the corresponding History Data managed entities as well. Note that CES Service Profile$_{B-PON}$ and GAL TDM Profile can be shared among multiple GEM Interworking Termination Point instances. If there are more GEM Interworking Termination Point instances associated with these profile managed entities, the OLT may not request to delete them.
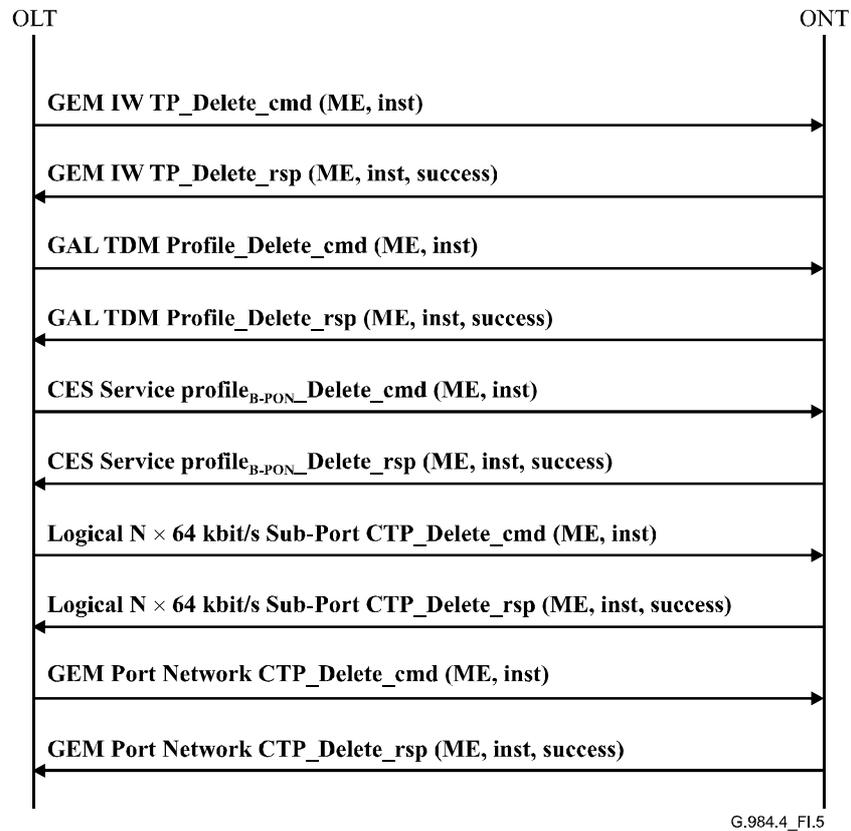
Figure I.5/G.984.4 − Connection tear-down of a structured CES service

Appendix II

OMCI message set

II.1   General remarks

II.1.1   Message type identifier

The message types are given in 11.1.4.

II.1.2   Entity Class identifier

The entity class identifiers are given in 11.1.6.

II.1.3   Result and reason

Responses to commands can indicate the result of the command. A value of "null" will indicate that the command was processed successfully. Non-null values will indicate the reason of the failure. If the result was "failure", the rest of the message contents will be filled with all 0x00s. The definition of each result and reason is as follows:

1)   *Command processed successfully*

There are two functions for command processing: command interpretation and command execution. This result means that the received command, such as Get/Set/Test/Reboot, was properly interpreted by the ONT's command interpretation function without errors and that the interpreted command was successfully transferred to the ONT's command execution function.

2)   *Command processing error*

This result means the command processing failed at the ONT due to some reason not described by item 3), 4), etc.

3)   *Command not supported*

This result means that the message type indicated in Byte 8 is not supported by the ONT.

4)   *Parameter error*

This result means that the command message received by the ONT was errored.

5)   *Unknown managed entity*

This result means that the managed entity class indicated in Bytes 10 and 11 is not supported by the ONT.

6)   *Unknown managed entity instance*

This result means that the managed entity instance indicated in Bytes 12 and 13 does not exist in the ONT.

7)   *Device busy*

This result means that the command could not be processed due to process-related congestion at the ONT.

8)   *Attribute(s) failed or unknown*

This result means that an optional attribute is not supported by the ONT or that a mandatory/optional attribute could not be executed by the ONT, even if it is supported. In conjunction with this result, attribute masks are used to indicate which attributes failed or were unknown.

The following two kinds of attribute masks are used when this result/reason is raised:

– *optional attribute mask coding*, which indicates whether or not the optional attribute is supported;

– *attribute execution mask coding*, which indicates whether or not the mandatory/optional attribute was executed.

See Set response and Get response message layouts (Appendices II.2.10 and II.2.12) for the placement of these masks.

If one or more optional attributes are not supported by the ONT, the "optional attribute mask coding" for each *unsupported* optional attribute becomes 1 while the corresponding "attribute execution mask coding" remains 0.

If one or more mandatory or optional attributes were not executed by the ONT, the "optional attribute mask coding" remains 0, while the "attribute execution mask coding" becomes 1 for each *failed* attribute.

9)   *Instance exists*

This result means that the ONT already has a managed entity instance that corresponds to the one the OLT is attempting to create.

II.1.4   Get, Get response and Set messages

For an attribute mask, a bitmap is used in the "Get", "Get response" and "Set" messages. This bitmap indicates which attributes are requested (Get) or provided (Get response and Set). The bitmap is composed as follows (see Table II.1):

Table II.1/G.984.4 – Attribute mask coding

Byte	Bit							
	8	7	6	5	4	3	2	1
1	Attribute 1	Attribute 2	Attribute 3	Attribute 4	Attribute 5	Attribute 6	Attribute 7	Attribute 8
2	Attribute 9	Attribute 10	Attribute 11	Attribute 12	Attribute 13	Attribute 14	Attribute 15	Attribute 16

The attribute numbers correspond to the ordering of the attributes in clause 9. Note that the Managed Entity identifier, which is an attribute of each managed entity, has no corresponding bit in the attribute mask. Thus, the attributes are counted starting from the first attribute after the Managed Entity identifier.

II.1.5   Alarm notifications

The ONT will send this notification each time an alarm status has changed for the entity indicated in the message identifier. The message shows the status of *all* alarms of this entity. It is up to the OLT to determine which alarm status has changed.

The maximum number of alarms that is supported by the OMCI is 224 because of the available message field of Get All Alarm Next message. The bitmap is composed as follows (see Table II.2):

Table II.2/G.984.4 – Alarm mask coding

Byte	Bit							
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
1	Alarm 0	Alarm 1	Alarm 2	Alarm 3	Alarm 4	Alarm 5	Alarm 6	Alarm 7
2	Alarm 8	Alarm 9	Alarm 10	Alarm 11	Alarm 12	Alarm 13	Alarm 14	Alarm 15
…								
28	Alarm 216	Alarm 217	Alarm 218	Alarm 219	Alarm 220	Alarm 221	Alarm 222	Alarm 223

The alarm numbers correspond to the alarm coding in clause 9. Bits in the alarm bitmap that correspond to non-existing alarms shall always be set equal to "0". Bits that correspond to existing alarms are set to a value of "0" to indicate that the corresponding alarm is cleared or a value of "1" to indicate that the alarm has been raised.

Alarm message sequence numbers can obtain values in the interval 1 to 255. Zero is excluded in order to make this counter similar to the MIB data sync counter.

II.1.6 Test, Test response and Test result

The descriptions below indicate how Test, Test response and Test result are related.

Test: This message is used to initiate either a self test or an MLT test (or additional tests defined in future).

Test response: This message is an immediate reaction to a Test message. The "Test response" message reports the ability of the ONT to run the required test, but it does not contain any specific results.

Test result: This message is used to report the result of either a self test (requested by the OLT) or an MLT test (or additional test defined in future). In the case of an AUTONOMOUS self test, the Test result notification is not used. Instead, notification is sent to the OLT via an alarm ONLY if the managed entity fails its autonomous self test.

A test on a particular managed entity instance is invoked by sending a Test message to this instance. Each managed entity that supports tests needs to have an action "Test" defined for it. The type of test that is invoked by a Test message depends on the managed entity.

The "Test response" message is an indication to the OLT that the test request is received and is being processed. The results of a requested test will be sent to the OLT via a specific "Test result" message.

The "Test response" message will be sent immediately after the Test message is received (i.e., within the normal response time). The transaction identifier of the "Test response" message is identical to the transaction identifier of the Test message that requested the test.

II.2 Message layout

II.2.1 Create

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = create
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									attribute value of first Set-by-create attribute (size depending on the type of attribute)
										…
										attribute value of last Set-by-create attribute (size depending on the type of attribute)
	xx-45	0	0	0	0	0	0	0	0	padding

It should be noted that the message contents for the "Create" message apply only to attributes that are "Set-by-create". Thus, the first byte of Message Contents field begins with the attribute value for the first Set-by-create attribute and so forth.

II.2.2 Create response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = create
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy 0111 = instance exists
	15-45	0	0	0	0	0	0	0	0	padding

II.2.3 Create Complete Connection

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = create complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-15									ani VP Network CTP-G or VC Network CTP-G instance
	16-17									uni VP Network CTP-G or VC Network CTP-G instance
	18-19									PON TC Adapter-G pointer for ANI side
	20-21									UNI-G/UNI$_{B\text{-}PON}$ pointer for UNI side
	22-23									VPI for ANI side
	24-25									VPI for UNI side
	26-27									VCI of ANI side for VC cross-connection creation, otherwise 0x0000
	28-29									VCI of UNI side for VC cross-connection creation, otherwise 0x0000
	30	0	0	0	0	0	0	x	x	direction 01 = uni-to-ani 10 = ani-to-uni 11 = bidirectional
	31-32									Priority Queue pointer for Upstream in ANI side
	33-34									Priority Queue pointer for Downstream in UNI side
	35-36									Traffic Descriptor Profile pointer for ani VP Network CTP-G or VC Network CTP-G
	37-38									Traffic Descriptor Profile pointer for uni VP Network CTP-G or VC Network CTP-G
	39									Administrative State for cross-connection
	40-45	0	0	0	0	0	0	0	0	padding

II.2.4   Create Complete Connection response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = create complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy 0111 = instance exists
	15-45	0	0	0	0	0	0	0	0	padding

II.2.5   Delete

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = delete
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.6 Delete response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = delete
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15-45	0	0	0	0	0	0	0	0	padding

II.2.7 Delete Complete Connection

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = delete complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.8 Delete Complete Connection response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = delete complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15-45	0	0	0	0	0	0	0	0	padding

II.2.9 Set

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = set
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									msb attribute mask
	15									lsb attribute mask
	16									attribute value of first attribute to set (size depending on the type of attribute)
										…
										attribute value of last attribute to set (size depending on the type of attribute)
	xx-45	0	0	0	0	0	0	0	0	padding

II.2.10 Set response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = set
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy 1001=attribute(s) failed or unknown
	15									"optional attribute" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = unsupported attribute
	16									"optional attribute" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = unsupported attribute
	17									"attribute execution" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = failed attribute
	18									"attribute execution" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = failed attribute
	19-45	0	0	0	0	0	0	0	0	padding

II.2.11 Get

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									msb attribute mask
	15									lsb attribute mask
	16-45	0	0	0	0	0	0	0	0	padding

Based on the size of the message contents field, the aggregate size of the attributes requested by a single Get command should not exceed 25 bytes.

II.2.12 Get response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = get
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy 1001= attribute(s) failed or unknown
	15									msb attribute mask
	16									lsb attribute mask
	17									attribute value of first attribute included (size depending on the type of attribute)
										…
										attribute value of last attribute included (size depending on the type of attribute)
	xx-41	0	0	0	0	0	0	0	0	padding
	42									"optional attribute" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = unsupported attribute
	43									"optional attribute" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = unsupported attribute
	44									"attribute execution" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = failed attribute

Field	Byte	8	7	6	5	4	3	2	1	Comments
	45									"attribute execution" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = failed attribute

Bytes 42 to 45 are always reserved for the "optional attribute" and "attribute execution" masks; however, the content of these bytes is only valid in conjunction with the "1001" encoding used to indicate failed or unknown attributes.

When ONT should transfer an attribute whose size could be larger than one packet, ONT responds using four bytes to indicate the size of that attribute with an adequate attribute mask. OLT should use Get next message in order to get such attribute.

II.2.13 Get Complete Connection

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									Entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.14 Get Complete Connection response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = get complete connection
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy

Field	Byte	8	7	6	5	4	3	2	1	Comments
	15-16									ani VP Network CTP-G or VC Network CTP-G instance
	17-18									uni VP Network CTP-G or VC Network CTP-G instance
	19-20									PON TC Adapter-G pointer for ANI side
	21-22									UNI-G/UNI$_{B-PON}$ pointer for UNI side
	23-24									VPI for ANI side
	25-26									VPI for UNI side
	27-28									VCI of ANI side for VC cross-connection creation, otherwise 0x0000
	29-30									VCI of UNI side for VC cross-connection creation, otherwise 0x0000
	31	0	0	0	0	0	0	x	x	direction 01 = uni-to-ani 10 = ani-to-uni 11 = bidirectional
	32-33									Priority Queue pointer for Upstream in ANI side
	34-35									Priority Queue pointer for Downstream in UNI side
	36-37									Traffic Descriptor Profile pointer for ani VP Network CTP-G or VC Network CTP-G
	38-39									Traffic Descriptor Profile pointer for uni VP Network CTP-G or VC Network CTP-G
	40									Administrative State for cross-connection
	41-45	0	0	0	0	0	0	0	0	padding

II.2.15 Get All Alarms

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get all alarms
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.16 Get All Alarms response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = get all alarms
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14									msb of the number of subsequent commands
	15									lsb of the number of subsequent commands
	16-45	0	0	0	0	0	0	0	0	padding

II.2.17 Get All Alarms Next

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get all alarms next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14									msb of the command sequence number
	15									lsb of the command sequence number
	16-45	0	0	0	0	0	0	0	0	padding

The command sequence numbers shall start from 0x00 onwards.

II.2.18 Get All Alarms Next response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = get all alarms next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14-15									entity class on which the alarms are reported
	16									msb entity instance on which the alarms are reported
	17									lsb entity instance on which the alarms are reported
	18-45	x	x	x	x	x	x	x	x	bitmap alarms

The bitmap that is used in the Get All Alarms Next response for a given managed entity class is identical to the bitmap that is used in the alarm notifications for that managed entity class.

In the case the ONT has received a Get All Alarms Next request message in which the command sequence number is out of range, the ONT should respond with a message in which bytes 14 to 45 are all set to 0x00. This corresponds to a response with entity class 0x00, entity instance 0x0000, and bitmap all 0x00s.

II.2.19 MIB Upload

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = MIB upload
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.20 MIB Upload Response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = MIB upload
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14									msb of the number of subsequent commands
	15									lsb of the number of subsequent commands
	16-45	0	0	0	0	0	0	0	0	padding

II.2.21 MIB Upload Next

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = MIB upload next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14									msb of the command sequence number
	15									lsb of the command sequence number
	16-45	0	0	0	0	0	0	0	0	padding

The command sequence numbers shall start from 0x00 onwards.

II.2.22 MIB Upload Next response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = MIB upload next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14-15									entity class of object
	16									msb entity instance of object
	17									lsb entity instance of object
	18									msb attribute mask
	19									lsb attribute mask
	20									value of first attribute (size depending on the type of the attribute)
										...
										value of the last attribute (size depending on the type of the attribute)
	xx-45	0	0	0	0	0	0	0	0	padding

If the ONT receives a MIB Upload Next request message in which the command sequence number is out of range, it should respond with a message in which bytes 14 to 45 are all set to 0x00. This corresponds to a response with entity class 0x0000, entity instance 0x0000, attribute mask 0x0000, and padding from byte 20 to byte 45.

Note that, if all attributes of a managed entity do not fit within one MIB Upload Next response message, the attributes will be split over several messages. The OLT can use the information in the attribute mask to determine which attribute values are reported in which MIB upload Next response message.

II.2.23 MIB Reset

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = MIB reset
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.24 MIB Reset response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = MIB reset
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = ONT Data
	12	0	0	0	0	0	0	0	0	msb entity instance
	13	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15-45	0	0	0	0	0	0	0	0	padding

II.2.25 Alarm

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	0						DB = 0, AR = 0, AK = 0 bits 5-1: action = alarm
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									alarm mask
										…
	41									alarm mask
	42-44	0	0	0	0	0	0	0	0	padding
	45									alarm sequence number

II.2.26 Attribute Value Change

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	0						DB = 0, AR = 0, AK = 0 bits 5-1: action = attribute value change
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									msb attribute mask
	15									lsb attribute mask
	16									attribute value of first attribute changed (size depending on the type of attribute)
										...
										attribute value of last attribute changed (size depending on the type of attribute)
	xx-45	0	0	0	0	0	0	0	0	padding

II.2.27 Test

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = test
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	0	0	x	x	x	x	xxxx = select test 0000 = all MLT tests 0001 = hazardous potential 0010 = foreign EMF 0011 = resistive faults 0100 = receiver off-hook 0101 = ringer 0110 = network termination 1 dc signature test 0111 = self test
	15-45	0	0	0	0	0	0	0	0	padding

Note that a single message can be used to initiate multiple tests (if desired). Additionally, the Test message can be modified to support future extensions by adding additional encodings to any byte that are reserved as Padding. This allows new tests that might be defined in the future to be supported without changing the principle of operation.

II.2.28 Test response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = test
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	xx-45	0	0	0	0	0	0	0	0	padding

The Test response message is an indication to the OLT that the test request is received and is being processed.

II.2.29 Start Software Download

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = start software download
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14									window size – 1
	15-18									image size in bytes
	19-45	0	0	0	0	0	0	0	0	padding

II.2.30 Start Software Download response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = start software download
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15									window size – 1
	16-45	0	0	0	0	0	0	0	0	padding

II.2.31 Download Section

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	x	0						DB = 0, AR = x, AK = 0 x = 0: no response expected (section within the window) x = 1: response expected (last section of a window) bits 5-1: action = sw download section
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14									download section number
	15-45									data

II.2.32 Download Section response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = sw download section
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15									download section number
	16-45	0	0	0	0	0	0	0	0	padding

II.2.33 End Software Download

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = end software download
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14-17									CRC-32
	18-21									image size in bytes
	22-45	0	0	0	0	0	0	0	0	padding

II.2.34 End Software Download response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = end software download
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed 　　　successfully (CRC correct) 0001 = command processing error 　　　(CRC incorrect) 0010 = command not supported 　　　(not applicable) 0011 = parameter error (not 　　　applicable) 0100 = unknown managed entity 0101 = unknown managed entity 　　　instance 0110 = device busy
	15-45	0	0	0	0	0	0	0	0	padding

II.2.35 Activate Image

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = activate image
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.36 Activate Image response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = activate image
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance

Message contents	14	0	0	0	0	x	x	x	x	result, reason
										0000 = command processed
										      successfully
										0001 = command processing error
										0010 = command not supported
										0011 = parameter error
										0100 = unknown managed entity
										0101 = unknown managed entity
										      instance
										0110 = device busy

	15-45	0	0	0	0	0	0	0	0	padding

II.2.37 Commit Image

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = commit image
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.38 Commit Image response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = commit image
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class = software image
	12									msb entity instance 0 = ONT-G 1, 2, ... , 127 = UNI card 129, 130, ... , 255 = ANI card
	13	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance

Message contents	14	0	0	0	0	x	x	x	x	result, reason
										0000 = command processed
										        successfully
										0001 = command processing error
										0010 = command not supported
										0011 = parameter error
										0100 = unknown managed entity
										0101 = unknown managed entity
										        instance
										0110 = device busy

	15-45	0	0	0	0	0	0	0	0	padding

II.2.39 Synchronize Time

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = synchronize time
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.40 Synchronize Time response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 Bits 5-1: action = synchronize time
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									Result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy
	15-45	0	0	0	0	0	0	0	0	padding

II.2.41 Reboot

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = reboot
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14-45	0	0	0	0	0	0	0	0	padding

II.2.42 Reboot response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = reboot
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14									result, reason 0000 = command processed 　　　successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity 　　　instance 0110 = device busy
	15-45									padding

II.2.43 Get next

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									msb attribute mask
	15									lsb attribute mask
	16									msb of the command sequence number
	17									lsb of the command sequence number
	18-45	0	0	0	0	0	0	0	0	padding

The command sequence numbers shall start from 0x00 onwards.

II.2.44 Get next response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK =1 bits 5-1: action = get next
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments

Message contents	14	0	0	0	0	x	x	x	x	result, reason
										0000 = command processed
										    successfully
										0001 = command processing error
										0010 = command not supported
										0011 = parameter error
										0100 = unknown managed entity
										0101 = unknown managed entity
										    instance
										0110 = device busy

	15									msb attribute mask
	16									lsb attribute mask
	17									attribute value (size depending on the type of attribute)
										…
	xx-45	0	0	0	0	0	0	0	0	padding

If the ONT receives a "Get next request" message in which the command sequence number is out of range, the ONT shall respond with parameter error.

II.2.45　Test result

The "Test result" message is used to report the result of a test. Currently, it is used to report the result of a self test or the result of an MLT test. If a new test is defined in the future, the corresponding test results can be reported by the "Test result" message by extending the layout. The transaction identifier of the "Test result" message is identical to the transaction identifier of the Test message that initiated the corresponding test.

The first byte of message contents is used to report an MLT test result. The result is limited to the two values of "test passed" or "test failed".

The second byte of message contents is used to report the result of a self test. Three different results can be reported: "test passed", "test failed" and "test not completed".

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	0						DB = 0, AR = 0, AK =0 bits 5-1: action = test result
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	a	b	c	d	e	f	MLT test result: 0 = fail test a/b/c/d/e/f 1 = pass test a/b/c/d/e/f a= hazardous potential b = foreign EMF c = resistive faults d = receiver off-hook e = ringer f = network termination 1 dc signature test
	15	0	0	0	0	0	0	x	x	self test result: xx = 00: failed xx = 01: passed xx = 10: not completed
	16-45	0	0	0	0	0	0	0	0	padding

II.2.46 Get current data

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	1	0						DB = 0, AR = 1, AK = 0 bits 5-1: action = get current data
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance
Message contents	14									msb attribute mask
	15									lsb attribute mask
	16-45	0	0	0	0	0	0	0	0	padding

Based on the size of the message contents field, the aggregate size of the attributes requested by a single Get current data command should not exceed 25 bytes.

II.2.47 Get current data response

Field	Byte	8	7	6	5	4	3	2	1	Comments
Transaction identifier	6-7									
Message type	8	0	0	1						DB = 0, AR = 0, AK = 1 bits 5-1: action = get current data
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10-11									entity class
	12									msb entity instance
	13									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	14	0	0	0	0	x	x	x	x	result, reason 0000 = command processed successfully 0001 = command processing error 0010 = command not supported 0011 = parameter error 0100 = unknown managed entity 0101 = unknown managed entity instance 0110 = device busy 1001 = attribute(s) failed or unknown
	15									msb attribute mask
	16									lsb attribute mask
	17									attribute value of first attribute included (size depending on the type of attribute)
										…
										attribute value of last attribute included (size depending on the type of attribute)
	xx-41	0	0	0	0	0	0	0	0	padding
	42									"optional attribute" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = unsupported attribute
	43									"optional attribute" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = unsupported attribute
	44									"attribute execution" mask (attributes 1-8), used with "1001" encoding: 0 = default 1 = failed attribute
	45									"attribute execution" mask (attributes 9-16), used with "1001" encoding: 0 = default 1 = failed attribute

Bytes 42 to 45 are always reserved for the "optional attribute" and "attribute execution" masks; however, the content of these bytes is only valid in conjunction with the "1001" encoding used to indicate failed or unknown attributes.

When ONT should transfer an attribute whose size could be larger than one packet, ONT responds using four bytes to indicate the size of that attribute with an adequate attribute mask. OLT should use Get next message in order to get such attribute.

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