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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

ONT management and control interface specification for ATM PON

ITU-T Recommendation G.983.2

(Formerly CCITT Recommendation)

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ITU-T Recommendation G.983.2

ONT management and control interface specification for ATM PON

Summary

In the ATM-PON system defined in ITU-T G.983.1 [3], the ONTs are located at the customer site. The ATM-PON element management system will only manage ONTs as part of the ATM-PON system through the OLT using the ONT management and control interface.

This Recommendation presents requirements for the ONT management and control interface. First, it specifies managed entities of a protocol-independent Management Information Base (MIB) that models the exchange of information between the OLT and ONT. Then, it covers the ONT management and control channel, protocol and detailed messages.

Source

ITU-T Recommendation G.983.2 was prepared by ITU-T Study Group 15 (1997-2000) and approved under the WTSC Resolution 1 procedure on 4 April 2000.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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ITU-T Recommendation G.983.2

ONT management and control interface specification for ATM PON

1 Scope

This Recommendation specifies the ONT Management and Control Interface (OMCI) for the ATM-PON system defined in ITU-T G.983.1 [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. The focus of this OMCI specification is on low-complexity FTTH and FTTBusiness ONTs. The Recommendation defines a simple protocol necessary to support the basic capabilities identified for these ONTs. It also allows optional components and future extensions.

2 References

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; all 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.

[1] ITU-T G.784 (1999), *Synchronous digital hierarchy (SDH) management.*

[2] ITU-T G.774 (2001), *Synchronous digital hierarchy (SDH) management information model for the network element view*.

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

[4] ITU-T I.321 (1991), *B-ISDN protocol reference model and its application*.

[5] ITU-T I.363.1 (1996), *B-ISDN ATM Adaptation Layer specification: Type 1 AAL*.

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

[7] ITU-T I.371 (2000), *Traffic control and congestion control in B-ISDN*.

[8] ITU-T I.610 (1999), *B-ISDN operation and maintenance principles and functions*.

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

[10] ITU-T Q.824.6 (1998), *Stage 2 and stage 3 description for the Q3 interface-customer administration: Broadband Switch Management*.

[11] ITU-T I.432.1 (1999), *B-ISDN user-network interface – Physical layer specification: General characteristics.*

3 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
AN	Access Node
ANI	Access Node Interface
APON	ATM over Passive Optical Network
ATC	ATM Transfer Capabilities
ATM	Asynchronous Transfer Mode
BES	Block Errored Second
B-ISDN	Broadband Integrated Services Digital Network
CBR	Constant Bit Rate
CES	Circuit Emulation Service
CRC	Cyclic Redundancy Check
CSS	Controlled Slip Second
DBR	Deterministic Bit Rate
ES	Errored Second
FEC	Forward Error Correction
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
GFR	Guaranteed Frame Rate
HN	Home Network
IP	Internet Protocol
ISDN	Integrated Services Digital Network
LAN	Local Area Network
LIM	Line Interface Module
LSB	Least Significant Bit
LT	Line Terminal
ME	Managed Entity
MIB	Management Information Base
MSB	Most Significant Bit
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
OpS	Operations System
PHY	Physical Interface
PON	Passive Optical Network
QoS	Quality of Service
SBR	Statistical Bit Rate
SDP	Simple Device Protocol
SDT	Structured Data Transfer
SES	Severely Errored Second
SNI	Service Node Interface
TE	Terminal Equipment
UAS	Unavailable Seconds
UBR	Unspecified Bit Rate
UNI	User Network Interface
VBR	Variable Bit Rate
VC	Virtual Channel
VCC	Virtual Channel Connection
VCI	Virtual Channel Identifier
VP	Virtual Path
VPC	Virtual Path Connection
VPI	Virtual Path Identifier
xDSL	x Digital Subscriber Line

4 Reference model and terms

4.1 OMCI in ITU-T G.983.1

The network architecture reference model of ATM-PON is described in ITU-T G.983.1 [3] and shown in Figure 1. The ATM-PON fits various access network architecture, i.e. FTTH (Fibre to the Home), FTTB/C (Fibre to the Building/Curb) and FTTCab (Fibre to the Cabinet).

The terminology of ONT, which will be used throughout this Recommendation, is more broadly defined as an ONU used for the FTTH and FTTBusiness (Fibre to the Business) configuration. In general, the differences between FTTH and FTTBusiness is 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.

The OMCI specification fits into the overall ITU-T G.983.1 [3] model for an access network system as illustrated in Figure 1.

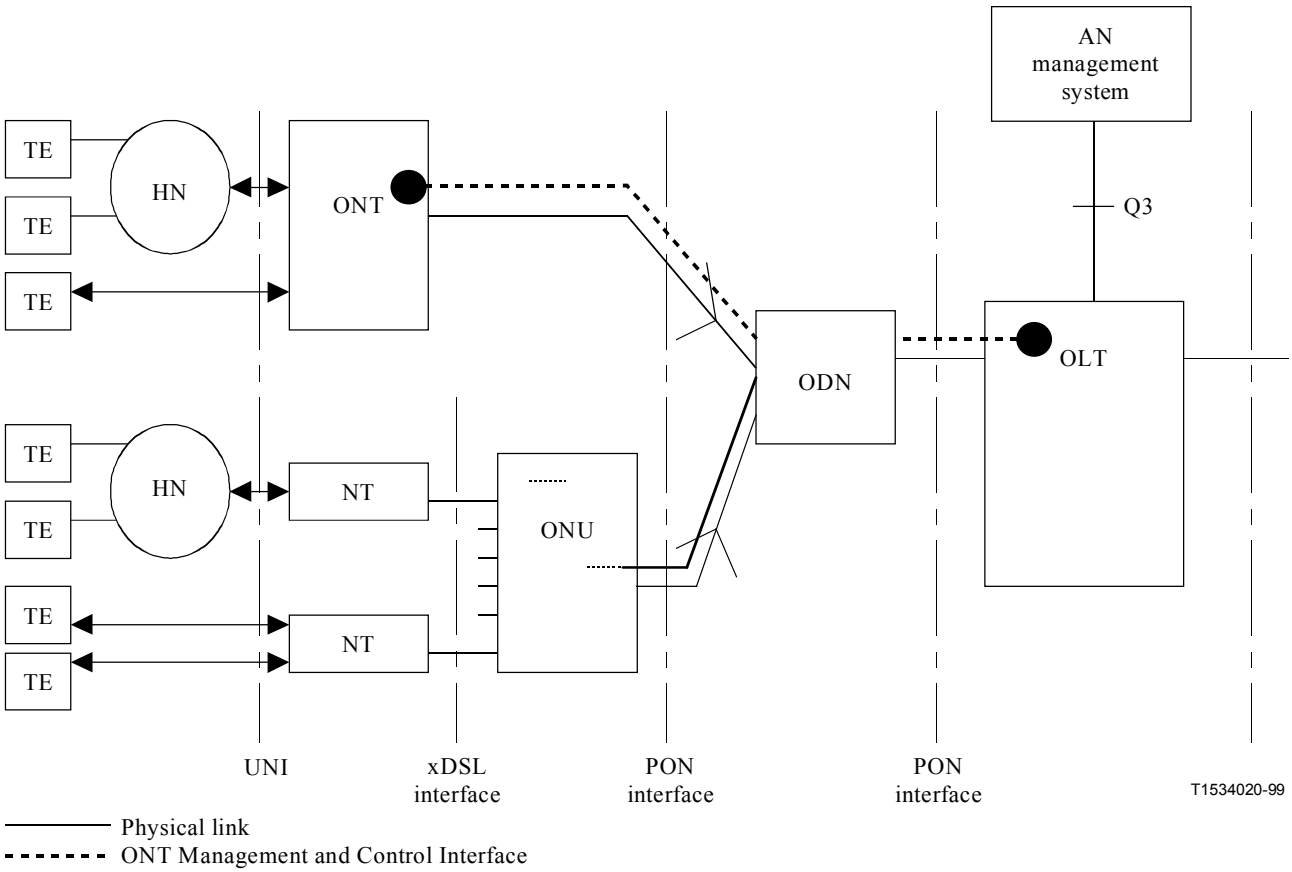


Figure 1/G.983.2 – Reference Model

4.2 ONT Functions

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

a) Access network line termination function (AN-LT).

b) User network interface line termination function (UNI-LT), noted that in the Fibre to the Business case, the UNIs from one ONT may belong to different users.

c) ATM multiplexing and de-multiplexing function (ATM-Mux).

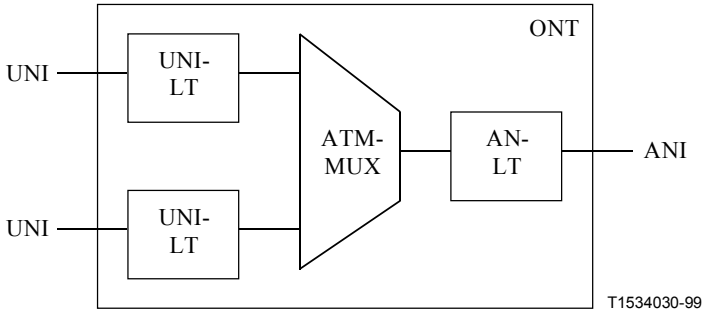


Figure 2/G.983.2 – ONT functional diagram

4.3 VP Mux functionality in the ONT

In ITU-T G.983.1 [3], the end-to-end ATM-PON system (i.e. OLT, ODN and ONT) can function as an ATM VP Cross-Connection with both provisioned and on-demand connectivity. The configuration of the ATM VP 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. The OMCI itself does not distinguish between these two cases. The OLT can, however, assign different priority to OMCI messages such that in case b) a fast response time of the OMCI is achieved.

The OLT and ONT as a whole can function as a VP as well as a VC switch. However, the low-cost ONT addressed in this Recommendation multiplexes and de-multiplexes ATM connections on VP level only. Thus, only VPI translation is supported in the ONT.

5 Requirements of the management interface specification

The OMCI is used by 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 event such as link failures.

The OMCI protocol runs across an ATM connection between the OLT controller to the ONT controller that is established at ONT initialization. The OMCI protocol is asymmetric: the controller in the OLT is master and the one in the ONT is the slave. A single OLT controller using multiple instances of the protocols 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.

5.1 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 link termination points and ATM Cross-Connections;

d) Configuration of interworking VCC termination points (non-ATM UNIs only);

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.

ATM VC management is not a part of this Recommendation (see [App.V-1] and [9] in clause 2).

5.2 Fault management

The ONT supports *limited* fault management only. Most of the operations are limited to failure indication. The OMCI support the failure reporting on the following managed entities that are described throughout clause 7.

a) ONT_{APON};

b) Subscriber Line Cardholder;

c) Subscriber Line Cards;

d) Physical Path Termination Point;

e) $TC\ Adapter_{APON}$;

f) Interworking VCC Termination Point;

g) $AAL\ 1\ Protocol\ Monitoring\ Current\ Data_{APON}$;

h) $AAL\ 5\ Protocol\ Monitoring\ Current\ Data_{APON}$;

i) $Priority\ Queue_{APON}$;

j) $UPC\ Disagreement\ Monitoring\ Current\ Data_{APON}$;

k) TC Adapter Performance Monitoring Current Data;

l) CES Physical Interface Monitoring Current Data and VP Link Termination Point.

An alarm table is defined for each of these entities.

The ONT shall also support selective OAM cell loop-back testing at the UNI. The ONT diagnostics is 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 monitor is not a part of this Recommendation (see [App.V-1] and ITU-T I.751 [9]).

5.3 Performance management

The ONT has only *limited* performance monitoring. For the low cost FTTH ONT the performance monitoring is limited to PMD and TC layer performance monitoring. However, for the FTTBusiness ONT, the ATM cell level protocol monitoring, traffic management and UPC disagreement monitoring may be required. The following are related managed entities:

a) UPC Disagreement Monitoring;

b) $AAL\ 1\ Protocol\ Monitoring\ Current\ Data_{APON}$;

c) $AAL\ 5\ Protocol\ Monitoring\ Current\ Data_{APON}$;

d) Native LAN Physical Interface Monitoring Current Data;

e) CES Physical Interface Monitoring Current Data;

f) TC Adapter Performance Monitoring Current Data.

Note that all the performance monitoring related managed entities are not required to be uploaded during the MIB upload (see 7.1.2).

All the history data shall be maintained in the OLT. ATM management of performance monitor is not a part of this Recommendation (see [App.V-1] and ITU-T I.751 [9]).

5.4 Security management

This is for further study.

6 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 low complexity FTTH and FTTBusiness ONTs. It defines the simplest protocol necessary to support capabilities identified by ITU-T G.983.1 [3]. It is important for early deployment and interoperability, yet 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 simple while maintaining consistency with the MIB used by the interface between the network-element manager and the OLT.

6.1 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, but are not necessary for operational compatibility.

The possible managed entities are listed in Table 1.

Table 1/G.983.2 – Managed entities in the OMCI

Managed entity	Required/Optional	Description
AAL 1 Profile$_{APON}$	CR	Used when the ONT supports CES UNIs
AAL 1 Protocol Monitoring Current Data$_{APON}$	O	Used when AAL 1 layer performance monitoring is supported
AAL 5 Profile$_{APON}$	CR	Used when the ONT supports LAN UNIs
AAL 5 Protocol Monitoring Current Data$_{APON}$	O	Used when AAL 5 layer performance monitoring is supported
ANI	O	PON IF, description purposes only, see 7.2 ANI Management
ATM VP Cross-Connection	CR	Used for VP multiplexing with VPI translation in the ONT
CES Service Profile$_{APON}$	CR	Used for CES services supported by the ONT
CES Physical Interface Monitoring Current Data	O	Used for the CES interface performance monitoring

Table 1/G.983.2 – Managed entities in the OMCI (*continued*)

Managed entity	Required/Optional	Description
Interworking VCC Termination Point	CR	Used for non-ATM UNIs
LAN Service Profile	CR	Used for LAN Services supported by the ONT
Logical Nx64kbit/s Sub-port Termination Point	CR	Used as logical interface for structured CES
Multipoint bridge (FFS)	O	Used when multicasting is supported
Native LAN Physical Interface Monitoring Current Data	O	Used for the Ethernet interface performance monitoring
ONT_{APON}	R	Used for ONT equipment management
ONT Data	R	Used for OMCI MIB management
Physical Path Termination Point ATM UNI	CR	Used for physical path termination point at the ATM UNI
Physical Path Termination Point CES UNI	CR	Used for physical path termination point at the CES UNI
Physical Path Termination Point Native LAN UNI	CR	Used for physical path termination point at the Ethernet UNI
PON IF Line Card	CR	Used for the PON line card plug-in, only used if PON interface is implemented on a plug-in unit
PON IF Line Cardholder	CR	Used for the PON line card plug-in slot, only used if PON interface is implemented on a plug-in unit
PON Physical Path Termination Point	O	Used for physical path at the ANI, description purpose only, see 7.2 ANI Management
PON TC Adapter	O	Used for TC layer at PON interface, description purpose only, see 7.2 ANI Management
Priority $Queue_{APON}$	CR	Used for the low cost ONTs that support priority queues
Software Image	R	Used for the software image of the ONT. Software image for the subscriber line cards is optional
Subscriber Line Card	CR	Used for the UNI line card plug-in
Subscriber Line Cardholder	CR	Used for the UNI line card plug-in slot

Table 1/G.983.2 – Managed entities in the OMCI (*concluded*)

Managed entity	Required/Optional	Description
TC Adapter$_{APON}$	CR	Used for TC layer at the UNI side for the ATM UNI
TC Adapter Protocol Monitoring Current Data	O	Used when TC layer performance monitoring is supported
Threshold Data$_{APON}$	CR	Used for the set-up threshold values
Traffic Descriptors	CR	Used for the ONT that supports UPC
Traffic Shaping Descriptor	CR	Used for the ONT that supports traffic shaping at non-ATM UNI
UNI$_{APON}$	R	User network interface
UPC Disagreement Monitoring Current Data$_{APON}$	CR	Used for the ONT that supports UPC
VPL Termination Point$_{APON}$	R	Used for the VP link termination in the VP Mux

6.2 Managed Entities Relation Diagrams

The relationships between the required managed entities are given in Figures 3 to 9.

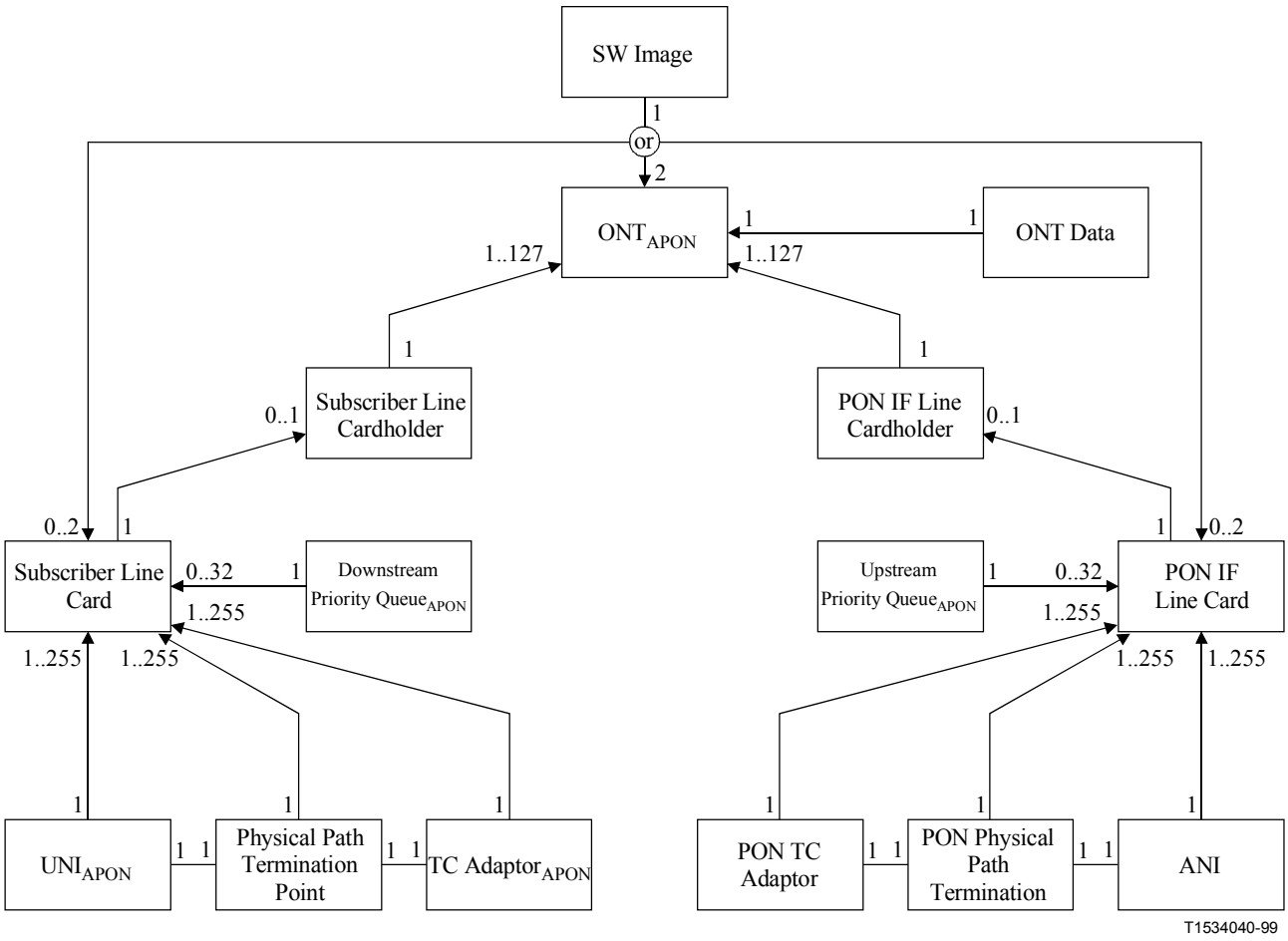


Figure 3/G.983.2 – Managed Entity relation diagram for non-integrated interfaces

The "or" in Figure 3 reflects that one Software Image instance can be contained in one of the following: the ONT, the Subscriber Line Card, or PON IF Line Card.

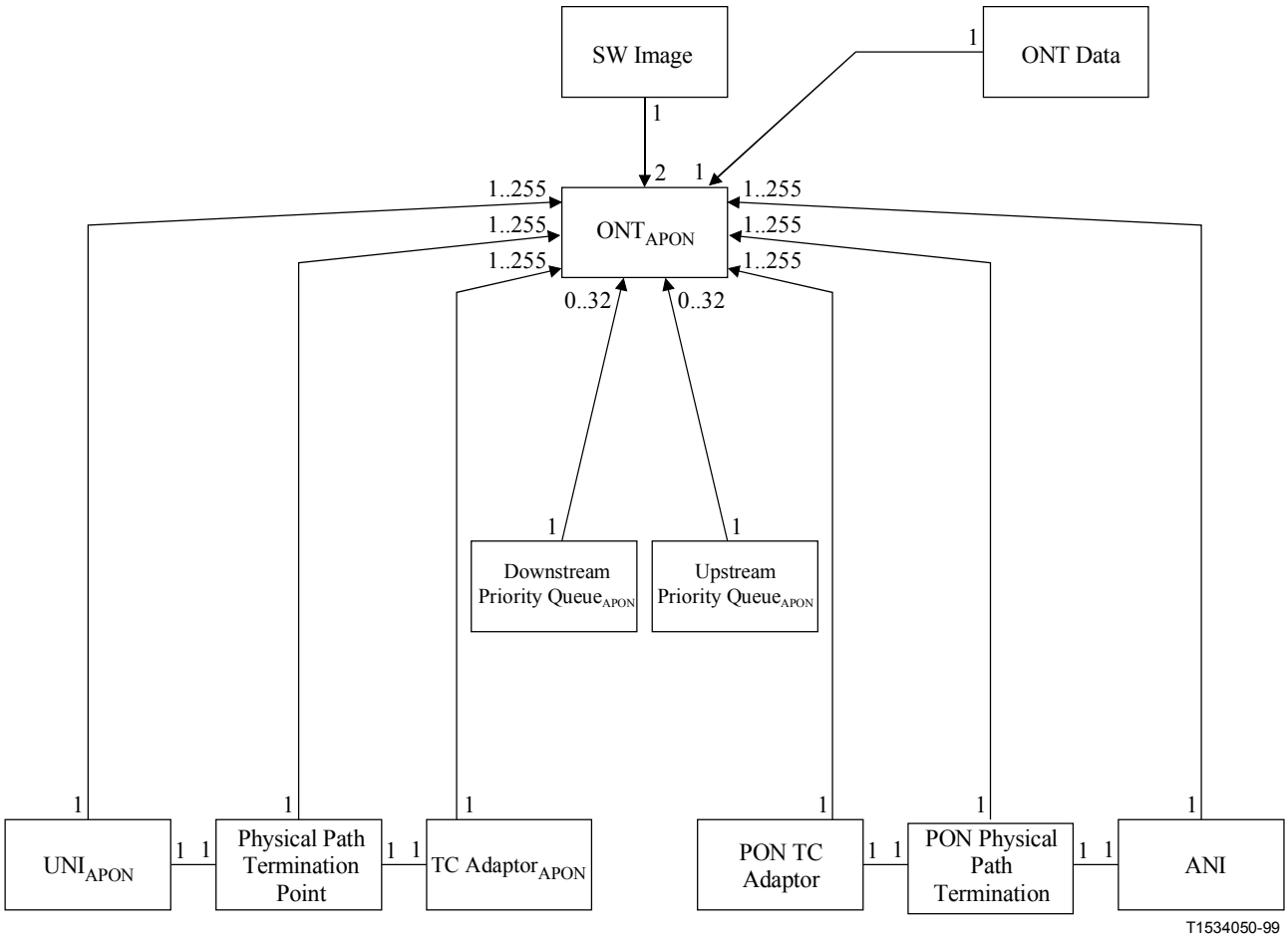


Figure 4/G.983.2 – Managed Entity relation diagram for integrated interfaces

Figure 3 shows an ONT with cardholders on both UNI and ANI side, whereas Figure 4 shows an ONT with integrated interfaces on both UNI and ANI side. Combinations of these figures are possible as well, e.g. an ONT with several Subscriber Line Cardholders on the UNI side and one integrated PON interface.

As for the ATM VP Cross-Connection function, two models are valid to meet the various application requirements. One model is a set of Figures 6 and 8, the other is a set of Figures 7 and 9. Only one of the models needs to be implemented.

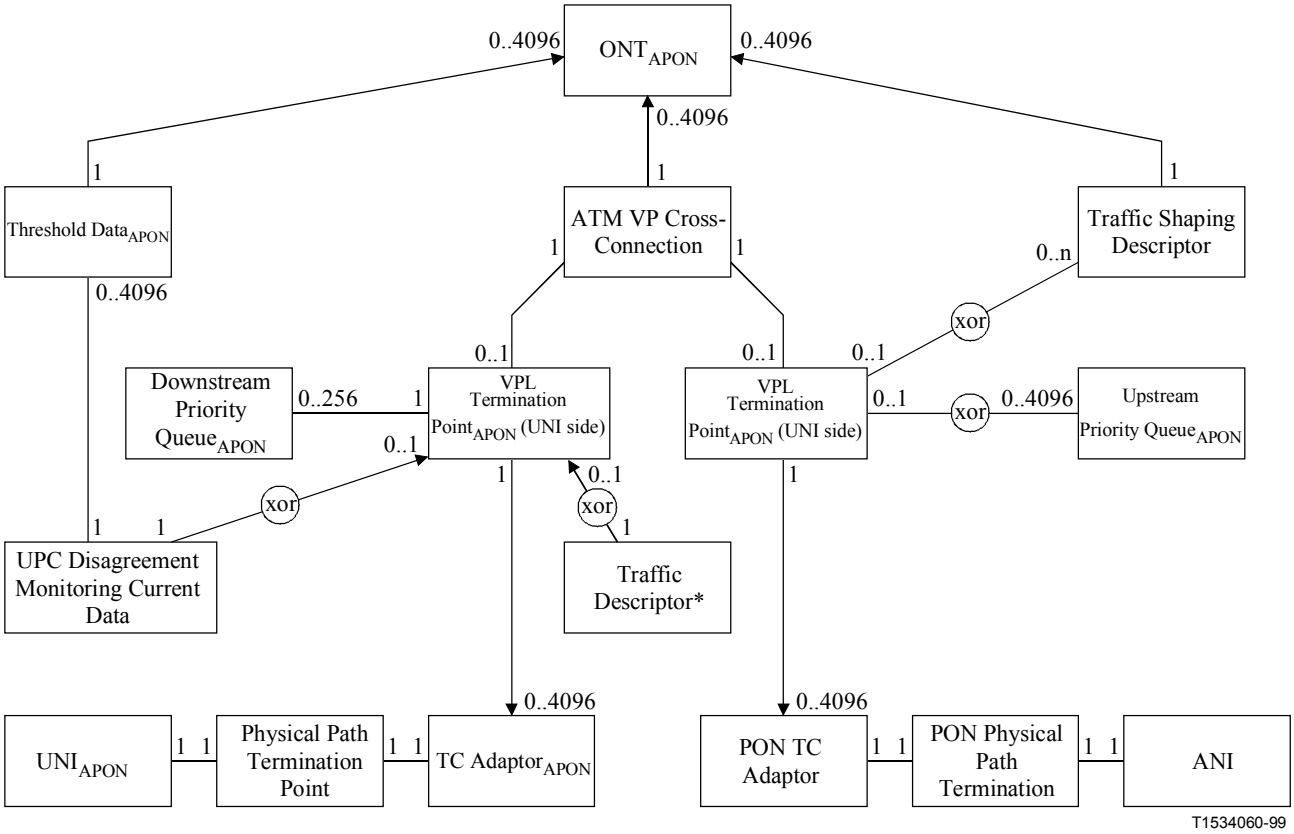


Figure 5/G.983.2 – Managed Entity relation diagram, ATM service

The "*" in Figure 5 indicates the Traffic Descriptor can be one of the specific descriptor managed entity defined in 7.5.2.

The "xor" in Figure 5 reflects the exclusive choice between the use of Upstream Priority Queues and the Traffic Descriptors in combination with UPC Disagreement Monitoring Current Data$_{APON}$ or Traffic Shaping Descriptor (see 7.1.1).

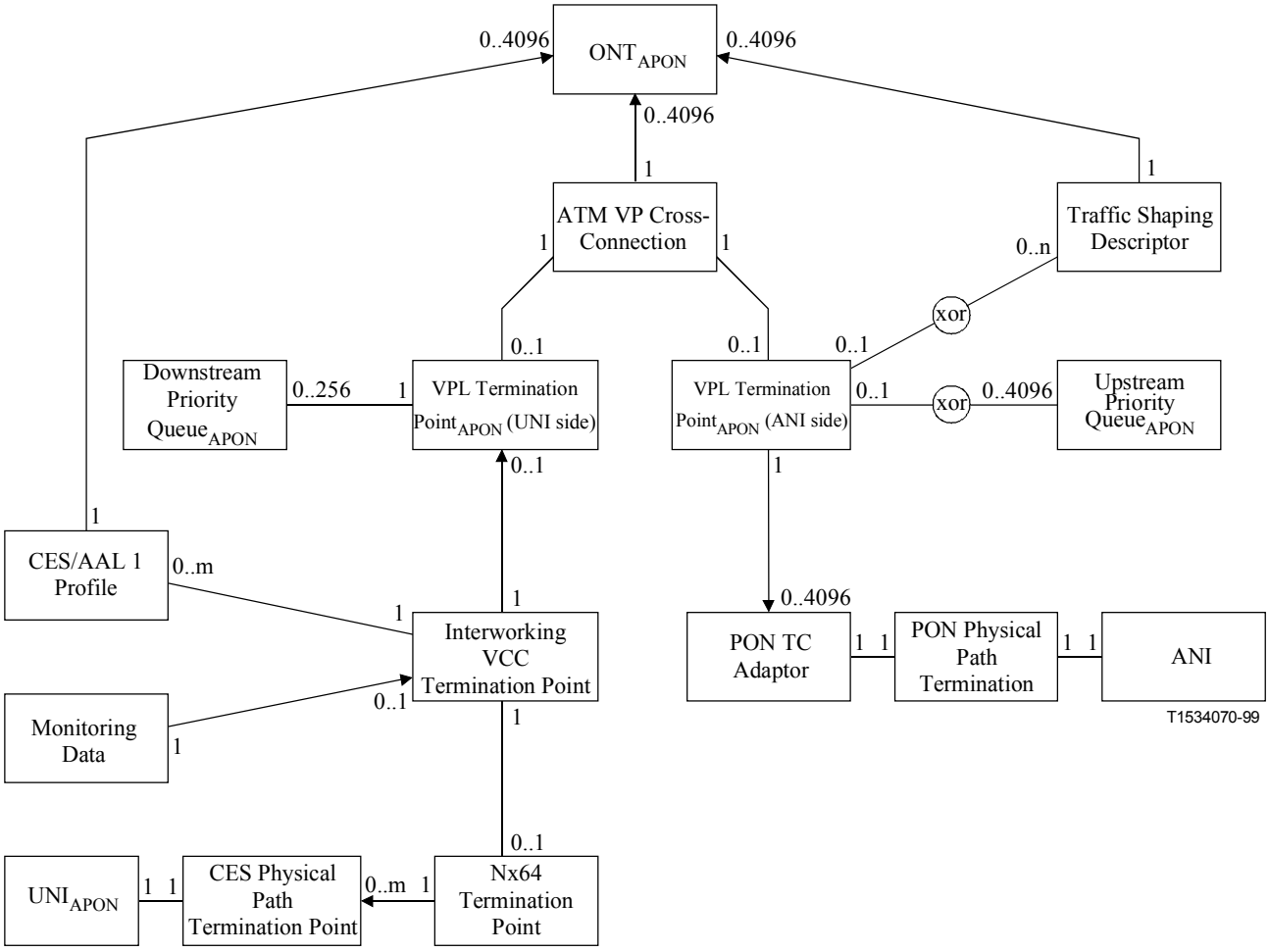


Figure 6/G.983.2 – Managed Entity relation diagram, structured CES service in the ONT that models VP Cross-connect function

The "xor" in Figure 6 reflects the exclusive choice between the use of the Upstream Priority Queues and the Traffic Shaping Descriptor (see 7.1.1).

Note that the value of m equals 31 for CES interworking to E1.

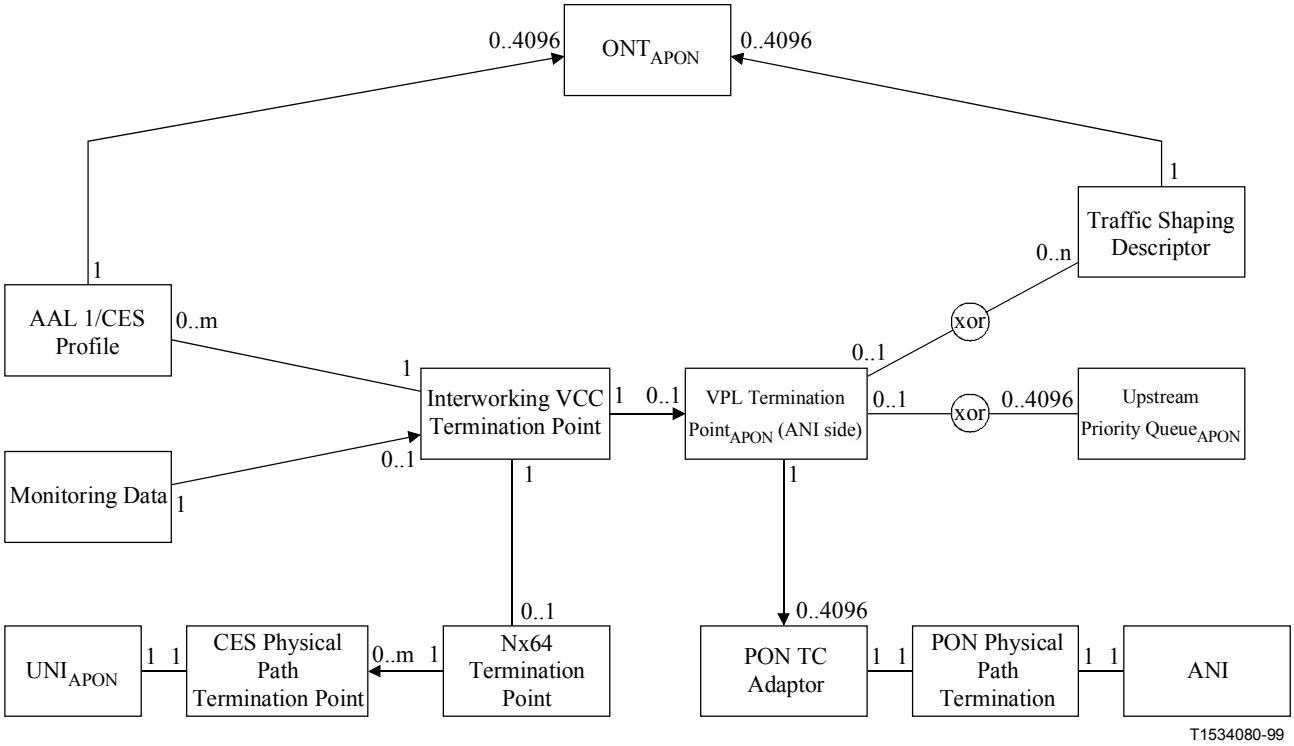


Figure 7/G.983.2 – Managed Entity relation diagram, structured CES service in the ONT that does not model VP Cross-connect function

The "xor" in Figure 7 reflects the exclusive choice between the use of the Upstream Priority Queues and the Traffic Shaping Descriptor (see 7.1.1).

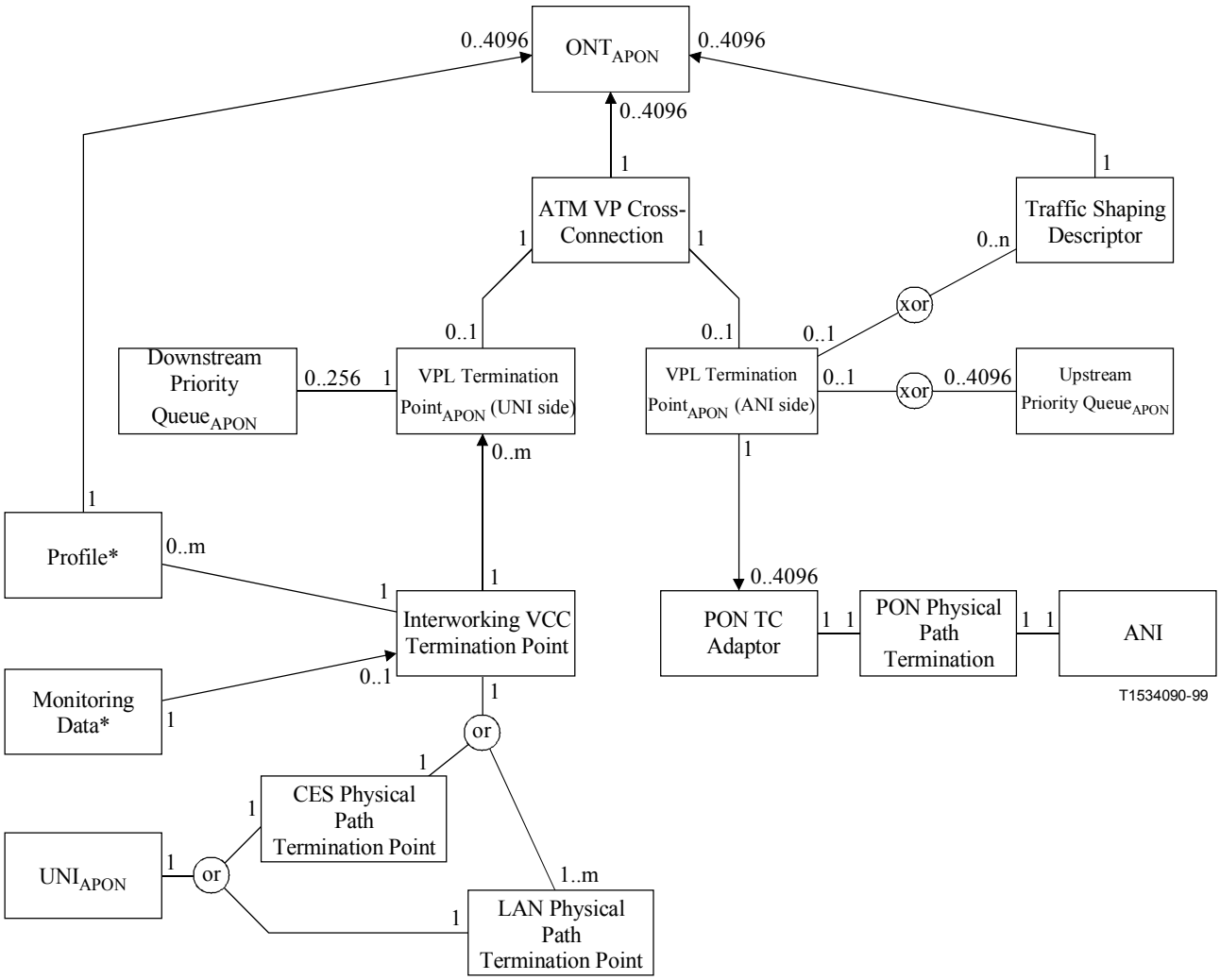


Figure 8/G.983.2 – Managed Entity relation diagram, unstructured CES and LAN service in the ONT that models VP Cross-connect function

The choice of a specific Service Profile and Monitoring Data are service specific. The "*" in Figure 8 indicates that the choice can be one of Service Profile and Monitoring Data defined in clause 7.

The "xor" in Figure 8 reflects the exclusive choice between the use of the Upstream Priority Queues and the Traffic Shaping Descriptor (see 7.1.1).

The "or" in Figure 8 reflects the choice of the associate managed entity based on the type of service (Circuit Emulation Service or a native LAN service).

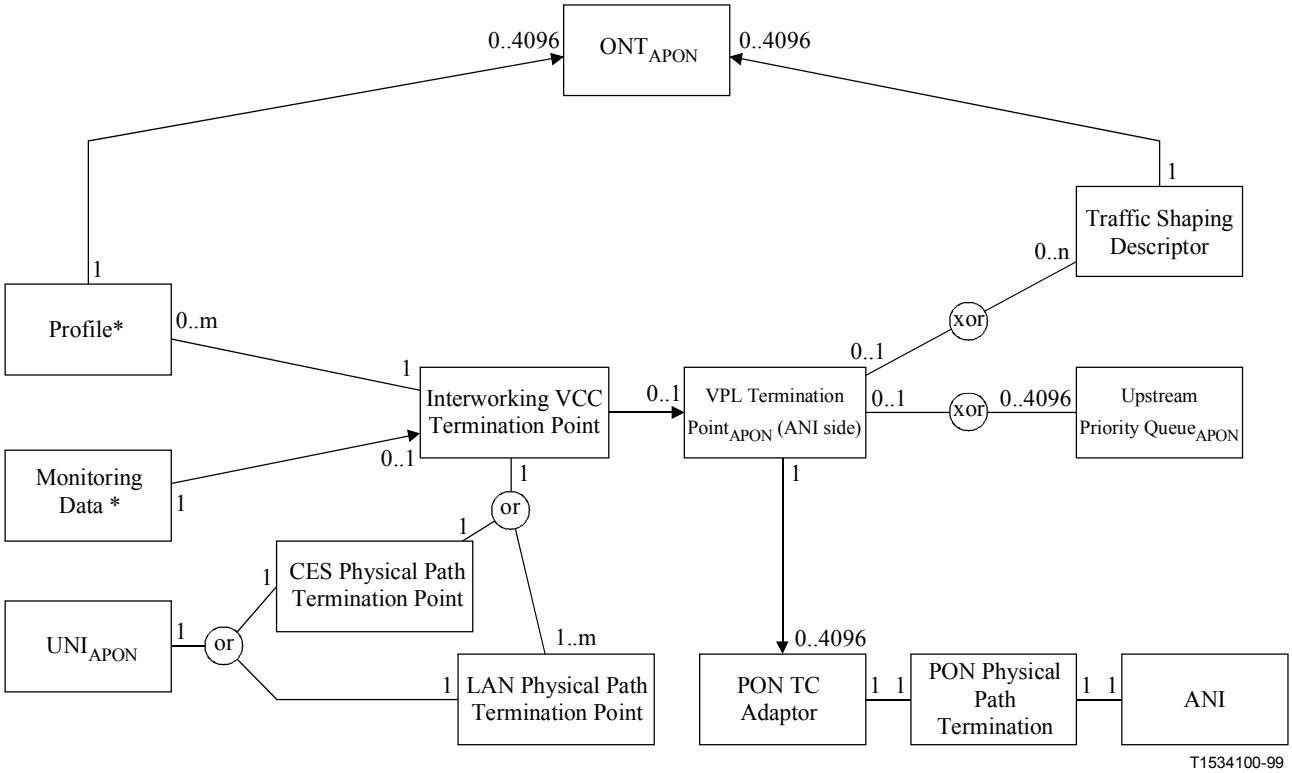


Figure 9/G.983.2 – Managed Entity relation diagram, unstructured CES and LAN service in the ONT that does not model VP Cross-connect function

The choice of a specific Service Profile and Monitoring Data are service specific. The "*" in Figure 9 indicates that the choice can be one of Service Profile and Monitoring Data defined in clause 7.

The "xor" in Figure 9 reflects the exclusive choice between the use of the Upstream Priority Queues and the Traffic Shaping Descriptor (see 7.1.1).

The "or" in Figure 9 reflects the choice of the associate managed entity based on the type of service (Circuit Emulation Service or a native LAN service).

7 MIB Description

A detailed description of all ONT managed entities is provided in the clauses that follow. 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) VP layer 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, which 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.

In all bit vectors indicated in this Recommendation, bit 1 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 which reference to the Boolean values "true" and "false", true will be coded as 0x01 and false will be coded as 0x00.

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

7.1 ONT Equipment Management

7.1.1 ONT_{APON}

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_{APON} 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" shall be 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 ONT is already defined in ITU-T G.983.1 [3] 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 upstream traffic" (0x00): the upstream traffic coming from the user is given a priority.
2) "Cell rate controlled upstream traffic" (0x01): the maximum upstream traffic of each individual connection is guaranteed. For more clarification see Appendix IV.

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 cross-connection function option: This attribute identifies the support of ATM VP Cross-Connection management functions for the interworking connections to non-ATM UNIs. The value is set to 0x00 in case ATM VP Cross-Connection management functions are not modelled. The value is set to 0x01 in case the ATM VP Cross-Connection management functions are modelled. The default value of this attribute is 0x01. (R) (mandatory) (1 byte)

Battery backup: This attribute provides a Boolean indication 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)

Actions

Get: Get one or more attributes.

Set: Set one or more attributes.

Reboot: Reboot the ONT.

Test: Test the ONT (this action is for further study).

Synchronize Time: This action is used to synchronize the start time of all Current Data managed entities of the ONT with a reference time of the OLT. The effect of this action is that all counters of all Current Data managed entities are set to 0x00 and restart counting. Also, the Interval End Time attribute of the Current Data 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 and not after a MIB reset command (optional).

Notifications

Attribute value change: This notification is used to report autonomous change to the attributes of this managed entity. The attribute value change notification shall identify the attribute changed and its new value.

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. The alarm list for this entity is given in Table 2.

Table 2/G.983.2 – Alarms of ONT_{APON}

Coding	Alarm	Description
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
6-255	Reserved	

7.1.2 ONT Data

This managed entity is contained in the ONT managed entity and is used to model the MIB itself. Appendix I.1.2 explains the use of this managed entity in respect to MIB synchronization. Appendix I.1.4 explains the alarm synchronization process, also issued on this managed entity.

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

One instance of this managed entity is contained in the instance of the ONT managed 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)

MIB data sync: This attribute is used to check the alignment of the MIB of the ONT with the corresponding MIB within the OLT. Upon autonomous instantiation, this attribute is set to 0x00. (R, W) (mandatory) (1 byte)

Actions

Get: Get the attribute.

Set: Set the attribute to a specific value.

Get all alarms: Latch a snapshot (i.e. copy) of the current alarm statuses of all managed entities and reset the alarm message counter.

Get all alarms next: Get the latched alarm status of the next managed entity within the current snapshot.

MIB reset: Reset the MIB data sync attributes to 0x00 and reset the MIB of the ONT to its default state. This default MIB consists of one instance of the ONT managed entity, one instance of the ONT Data managed entity, two instances of the Software Image managed entity, zero or more instances of the Subscriber Line Cardholder managed entity, zero or more instances of the PON IF Line Cardholder and zero or more instances of the Priority $Queue_{APON}$ managed entity (for the priority queues that reside in the ONT).

MIB upload: Latch a snapshot (i.e. copy) of the current MIB.

MIB upload next: Get the latched attribute values of the managed entity within the current snapshot.

Notifications

None.

7.1.3 Subscriber Line Cardholder

This managed entity represents the slots of the ONT that are capable of holding Subscriber Line Cards.

An instance of this managed entity shall exist for each slot. Instances of this managed entity are created automatically by the ONT after the ONT initialization. After the creation of this managed entity, the associated attributes are updated according to the data within the ONT itself.

Relationships

An instance of the Subscriber Line Cardholder may contain instances of the Subscriber Line Card managed entity to model the containment of Subscriber 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 could 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 UNI slot id is in the range of 0x01-0x7F (1-127). The integrated Subscriber Line interfaces (i.e. no plug-in UNI cards) can be associated with "pseudo" slot id 0x00. The code 0x01 is used for the left most lower slot of the ONT when looking at the side where the Subscriber Line Cards are plugged in, 0x02 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.

NOTE – Up to 127 slots are supported. (R) (mandatory) (2 bytes)

Actual Plug-in unit Type: This attribute is equal to the type of the LIM in the cardholder or equal to a value of 0x00 (= no LIM) in case the cardholder is empty. This attribute will then be redundant with attribute "Type" of managed entity Subscriber Line Card. (R) (mandatory) (1 byte)

Expected Plug-in unit Type: This attribute identifies which type of plug-in unit is provisioned for the slot. For type coding, see Table 3. The value of 0x00 (no LIM) means that the Subscriber Line Cardholder is not provisioned to contain a LIM. The value of 0xFF (255) means that the Subscriber Line Cardholder is configured for plug-and-play. Upon autonomous instantiation, this attribute is set to 0x00. (R, W) (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 the Actual Plug-in unit type. The attribute value change notification shall identify the attribute changed and its new value.

Alarm: This notification is used to notify the management system that there is something wrong with the provisioned plug-in unit. Both ONT and OLT should know the alarm list (see Table 4) used by this entity. In case of no provisioning (no LIM configured), or in case the SubscriberLine Cardholder has been configured for plug-and-play no alarms are raised. In case the plugInLIMMissingAlarm is active, the plugInTypeMismatchAlarm shall not be raised.

Table 3/G.983.2 – Subscriber Line Card types

Coding	Contents	Description
0	no LIM	Default value
1	A1.5	ATM 1.544 Mbit/s module
2	A2	ATM 2.048 Mbit/s
3	A6.3	ATM 6.312 Mbit/s module
4	A6.3U	ATM 6.312 Mbit/s module, Remote (U-interface)
5	A8	ATM 8.448 Mbit/s
6	A25	ATM 25.6 Mbit/s module
7	A34	ATM 34.368 Mbit/s module
8	A45	ATM 44.736 Mbit/s module
9	A45/34	Configurable ATM 44.736/34.368 Mbit/s module
10	A150SMF SDH	ATM STM-1 SMF UNI
11	A150MMF SDH	ATM STM-1 MMF UNI
12	A150UTP SDH	ATM STM-1 UTP UNI
13	C1.5 (DS1)	1.544 Mbit/s Local (T-interface) AAL 1 module
14	C2.0 (E1)	2.048 Mbit/s Local (T-interface) AAL 1 module
15	C6.3 (J2)	6.312 Mbit/s Local (T-interface) AAL 1 module
16	C-DS1/E1	Configurable DS1/E1 AAL 1 module
17	C-DS1/E1/J1	Configurable DS1/E1/J1 AAL 1 module
18	C6.3U (J2)	6.312 Mbit/s Remote (U-interface) AAL 1 module
19	C192k	192 kbit/s Local (T-interface) AAL 1 module
20	C44.7 (DS3)	44.736 Mbit/s Local (T-interface) AAL 1 module
21	C34.3 (E3)	34.368 Mbit/s Local (T-interface) AAL 1 module
22	10Base-T	10 Base-T Ethernet LAN IF
23	100Base-T	100 BaseT Ethernet LAN IF
24	10/100Base-T	10/100 Base-Tx Ethernet LAN IF
25	Token Ring	Token Ring LAN IF
26	FDDI	FDDI LAN IF
27	FR	Frame relay
28	C1.5 (J1)	1.544 Mbit/s Local (T-interface) AAL 1 module
29	A150SMF SONET	ATM OC-3 SMF UNI
30	A150MMF SONET	ATM OC-3 MMF UNI
31	A150UTP SONET	ATM OC-3 UTP UNI
32..252	Reserved	
253	PON155	Symmetric 155/155 Mbit/s PON IF
254	PON622	Asymmetric 155/622 Mbit/s PON IF
255	Plug-and-play/Unknown	Plug-and-play (for the Subscriber Line Cardholder managed entity only) Unrecognized module (for the Subscriber Line Card managed entity only)

Table 4/G.983.2 – Alarms of Subscriber Line Cardholder

Coding	Alarm	Description
0	PlugInLimMissingAlarm	Configured Plug-in LIM is not present
1	PlugInTypeMismatchAlarm	Inserted Plug-in LIM is wrong type
2-255	Reserved	

Figure 10 shows a state diagram of the various behaviours of inserting/removing a particular Subscriber Line Card into/from a Subscriber Line Cardholder that is provisioned to a specific type or to plug-and-play.

In the figure, state S3' is conceptual identical to state S3 except in the behaviour when entering or leaving this state upon provisioning or de-provisioning.

In order to avoid the cluttered picture, the following state transitions – although possible – are not shown in the figure: from S3 to S9 on provisioning of plug-and-play mode, from S3' to S8 on provisioning of plug-and-play mode, from S9 to S3 on de-provisioning of plug and play-mode, and from S8 to S3' on de-provisioning of plug-and-play mode.

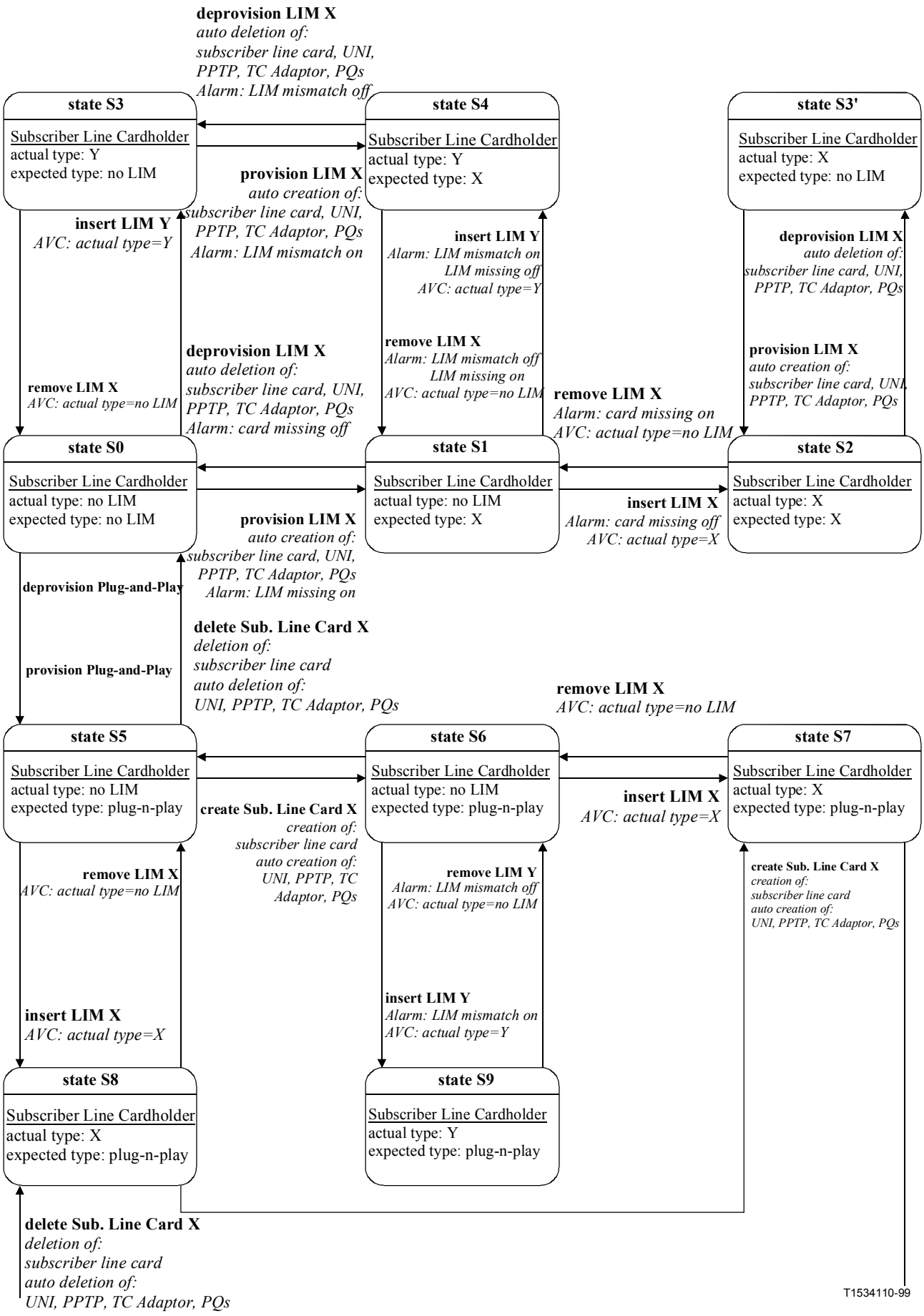


Figure 10/G.983.2 – Subscriber Line Cardholder state diagram

7.1.4 Subscriber Line Card

This managed entity is used to represent the Subscriber line card that is provisioned in an ONT slot. An instance of this managed entity shall be automatically created by the ONT when the OLT has provisioned the subscriber line card (i.e. when the OLT has set attribute "Expected Plug-in Unit Type" of the Subscriber line Card Holder to a specific LIM type). See 7.1.3. Moreover, an instance of this managed entity can also be created by the ONT on request of the OLT if the attribute "Expected Plug-in Unit Type" of the corresponding Subscriber line Card Holder is equal to the value 0xFF (255) which corresponds to "plug-and-play".

An instance of this managed entity shall be deleted by the ONT when the OLT has de-provisioned the subscriber line card (i.e. when the OLT has set attribute "Expected Plug-in Unit Type" of the Subscriber line Card Holder to 0x00, i.e. "no LIM"). Moreover, an instance of this managed entity can also be deleted by the ONT on request of the OLT if the attribute "Expected Plug-in Unit Type" of the corresponding Subscriber line Card Holder is equal to the value 0xFF, i.e. "plug-and-play".

Relationships

One instance of this managed entity is contained by an instance of the Subscriber 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 Subscriber Line Cardholder managed entity instance containing this Subscriber Line Card instance. (R, Set-by-create (if applicable)) (mandatory) (2 bytes)

Type: This attribute identifies the Subscriber Line Card type. This attribute is a unique code as defined in Table 3. The value of 0xFF (255) means "unknown", i.e. the inserted Subscriber Line Card cannot be recognized by the ONT. In this case, the attributes Serial Number, Version and Vendor id do not contain valid information. Upon autonomous instantiation, this attribute is set to 0x00. (R, Set-by-create (if applicable)) (mandatory) (1 byte)

Number of ports: This attribute gives the quantity of access ports on the Subscriber Line Card. Upon instantiation, this attribute is set equal to 0x01. (R) (optional) (1 byte)

Serial Number: The serial number is unique for each Subscriber Line Card. Note that the serial number may contain the vendor id and/or version number. Upon instantiation, this attribute consists of all spaces. (R) (mandatory) (8 bytes)

Version: This attribute identifies the version of the Subscriber Line Card as defined by the vendor. A value of 0x00 shall be 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)

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

Administrative State: This attribute is used to "unlock" (value 0x00) and "lock" (value 0x01) the functions performed by the Subscriber Line Card. When the administrative state is set to "lock", all user traffic to and from this Subscriber Line Card is blocked and alarms for this Subscriber Line Card and all associated managed entities are no longer generated. Upon autonomous instantiation, this attribute is set to 0x01. (R, W, set-by-Create (if applicable)) (mandatory) (1 byte)

Actions

Create: Create an instance of this managed entity (optional, only when plug-and-play is supported).

Delete: Delete an instance of this managed entity (optional, only when plug-and-play is supported).

Get: Get one or more attributes.

Set: Set one or more attributes.

Reboot: Reboot the Subscriber Line Card.

Test: Test the Subscriber Line Card (this action is optional).

Notifications

Attribute value change: This notification is used to report autonomous changes of attributes of this managed entity. The notification shall identify its new value.

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 5.

Table 5/G.983.2 – Alarms of Subscriber Line Card

Coding	Alarm	Description
0	EquipmentAlarm	A failure on an internal interface or failed self test
1	PoweringAlarm	LIM fuse failure or failure of LIM DC/DC converter
2-255	Reserved	

7.1.5 PON IF Line Cardholder

This managed entity represents slots of the ONT that are capable of holding network card on ANI side. An instance of this managed entity shall exist for each slot. Instances of this managed entity are created automatically by the ONT that supports PON IF plug-in after the ONT initialization. (For integrated PON interfaces, no instances of this managed entity will be created.)

NOTE 1 – This definition merely provides a placeholder to facilitate equipment management of removable PON IF line cards, however full details of redundant PON IF operation have not yet been fully defined and are for further study.

Relationships

An instance of the PON IF Line Cardholder may contain instances 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 is in the range of 0x81-0xFF (129-255). The integrated PON IF (i.e. no plug-in PON IF cards) can be associated with "pseudo" slot id 0x80 (128). The code 0x81 (129) is used for the left most 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.

NOTE 2 – Only up to 127 slots are supported. (R) (mandatory) (2 bytes)

Actions

Get: Get one or more attributes.

Notifications

None.

7.1.6 PON IF Line Card

This managed entity is used to model a field replaceable PON IF Line Card contained within an ONT.

An instance of this managed entity shall be automatically created by the ONT.

NOTE – This definition merely provides a placeholder to facilitate equipment management of removable PON IF line cards, however full details of redundant PON IF operation have not yet been fully defined and are for further study.

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)

Actions

Get: Get one or more attributes.

Set: Set one or more attributes.

Reboot: Reboot the PON IF Line Card.

Test: Test the PON IF Line Card (this action is optional and for further study).

Notifications

Attribute Value Change: This notification is used to report autonomous changes to the attributes of this managed entity. The notification shall identify the attribute that changed and its new value.

Alarm: Alarms on PON IF are also transmitted to the OLT by PLOAM messages (see ITU-T G.983.1 [3]). Alarms for redundant PON IF are for further study.

7.1.7 Software Image

This managed entity represents a program stored in the ONT.

Two instances of this managed entity shall be automatically created by the ONT after the creation of ONT managed entity (mandatory) and each Subscriber Line Card entity (optional). It is used to report to the management system the software currently installed in non-volatile memory. After the creation of the instances of this managed entity, the associated attributes are updated according to the data within the ONT and Subscriber Line Cards.

Relationships

Two instances of this managed entity are contained in an instance of the ONT and Subscriber Line Card managed entities.

Attributes

Managed Entity id: This attribute provides a unique number for each instance of this managed entity. The number consists of a two-byte field. The first field (MSB) identifies the ME instance (ONT (value 0x00) or removable Subscriber/PON IF Line Card (value 0x01-0x7F/0x81-0xFF) containing the associated Software Image ME. The second field (LSB) distinguishes between the two (redundant) Software Image ME instances (values 0x00 and 0x01). (R) (mandatory) (2 bytes)

Version: This attribute identifies the version of the software. Upon autonomous instantiation this attribute consists of all spaces. (R) (mandatory) (14 bytes)

Is committed: This attribute indicates whether the associated software image is "committed" (value 0x01) or "uncommitted" (value 0x00). By definition, the "committed" software image will be loaded and executed upon a reboot of the ONT and/or associated removable Subscriber/PON IF Line Card ME. During normal operation, one software image will always be "committed" while the other is "uncommitted". Under no circumstances, both software images are allowed to be "committed" at the same time. On the other hand, both software images are only allowed to be non-committed at the same time if both are invalid. Upon autonomous instantiation, this attribute of instance 0 shall be initialized to "committed" and this attribute of instance 1 shall be initialized to "uncommitted". (R) (mandatory) (1 byte)

Is active: This attribute indicates whether the associated software image is "active" (value 0x01) or "inactive" (value 0x00). By definition, the active software image is one that is currently loaded and executing in the ONT (or associated Subscriber/PON IF Line Card). Under normal operation, one software image will always be "active" while the other is "inactive". Under no circumstances, both software images are allowed to be "active" at the same time. On the other hand, both software images are only allowed to be inactive at the same time if both are invalid. Upon autonomous instantiation, this attribute of instance 0 shall be initialized to "active" and this attribute of instance 1 shall be initialized to "inactive". (R) (mandatory) (1 byte)

Is valid: This attribute indicates whether the associated software image is "valid" (value 0x01) or "invalid" (value 0x00). By definition, a software image is "valid" if it has been verified to be an executable code image. The verification mechanism is not subject to standardization, however at a minimum it must include a data integrity (CRC) check of the entire code image. Upon autonomous instantiation, the associated code image is verified and this attribute is set according to the result of this verification. (R) (mandatory) (1 byte)

Actions

Get: Get one or more attributes.

Start Download: Initiate a software download sequence to the alternate (i.e. currently inactive) software image. This action is only valid for a software image that is currently inactive and is not committed (i.e. is not selected as the bootable image). (optional)

Download Section: Download a section of a software image. This action is only valid for a software image that is currently being downloaded (image 1 in state S2/image 0 in state S2'). (optional)

End Download: Signal the completion of a download sequence, providing both the valid CRC and version information for a final verification of an associated downloaded software image. This action is only valid for a software image that is currently being downloaded (image 1 in state S2/image 0 in state S2'). (optional)

Activate Image: Load/execute a valid software image. When this action is applied to a software image that is currently inactive, execution of the current code image is suspended; the associated software image is loaded from non-volatile memory; and execution of this new code image is initiated. When this action is applied to a software image that is already active, a soft restart is performed (i.e. the software image is not reloaded from non-volatile memory, execution of the current volatile code image is simply restarted). This action is only valid for a valid software image. (optional)

Commit Image: Selects a valid software image to be the default image to be loaded and executed by the boot code upon start-up (i.e. sets the Is_committed attribute value to 0x01 for the associated Software Image ME and sets the Is_committed attribute value to 0x00 for the other Software Image ME). This action is only valid for a valid software image. (optional)

In Figure 11, a state diagram is given, showing an example of the "life cycle" of software images under the actions given above. State S0 is a conceptual initialization state for when neither software images are valid (i.e. executable). During S0, the OMCC is not functional.

Notifications

Attribute value change:	This notification is used to report autonomous changes of attributes of this managed entity. The notification shall identify its new value.

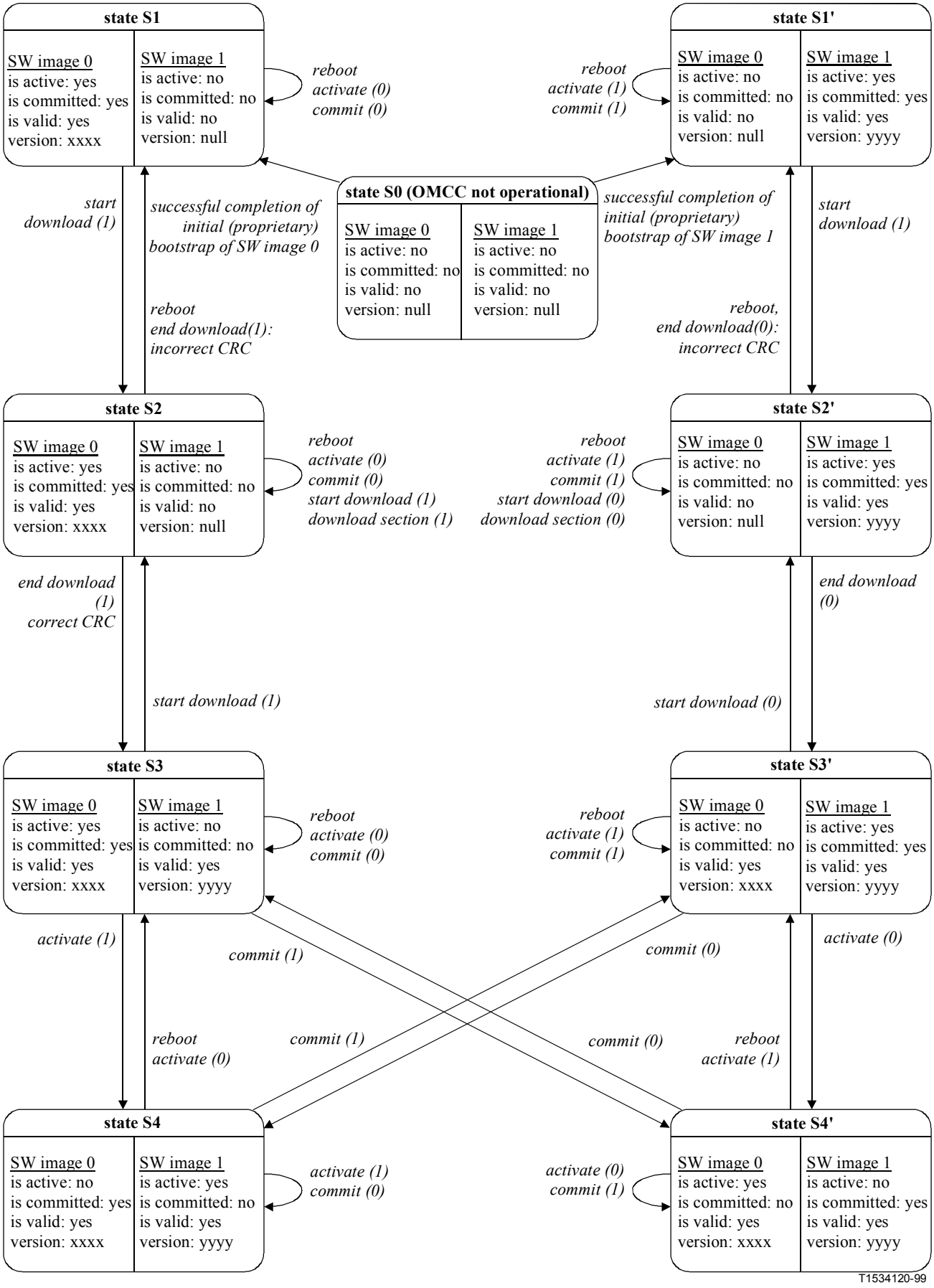


Figure 11/G.983.2 – Software Image State diagram

7.2 ANI Management

The OMCI will not maintain the PON interface information. OLT will maintain the PON interface related managed entities, and will get all the ONT related information needed for those managed entities via PLOAM cells (e.g. Transmit Failure) as specified in ITU-T G.983.1 [3]. However, for the purpose of description, the ONT will autonomously create one instance of each of the managed entities "PON Physical Path Termination Point", "ANI" and "PON TC Adapter" upon creation of the ONT managed entity. Additionally these managed entities will not have any attributes (except for the Managed Entity id), nor have any actions or notifications associated with them, and will not be uploaded in the MIB upload.

7.2.1 PON Physical Path Termination Point

An instance of this managed entity represents a point in the ONT where a PON Physical Path terminates and physical path level functions (e.g. path overhead functions) are performed.

An instance of this managed entity is automatically created by the ONT after initialization. However, this instance will not be reported during a MIB upload.

Relationships

One or more instances of this managed entity are contained in an instance of the ONT or PON IF Line Card managed entities.

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 first byte is the slot id (defined in 7.1.5). If the PON IF is integrated, this value is 0x80 (128). The second byte is the port id with value range from 0x01 to 0xFF (1 to 255), 0x01 is used for the leftmost/lowest port on a PON IF Line Card, 0x02 is used for the next right/upper port, and so forth. (R) (mandatory) (2 bytes)

Actions

None.

Notifications

None.

7.2.2 ANI

This managed entity is used to organize data associated with the Access Network Interface (ANI) supported by the ONT. One instance of this managed entity shall exist for each ONT.

An instance of this managed entity is automatically created by the ONT after initialization. However, this instance will not be reported during an MIB upload.

Relationships

One or more instances of this managed entity are contained in an instance of the ONT or PON IF Line Card managed entities.

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)

Actions

None.

Notifications

None.

7.2.3 PON TC Adapter

An instance of this managed entity represents a point in the ONT where the adaptation of the ATM Layer to the underlying physical infrastructure (i.e. the PON) takes place. One instance of this managed entity shall exist for each ONT.

An instance of this managed entity is automatically created by the ONT after initialization. However, this instance will not be reported during an MIB upload.

Relationships

One or more instances of this managed entity will exist for the PON Physical Path Termination Point.

Attributes

Managed Entity id: This attribute provides an unique number for each instance of this managed entity. The assigned number is the same as the id of the PON Physical Path Termination Point with which this PON TC Adapter is associated. (R) (mandatory) (2 bytes)

Actions

None.

Notifications

None.

7.3 UNI Management

7.3.1 Physical Path Termination Point ATM UNI

This managed entity represents the point at an ATM UNI in the ONT where physical paths terminates and physical path level functions (e.g. path overhead functions) are performed.

An instance of this managed entity shall be automatically created/deleted by the ONT upon the creation/deletion of a Subscriber Line Card of ATM type.

Relationships

One or more instances of this managed entity shall be contained in an instance of the ONT or the Subscriber Line Card managed entity with ATM type.

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 first byte is the slot id (defined in 7.1.3). If the UNI is integrated, this value is 0x00. The second byte is the port id with value range from 0x01 to 0xFF (1 to 255), 0x01 is used for the leftmost/lowest port on a Subscriber Line Card, 0x02 is used for the next right/upper port, and so forth. (R) (mandatory) (2 bytes)

Expected type: With the following coding: 0x00 = by autosensing, 0x01 to 0xFE (1 to 254) = one of the values from Table 3 that are compatible with the type of the LIM. Upon autonomous instantiation, the value 0x00 is used. (R, W) (mandatory) (1 byte)

Sensed type: If the value of "Expected type" is not equal to 0x00, then the value of "Sensed type" equals the value of "Expected type". If the value of "Expected type" equals 0x00, then the value of "Sensed type" equals one of the values from Table 3 (0x01 to 0xFE), and by necessity compatible with the Type of Subscriber Line Card managed entity. Upon autonomous instantiation, the value 0x00 is used. (R) (mandatory for the case of ONT supports LIMs with configurable interface types, e.g. ATM45/34) (1 byte)

Cable configuration: For ATM45 interface, there are two options for the cable length. This attribute is used to select the option. Value 0x00: cable length ≤ 68.6 m; value 0x01 cable length > 68.6 m. (R, W) (mandatory for interfaces with cable configuration options) (1 byte)

Loopback Configuration: This attribute represents the loopback configuration of this physical interface. Value 0x00: no loopback; value 0x01: loopback2; value 0x02: other loopback. Upon autonomous instantiation, the value 0x00 is used. (R, W) (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 shall identify its new value.

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 below. The SDH and SONET interface related alarm should be consistent with the existing standards.

Table 6/G.983.2 – Alarms of Physical Path Termination Point

Coding	Alarm	Description
0	TF	Transmitter failure
1	LOS	Loss of signal
2	LOF	Loss of frame
3	OOF	Out of frame
4	RAI	Remote alarm indication
5	ERR	Block error
6	OOF (PLCP)	Out of frame (physical layer convergence protocol)
7	RAI (PLCP)	Remote alarm indication (physical layer convergence protocol)
8	ERR (PLCP)	Block error (physical layer convergence protocol)
9	REI (PLCP)	Remote error indication (physical layer convergence protocol)
10	MS-SD	Multiplex section – signal degraded
11	MS-RDI	Multiplex section – remote defect indication
12	MS-ERR	Multiplex section – block error
13	MS-REI	Multiplex section – remote error indication
14	MS-AIS	Multiplex section – alarm indication signal
15	P-RDI	Path – remote defect indication
16	P-ERR	Path – block error
17	P-REI	Path – remote error indication
18	P-AIS	Path-alarm indication signal
19	LOP	Loss of pointer in the VC4
20	1.5M REC	1.544 Mbit/s receive alarm
21	1.5 AIS	1.544 Mbit/s alarm indication signal
22	1.5 M BAIS	1.544 Mbit/s back alarm indication signal
23	6M REC	6.312 Mbit/s receive alarm
24	6M SEND	6.312 Mbit/s send alarm
25	6M ERR	6.312 Mbit/s block error
26	2M RDI	2.048 Mbit/s remote defect indication
27	2M E-ERR	2.048 Mbit/s CRC-4 error indication
28	2M AIS	2.048 Mbit/s alarm indication signal
29	8M RDI	8.448 Mbit/s remote defect indication
30	8M AIS	8.448 Mbit/s alarm indication signal
31	34M RDI	34.368 Mbit/s remote defect indication
32	34M AIS	34.368 Mbit/s alarm indication signal
33	34M FEBE	34.368 Mbit/s far end block error
34	45M RDI	44.736 Mbit/s remote defect indication
35	45M AIS	44.736 Mbit/s alarm indication signal
36	45 IDOL	44.736 Mbit/s idol
37-255	Reserved	

7.3.2 Physical Path Termination Point Native LAN UNI

This managed entity represents the points at Native LAN UNI in the ONT where physical paths terminate and physical path level functions (e.g. Ethernet function) are performed.

An instance of this managed entity shall be automatically created/deleted by the ONT upon the creation/deletion of a Subscriber Line Card with Ethernet type.

Relationships

One or more instances of this managed entity shall be contained in an instance of the ONT or Subscriber Line Card managed entity classified as a native LAN type (e.g. Ethernet).

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 first byte is the slot id (defined in 7.1.3). If the UNI is integrated, this value is 0x00. The second byte is the port id with value range from 0x01 to 0xFF (1 to 255), 0x01 is used for the leftmost/lowest port on a Subscriber Line Card, 0x02 is used for the next right/upper port, and so forth. (R) (mandatory) (2 bytes)

Expected type: With the following coding: 0x00 = by autosensing, 0x01 to 0xFE (1 to 254) equals one of the values from Table 3 that are compatible with the type of the LIM. Upon autonomous instantiation, the value 0x00 is used. (R, W) (mandatory) (1 byte)

Sensed type: If the value of "Expected type" is not equal to 0x00, then the value of "Sensed type" equals the value of "Expected type". If the value of "Expected type" equals 0x00, then the value of "Sensed type" = one of the values from Table 3 and by necessity compatible with the Type of Subscriber Line Card managed entity. Upon autonomous instantiation, the value 0x00 is used. (R) (mandatory for the case of ONT supports LIMs with configurable interface types, e.g. 10/100 BaseT card) (1 byte)

Auto Detection Configuration: For 10/100 Base-Tx Ethernet interface this attribute is used to set the configuration options: Auto-sensing: 0x00; 10BaseT only 0x01; 100BaseT only 0x02. (R, W) (mandatory for interfaces with auto detection options) (1 byte)

Ethernet loopback configuration: This attribute is used to set Ethernet loopback configuration: No loopback (value 0x00), Loop1 (value 0x01, Loopback of downstream traffic before FEC), Loop2 (value 0x02, Loopback of downstream traffic after FEC), Loop3 (value 0x03, Loopback of downstream traffic after PHY transceiver). Upon autonomous instantiation, the value 0x00 is used. (R, W) (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 shall identify its new value.

7.3.3 Physical Path Termination Point Circuit Emulation Service UNI

This managed entity represents the points at CES UNI in the ONT where physical paths terminate and physical path level functions are performed.

An instance of this managed entity shall be automatically created/deleted by the ONT upon the creation/deletion of a Subscriber Line Card with CES type.

Relationships

One or more instances of this managed entity shall be contained in an instance of the ONT or Subscriber Line Card managed entity classified as CES type.

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 first byte is the slot id (defined in 7.1.3). If the UNI is integrated, this value is 0x00. The second byte is the port id with value range from 0x01 to 0xFF (1 to 255), 0x01 is used for the leftmost/lowest port on a Subscriber Line Card, 0x02 is used for the next right/upper port, and so forth. (R) (mandatory) (2 bytes)

Expected type: With the following coding: 0x00 = by autosensing, 0x01 to 0xFE (1 to 254) equals one of the values from Table 3 that are compatible with the type of the LIM. Upon autonomous instantiation, the value 0x00 is used. (R, W) (mandatory) (1 byte)

Sensed type: If the value of "Expected type" is not equal to 0x00, then the value of "Sensed type" equals the value of "Expected type". If the value of "Expected type" equals 0x00, then the value of "Sensed type" = one of the values from Table 3 and by necessity compatible with the Type of Subscriber Line Card managed entity. Upon autonomous instantiation, the value 0x00 is used. (R) (mandatory for the case of ONT supports LIMs with configurable interface types, e.g. C1.5/2/6.3) (1 byte)

CES loopback configuration: This attribute represents the loopback configuration of the physical interface. Value 0x00: no loopback; value 0x01: payload loopback; value 0x02 line loopback; value 0x03 other loopback. Upon autonomous instantiation, the value 0x00 is used. (R, W) (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 shall identify its new value.

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 7. These alarms should be consistent with the existing standards.

Table 7/G.983.2 – Alarm table of CES UNI Physical Path Termination Point

Coding	Alarm	Description
0	TF	Transmitter failure
1	LOS	Loss of signal
2	LOF	Loss of frame
3	OOF	Out of frame
4	RAI	Remote alarm indication
5	1.5 M BAIS	1.544 Mbit/s back alarm indication signal
6	R-INH	Receive alarm – inhibit
7	6M REC	6.312 Mbit/s receive alarm
8	6M SEND	6.312 Mbit/s send alarm
9	6M ERR	6.312 Mbit/s block error
10	6M BERR	6.312 Mbit/s back error
11	34M REC	34.368 Mbit/s receive alarm
12	34M AIS	34.368 Mbit/s alarm indication signal
13	2M REC	2.048 Mbit/s receive alarm
14	2M AIS	2.048 Mbit/s alarm indication signal
15	1.5M REC	1.544 Mbit/s receive alarm
16	1.5 AIS	1.544 Mbit/s alarm indication signal
17	INFO0	INFO0 reception (INFO0)
18	45M RDI	44.736 Mbit/s remote defect indication
19	45M AIS	44.736 Mbit/s alarm indication signal
20-255	Reserved	

7.3.4 Logical Nx64kbit/s Sub-port Termination Point

This managed entity is used to generically model *logical* sub-ports contained within a higher level physical layer interface (e.g. DS0s within a DS1, DS1s within a DS3, etc.). A single instance of this managed entity can represent an arbitrary (i.e. consecutive or non-consecutive) group of multiple channels/time slots (e.g. multiple DS0/DS1) at the user side as an integral bundle.

An instance of this managed entity shall be created by the OLT before the creation of an associated Interworking VCC Termination Pointer (see 7.3.7 Interworking VCC Termination Point).

Relationships

Zero or more instances of this ME shall be contained in an instance of the Physical Path Termination Point Circuit Emulation Service UNI.

Attributes

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

Physical Path Termination Pointer: This attribute provides a pointer to the instance of the corresponding Physical Path Termination Point Circuit Emulation Service UNI managed entity id. (R, Set-by-create) (mandatory) (2 bytes)

List of Time Slots: Bitmap, which indicates the time slots. Each bit indicates whether the corresponding time slot is included in the connection or not. The correspondence is as indicated in Table 8. (R, Set-by-create) (mandatory) (12 bytes)

Table 8/G.983.2 – Coding List of Time Slots

Byte	Bit							
	8	**7**	**6**	**5**	**4**	**3**	**2**	**1**
1	TS 0	TS 1	TS 2	TS 3	TS 4	TS 5	TS 6	TS 7
2	TS 8	TS 9	TS 10	TS 11	TS 12	TS 13	TS 14	TS 15
...								
12	TS 88	TS 89	TS 90	TS 91	TS 92	TS 93	TS 94	TS 95

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.

7.3.5 UNI_{APON}

This managed entity is used to organize data associated with the ATM User Network Interfaces (UNIs) supported by the ONT. For non-ATM UNIs this is used as a logical ATM UNI. One instance of this managed entity shall exist for each UNI supported by the ONT.

Instances of this managed entity shall be automatically created/deleted by the ONT immediately following the creation/deletion of a Subscriber Line Card. 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).

Relationships

Zero or more instances of the UNI_{APON} managed entity may be contained in an instance of the ONT or Subscriber Line Card managed entity.

Attributes

Managed Entity id: This attribute provides an 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)

Local Maximum Number of Supportable VPCs: This attribute identifies the number of VPCs that can be supported by the ONT at this end of the interface. Default is 0x0100 (256). (R) (mandatory) (2 bytes)

Local Maximum Number of Allocated VPI Bits: This attribute identifies the maximum number of allocated bits of the VPI sub-field that can be supported by the ONT at this UNI. Default is 0x08. (R) (mandatory) (1 byte)

Loopback Location Code: This attribute provides the code that identifies incoming ATM layer OAM loopback cells that are to be looped-back at this UNI (see also Appendix III). The default of this attribute consists of all 0xFFs. (R, W) (mandatory) (16 bytes)

Configuration Option Status: This attribute holds the UNI Configuration Code field. Its bits are assigned as described in Table 9. (R, W) (mandatory) (2 bytes)

Table 9/G.983.2 – Coding of the Configuration Option Status attribute

Bit	Name	Setting
1	ServerTrailFaultPropagation ATM layer	0: Upstream VP-AIS generation in the ATM cell flow is deactivated 1: Upstream VP-AIS generation in the ATM cell flow is activated
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 AAL layer	0: All AAL layer alarm reporting through the OMCC is inhibited 1: All AAL 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

Attribute value change: This notification is used to report autonomous changes of attributes of this managed entity. The notification shall identify its new value.

7.3.6 TC Adapter$_{APON}$

An instance of this managed entity represents a point in the ATM Subscriber Line Card where the adaptation of the ATM Layer to the underlying physical infrastructure (e.g. SDH or PDH transport network) takes place. ITU-T I.321 [4] identifies this adaptation function as one of many functions performed at the Transmission Convergence (TC) Sublayer of the B-ISDN protocol stack. This managed entity is responsible for generating alarms that report the (in)ability of the managed entity to delineate ATM cells from the payload of a terminated digital transmission path.

An instance of this managed entity shall be automatically created/deleted by ONT upon the creation/deletion of an ATM UNI and its Physical Path Termination Point.

Relationships

Zero or more instances of this managed entity shall be contained in the ONT managed entity. One instance of this managed entity shall exist for each instance of the Physical Path 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 id of the Physical Path Termination Point with which this TC Adapter$_{APON}$ is associated. (R) (mandatory) (2 bytes)

Framer configuration: Some UNIs such as the ATM45 have two methods of mapping of ATM cells into the payload of a DS3 frame, physical layer convergence protocol (PLCP) based mapping and HEC based mapping. This attribute is used to select the "PLCP option" (value 0x01) or the "HEC option" (value 0x00). Upon autonomous instantiation, this attribute is set to "PLCP option". (R, W) (mandatory for interfaces with framer configuration options) (1 byte)

Cell Scrambling Control: This attribute is used to activate/deactivate the ATM cell scrambling function. This attribute is only present for ATM interfaces where ATM cell scrambling may be controlled, i.e. "activated" (value 0x01) or "deactivated" (value 0x00). [App.V-7] requires cell scrambling for ATM/SONET interfaces but allows cell scrambling to be controlled (i.e. turned on and off) for ATM/DS3 interfaces. Upon autonomous instantiation, this attribute is set to "activated". (R, W) (mandatory for interfaces with scrambling options) (1 byte)

Cell Rate Decoupling Type: This attribute is used to select the cell rate decoupling type whenever the [11] in clause 2 and [App.V-8] give different definitions. ITU-T defined type: 0x00; ATM Forum define type: 0x01. Upon autonomous instantiation, 0x00 is used. (R, W) (mandatory for interfaces with decoupling options) (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 shall identify its new value.

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 10.

Table 10/G.983.2 – Alarms of TC Adapter$_{APON}$

Coding	Alarm	Description
0	LCD	Loss of cell delineation
1-255	Reserved	

7.3.7 Interworking VCC 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. nxDSO/DS1/DS3/E3/Ethernet) takes place. At this point, ATM cells are generated from a bit stream (e.g. nxDSO/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 attribute, the following mechanism will be used to create a CES interworking connection:

- for the structured service: Create first a VP Link Termination Point instance, *and* an Nx64 kbit/s Termination Point instance, and then create an Interworking VCC Termination Point; the latter would contain a reference to the VP Link Termination Point instance on one hand and the Nx64 kbit/s Termination Point instance on the other hand; or
- for the unstructured service: Create first a VP Link Termination Point instance, and then create an interworking VCC Termination Point; the latter would contain a reference to the VP Link Termination Point instance on one hand and to the CES UNI Physical Path Termination Point instance on the other hand.

Establishment of a "Native LAN interworking connection"

Create first a VP Link Termination Point instance, and then create an interworking VCC Termination Point. The latter would contain a reference to the VP Link Termination Point instance on one hand and to the Native LAN Physical Path Termination Point instance on the other hand.

Relationships

One instance of this managed entity shall exist 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 Interworking VCC Termination Point. (R, Set-by-create) (mandatory) (2 bytes)
VPL Connectivity Pointer:	This attribute provides an instance identifier of the VP Link Termination Point that is associated with this Interworking VCC Termination Point. (R, Set-by-create) (mandatory) (2 bytes)
Interworking Option:	This attribute identifies the type of non-ATM function that is being interworked; the option can be CES (0x00) or LAN (0x01) 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 (if Interworking option = 0x00), or LAN Service Profile (if the interworking option = 0x01). (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 (if Interworking option = 0x00), or AAL 5 (if Interworking option = 0x01) profile. (R, Set-by-create) (mandatory) (2 bytes)
Interworking Termination Point pointer:	This attribute provides a pointer either to the associated instance of the Physical Path Termination Point managed entity for the case of LAN services or unstructured CES services, or to the logical Nx64kbit/s sub-port Termination Point in the structured CES. (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

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 11. See also Appendix III.

Table 11/G.983.2 – Alarms of interworking VCC Termination Point

Coding	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 Interworking VCC Termination Point is a segment end point (optional)
5	End-to-End Loss of Continuity	Loss of continuity is detected at the Interworking VCC Termination Point (optional)
6-255	Reserved	

7.3.8 AAL 1 Profile$_{APON}$

This managed entity organizes data that describe the AAL Type 1 processing functions of the ONT. It is used with the Interworking VCC Termination Point managed entity.

In an ATM environment, AAL Type 1 configuration parameters are associated with an Interworking VCC 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 Interworking VCC Termination Point instances.

This managed entity is instantiated and, respectively deleted on request of the OLT.

Relationships

One instance of this managed entity shall exist for each combination of AAL 1 parameter values used within an ONT and may be associated with zero or more instances of the Interworking VCC Termination Point.

Attributes

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

Sub Type: This attribute identifies the AAL subtype. Valid values for this attribute are "null" (value 0x00), "voice-band based on 64 kbit/s" (value 0x01), "Synchronous Circuit Emulation" (value 0x02), "Asynchronous Circuit Emulation" (value 0x03), "High-quality Audio" (value 0x04) and "Video" (value 0x05). (R, Set-by-create) (mandatory) (1 byte)

CBR Rate: This attribute represents the rate of the CBR service supported by the AAL. Allowed values are 64 kbit/s (value 0x40), 1 544 kbit/s (value 0x0608), 44 736 kbit/s (value 0xAEC0), nx64 kbit/s (value n x 0x40), 2 048 kbit/s (value 0x0800), etc. (R, Set-by-create) (mandatory) (2 bytes)

Forward Error Correction Type: This attribute indicates the FEC method: no FEC (value 0x00), FEC for Loss Sensitive Signal Transport (value 0x01), or FEC for Delay Sensitive Signal Transport (value 0x02). (R, Set-by-create) (optional) (1 byte)

Structured Data Transfer: This attribute indicates whether Structured Data Transfer (SDT) has been configured at the AAL. A value of 0x01 means SDT has been selected. A value of 0x00 means that no SDT has been selected. This attribute value cannot be set to 0x01 when the Forward Error Correction Type attribute equals 0x01. (R, Set-by-create) (optional) (1 byte)

Partially Filled Cells: This attribute identifies the number of leading octets in use. (R, Set-by-create) (optional) (1 byte)

Clock Recovery Type: This attribute indicates whether the clock recovery type is "synchronous" (value 0x00), which indicates that timing is derived from the physical interface, or of type "SRTS" (Synchronous Residual Time Stamp, value 0x01), or "ACR" (Adaptive Clock Recovery, value 0x02). (R, Set-by-create) (mandatory) (1 byte)

Cell Loss Integration Period: This attribute represents the duration in milliseconds, of the cell-loss integration period. If the cell loss persists for such a period, this entity will generate a cell 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.

7.3.9 AAL 1 Protocol Monitoring Current Data$_{APON}$

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, e.g. the Header Errors, are only updated at the end of each period. Instances of this managed entity are created by the OLT whenever an instance of the Interworking VCC Termination Point managed entity is created that represents AAL 1 functions. Instances of this managed entity are deleted by the OLT.

Relationships

One instance of this managed entity can exist for each instance of the interworking VCC Termination Point managed entity that represents AAL 1 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 Interworking VCC Termination Point. (R, Set-by-Create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the attribute counters are adapted. 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 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 id: This attribute provides a pointer to an instance of the Threshold Data managed entity that contains the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-Create) (mandatory) (2 bytes)

Header Errors: This attribute represents a count of the number of AAL 1 header errors detected, including those corrected. Header errors include correctable and not correctable CRC and parity errors. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (2 bytes)

Sequence Violations: This attribute represents a count of incoming AAL Type 1 SAR-PDUs where the sequence count in the PDU header causes a transition from the SYNC state to the OUT OF SEQUENCE state as defined by ITU-T I.363.1. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (2 bytes)

Cell Loss: This attribute represents a count of the number of lost cells, as detected by the AAL 1 sequence number processing, for example. This count records the number of cells detected as lost in the network prior to the destination Interworking function AAL 1 layer processing. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (2 bytes)

Cell Misinsertion: This attribute represents a count of sequence violation events which the AAL CS interprets as misinserted of cells as defined by ITU-T I.363.1. If the actual counter saturates, it remains on its maximum value. (R) (mandatory) (2 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 ATM cell 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. (R) (mandatory) (2 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. (R) (mandatory) (2 bytes)

SDT Pointer Reframes: This attribute represents a count of the number of events in which the AAL 1 reassembler found that a structured data pointer is not where it is expected, and the pointer must be re-acquired. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. If the actual counter saturates, it remains on its maximum value. (R) (optional) (2 bytes)

SDT Pointer Parity Check Failures: This attribute represents a count of the number of times the AAL reassembler detects a parity check failure at the point where a structured data pointer is expected. This count is only meaningful for structured data transfer modes as unstructured modes do not use pointers. If the actual counter saturates, it remains on its maximum value. (R) (optional) (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.

Set: Set one or more attributes.

Notifications

Alarm: This notification is used to notify the management system when a Threshold Crossing Alert has been detected or cleared. The alarm change notification "on" will be sent at the crossing of the threshold by the actual counter; the alarm change notification "off" will be sent at the end of the 15 min period since then the actual counters are reset to 0x00. The alarm list for this entity is given in Table 12.

Table 12/G.983.2 – Alarms of AAL 1

Coding	Alarm	Description
0	Header errors	Header errors threshold crossing
1	Sequence Violation	Sequence Violation threshold crossing
2	Cell loss	Cell loss threshold crossing
3	Cell misinsertion	Cell misinsertion threshold crossing
4	Buffer Underflows	Buffer Underflows threshold crossing
5	Buffer Overflows	Buffer Overflows threshold crossing
6	SDT Pointer Reframes	SDT Pointer Reframes threshold crossing
7	SDT Pointer Parity Check Failures	SDT Pointer Parity Check Failures threshold crossing
8	CSA	Cell starvation alarm
9-255	Reserved	

7.3.10 AAL 5 Profile$_{APON}$

This managed entity organizes data that describe the AAL Type 5 processing functions of the ONT. It is used with the Interworking VCC Termination Point managed entity.

In an ATM environment, AAL Type 5 configuration parameters are associated with an Interworking VCC Termination Point managed entity through a pointer relationship. Each instance of the managed entity defines a combination of parameter values that may be associated with multiple Interworking VCC Termination Point instances.

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

Relationships

One instance of this managed entity shall exist for each combination of AAL 5 parameter values used within an ONT and may be associated with zero or more instances of the Interworking VCC Termination Point.

Attributes

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

Max CPCS PDU Size: This multi-valued attribute represents the maximum CPCS PDUsize that will be transmitted over the connection in both the upstream and downstream direction of transmission. (R, Set-by-create) (mandatory) (2 bytes)

AAL Mode: This attribute indicates whether the AAL for the supporting VPC is operating in one of the following optional modes: a message assured (0x00), message unassured (0x01), a streaming assured (0x02), and streaming non-assured (0x03). (R, Set-by-create) (mandatory) (1 byte)

SSCS Type: This attribute identifies the SSCS type for the AAL. Valid values are "null" (0x00), "Data SSCS based on SSCOP, assured operation" (0x01), "Data SSCS based on SSCOP, non-assured operation" (0x02), or "Frame Relay SSCS" (0x03). (R, Set-by-create) (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.

Notifications

None.

7.3.11 AAL 5 Protocol Monitoring Current Data$_{APON}$

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, e.g. the CRC violations, are only updated at the end of each period.

Instances of this managed entity are created automatically by the OLT whenever an instance of the Interworking VCC Termination Point managed entity is created that represents the AAL 5 functions. Instances of this managed entity are deleted by the OLT.

Relationships

One instance of this managed entity can exist for each instance of the Interworking VCC Termination Point managed entity that represents AAL 5 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 Interworking VCC Termination Point. (R, Set-by-Create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the attribute counters are adapted. 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 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 id: This attribute provides a pointer to an instance of the Threshold Data managed entity that contains the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-Create) (mandatory) (2 bytes)

Sum of Invalid CS Field Errors: This attribute provides a sum-of-errors count for invalid Convergence Sublayer (CS) field errors. For AAL Type 5, this attribute provides a single count of the number of CS_PDUs discarded due to one of the following error conditions: Invalid Common Part Indicator (CPI), oversized received SDU, or length violation. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

CRC Violations: This attribute represents a count of CRC violations that were detected for the incoming SAR PDUs. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Reassembly Timer Expirations: This attribute provides a count of reassembly timer expirations. If the actual counter saturates, it remains on its maximum value. (R) (mandatory if reassembly timer is implemented) (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.

Set: Set one or more attributes.

Notifications

Alarm: This notification is used to notify the management system when a threshold crossing alert is detected or cleared. The alarm change notification "on" will be sent at the crossing of the threshold by the actual counter; the alarm change notification "off" will be sent at the end of the 15-minute period since then the actual counters are reset to 0x00. The alarm list for this entity is given in Table 13.

Table 13/G.983.2 – Alarms of AAL 5

Coding	Alarm	Description
0	Invalid Fields	Exceeds threshold
1	CRC Violation	Exceeds threshold
2	Reassembly Timer Expirations	Exceeds threshold
3-255	Reserved	

7.3.12 CES Service Profile$_{APON}$

An instance of this managed entity is a support managed entity used to organize data that describe the CES Service functions of the ONT. An instance of this managed entity shall be created and deleted by the OLT.

Relationships

Zero or more instances of this managed entity shall be contained in the ONT managed entity. One instance of this managed entity may be associated to zero or more instances of the Interworking VCC Termination Point.

Attributes

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

CES Buffered CDV Tolerance: This attribute represents the duration of user data that must be buffered by the CES interworking entity to offset Cell Delay Variation. This timing will be in 10 ms increment. The default value for DS1 CES is 750 ms and 1 000 ms for DS3 CES. (R, W, Set-by-create) (mandatory) (2 bytes)

Channel Associated Signalling: This attribute selects which AAL 1 format should be used. It applies to structured interfaces only. For unstructured interfaces this value, if present, must be set to the default of 0x00. The valid values are basic (0x00), e1Cas (0x01), SfCas (0x02), ds1EsfCas (0x03), j2Cas (0x04). (R, W, Set-by-create) (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.

Set: Set one or more attributes.

Notifications

None.

7.3.13 LAN Service Profile

An instance of this managed entity organizes data that describe the LAN Service functions of the ONT. An instance of this managed entity shall be created and deleted by the OLT.

Relationships

Zero or more instances of this managed entity shall be contained in the ONT managed entity. One instance of this managed entity may be associated to zero or more instances of the Interworking VCC Termination Point.

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 id of the Physical Path Termination Point Native LAN UNI. (R, Set-by-create) (mandatory) (2 bytes)

Configure Data Value: This is a vendor defined attribute which can be used for their own native LAN service function. This attribute can be used as one or more values. (R, W, Set-by-create) (mandatory) (30 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.

7.3.14 Native LAN Physical Interface Monitoring Current Data

This managed entity contains the last completed 15-minute interval collected statistic data for an Ethernet interface. The statistic data value is only updated at the end of each period.

Instances of this managed entity are created/deleted by the OLT after an instance of the Native LAN UNI Physical Path Termination Point managed entity is created/deleted.

Relationships

One instance of this Native LAN Physical Interface Monitoring Current Data managed entity can exist for each instance of the Native LAN UNI Physical Path Termination Point.

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 id of Native LAN UNI Physical Path Termination Point. (R, Set-by-create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the statistic data value are adapted. 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 set equal to the number of the last completed interval. The actual counters of this managed entity start counting directly. The statistic data value is updated at the end of the interval. (R) (mandatory) (1 byte)

Statistic Data Value: This is a vendor defined attribute which can be used for their own performance monitoring. This attribute can be used as one or more values. (R, W, Set-by-create) (optional) (29 bytes)

Because of the various operators requirement and cost advantages, each vendor's ONT may support different levels of performance management of the physical interfaces of Ethernet. The detailed definition of the set of attributes for this managed entity is left for further study. Each vendor may use vendor defined attributes for his implemented feature.

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.

7.3.15 CES Physical Interface Monitoring Current Data

This managed entity contains the last completed 15-minute interval collected statistic data for a physical interface (e.g. DS1/E1/J1/J2) of CES UNI.

Instances of this managed entity are created/deleted by the OLT after an instance of the Physical Path Termination Point CES UNI managed entity is created/deleted.

The performance management of the physical interfaces used by CES UNI shall be supported. Possible interfaces include DS1/DS3/E1/E3/J1/J2. The performance management requirements of particular interface are described in the corresponding ITU-T or other standard document, e.g. [ITU-T G.784 [1]]. Failure/notifications should include threshold alerts for unacceptable performance (error) rates. Performance data should include transmission counts of Errored Seconds (ES), Severely Errored Seconds (SES) and Unavailable Seconds (UAS).

Notice that because of the various operator's requirements and cost advantages, each vendor's ONT may support different levels of performance management of the physical interfaces. It is not stated here that the errored seconds stated below have to be generated for all the possible combinations such as near-end path, far-end path, near-end line, far-end line etc. Each vendor may use vendor specific combinations for its implemented features.

Relationships

One instance of this managed entity shall exist for each instance of the Physical Path Termination Point CES.

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 id of CES UNI Physical Path Termination Point. (R, Set-by-create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the attribute counters are adapted. 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 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$_{APON}$ id: This attribute provides a pointer to an instance of the Threshold Data$_{APON}$ managed entity that contains the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-Create) (mandatory) (2 bytes)

Error Seconds: The number of Errored Seconds encountered by a physical interface in the last completed 15-minute interval. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Severely Error Seconds: The number of Severely Errored Seconds encountered by a physical interface in the last completed 15-minute interval. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Bursty Error Seconds: The number of Bursty Errored Seconds encountered by a physical interface in the last completed 15-minute interval. A BES is any second that is not a UAS that contains between 2 and 319 error events, but no LOS, AIS, or OOF condition. If the actual counter saturates it remains on its maximum value. (R) (Optional) (2 bytes)

Unavailable Seconds: The number of Unavailable Seconds encountered by a physical interface in the last completed 15-minute interval. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Controlled Slip Seconds: The number of Controlled Slip Seconds encountered by a physical interface in the last completed 15-minute interval. If the actual counter saturates it remains on its maximum value. (R) (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.

Set: Set one or more attributes.

Notifications

Alarm: This notification is used to notify the management system when a threshold crossing alert is detected or cleared. The alarm change notification "on" will be sent at the crossing of the threshold by the actual counter; the alarm change notification "off" will be sent at the end of the 15 min period since then the actual counters are reset to 0x00. Both ONT and OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 14.

Table 14/G.983.2 – Alarms of CES Physical Interface Monitoring Current Data

Coding	Alarm	Description
0	ES	Exceeds threshold
1	SES	Exceeds threshold
2	BES	Exceeds threshold
3	UAS	Exceeds threshold
4	CSS	Exceeds threshold
5-255	Reserved	

7.3.16 TC Adaptor Protocol Monitoring Current Data

This managed entity contains the last completed 15-minute interval collected performance monitoring as a result of performing Transmission Convergence level protocol monitoring. All the attribute counters, e.g. the discarded cells due to HEC violations, are only updated at the end of each period.

Instances of this managed entity are created/deleted by the OLT after an instance of the corresponding TC Adaptor managed entity is created/deleted.

Relationships

One instance of this managed entity can exist for each instance of TC $\text{Adaptor}_{\text{APON}}$.

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 id of TC $\text{Adaptor}_{\text{APON}}$. (R, Set-by-create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the attribute counters are adapted. 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 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 $\text{Data}_{\text{APON}}$ id: This attribute provides a pointer to an instance of the Threshold $\text{Data}_{\text{APON}}$ managed entity that contains the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-Create) (mandatory) (2 bytes)

Discarded Cells due to HEC violations: This read-only attribute provides a raw, thresholded count of the number of ATM cells that were discarded (per interface) due to an HEC violation. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (4 bytes)

Errored Cells due to HEC violations: This read-only attribute provides a raw, thresholded count of the number of ATM cells that were errored (per interface) due to an HEC violation. 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.

Notifications

Alarm: This notification is used to notify the management system when a threshold crossing alert is detected or cleared. The alarm change notification "on" will be sent at the crossing of the threshold by the actual counter; the alarm change notification "off" will be sent at the end of the 15 min period since then the actual counters are reset to 0x00. Both ONT and OLT should know the alarm list, given in Table 15, used by this entity.

Table 15/G.983.2 – TC Adaptor Protocol Monitoring Current Data

Coding	Alarm	Description
0	Discarded Cells due to HEC violations	Exceeds threshold
1	Errored cells due to HEC violations	Exceeds threshold
2-255	Reserved	

7.3.17 Threshold Data$_{APON}$

An instance of this managed entity 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

Zero or more instances of this managed entity shall be contained in the ONT managed entity. This managed entity may be related to multiple instances of the Current Data type managed entities, which have the Threshold Data$_{APON}$ id attribute that points to an instance of this managed entity.

Related Managed Entities:

- AAL 1 Protocol Monitoring Current Data$_{APON}$.
- AAL 5 Protocol Monitoring Current Data$_{APON}$.
- CES Physical Interface Monitoring Current Data.
- Ethernet Statistical Current Data.
- TC Adapter Protocol Monitoring Current Data.
- UPC Disagreement Monitoring Current Data$_{APON}$.

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 Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

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

Threshold Value 3: This attribute provides the associated threshold value for the 3rd thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

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

Threshold Value 5: This attribute provides the associated threshold value for the 5th thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Threshold Value 6: This attribute provides the associated threshold value for the 6th thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Threshold Value 7: This attribute provides the associated threshold value for the 7th thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Threshold Value 8: This attribute provides the associated threshold value for the 8th thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Threshold Value 9: This attribute provides the associated threshold value for the 9th thresholded counter in the Current Data type managed entity. (R, W, Set-by-create) (mandatory) (2 bytes)

Threshold Value 10: This attribute provides the associated threshold value for the 10th thresholded counter in the Current Data type managed entity. (R, W, 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.

Set: Set one or more attributes.

Notifications

None.

7.4 VP MUX Management

7.4.1 VP Link Termination Point$_{APON}$

This managed entity is used to represent the termination of VP links on an ONT. 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 Link Termination Point$_{APON}$ managed entity for point-to-point cross-connection (the multipoint cross-connection is for further study).

Instances of the VP Link Termination Point$_{APON}$ managed entity will be created on demand of the OLT:

- as a consequence of action "create" on the VP Link Termination Point$_{APON}$ managed entity, or
- as a consequence of action "create complete connection" on the ATM VP Cross-Connection managed entity.

Instances of the VP Link Termination Point$_{APON}$ managed entity will be deleted on demand of the OLT:

- as a consequence of action "delete" on the VP Link Termination Point$_{APON}$ managed entity, or
- as a consequence of action "delete complete connection" on the ATM VP Cross-Connection managed entity.

Notice that a VP Link Termination Point$_{APON}$ can be deleted only when no ATM VP Cross-Connection or no Interworking VCC Termination Point is associated with it. It is the responsibility of the OLT to make sure that the VP Link Termination Point$_{APON}$ meets this condition at the time when the OLT requests to delete it.

Relationships

Zero or more instances of the VP Link Termination Point$_{APON}$ managed entity shall exist for each instance of the TC Adapter$_{APON}$, PON TC Adapter or Interworking VCC Termination Point managed entity.

Relationship to Priority queue$_{APON}$ /Traffic Descriptor Pointer: see attribute definition.

Relationship to UPC Disagreement Monitoring Current data$_{APON}$: one or zero implied in the managed entity id of UPC Disagreement Monitoring Current data$_{APON}$.

This managed entity is related to the ATM VP Cross-Connection managed entity through the Termination Point ANI/UNI side attributes of the ATM VP Cross-Connection 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)

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

UNI/ANI Pointer: This attribute associates the VP Link with the ANI (i.e. PON interface) or a UNI. It points to the connected ANI/UNI instance id. (R, Set-by-create) (mandatory) (2 bytes)

Direction: This attribute specifies whether the VP Link is used for the UNI-to-ANI (value 0x01) or the 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$_{APON}$ used for this VP Link Termination Point in the downstream direction. Note that the value of this pointer is null when the VP Link Termination Point is at ANI side. (R, Set-by-create) (mandatory) (2 bytes)

Priority Queue Pointer for upstream: This attribute points to the instance of the Priority Queue$_{APON}$ used for this VP Link Termination Point in the upstream direction. It is used when the UNI/ANI pointer indicates an ANI instance id and **Traffic Management Option** attribute in ONT$_{APON}$ is 0x00, this pointer is null otherwise. (R, Set-by-create) (mandatory) (2 bytes)

Traffic Descriptor Pointer/Traffic Shaping Descriptor Pointer: This attribute serves as a pointer to the instance of the Traffic Descriptor or Traffic Shaping Descriptor managed entity, which contains the traffic parameters used for this VP Link Termination Point. This attribute is used when the **Traffic Management Option** attribute in ONT_{APON} is 0x01. It applies to UNI side VP Link Termination Point if UPC is used. In this case this pointer points to a Traffic Descriptor managed entity.

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

See also Appendix IV.

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). The OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 16. See also Appendix III.

Table 16/G.983.2 – Alarms of VP Link Termination $Point_{APON}$

Coding	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 Link Termination Point is a segment end point (optional)
5	End-to-End Loss of Continuity	Loss of continuity is detected when the VP Link Termination Point supports an Interworking VCC Termination Point (optional)
6-255	Reserved	

7.4.2 ATM VP Cross-Connection

For point-to-point ATM VP Cross-Connections, this managed entity is used to represent the Cross-Connect relationship between two VP Link Termination $Points_{APON}$. For multipoint ATM VP Cross-Connections, which is optional, the use of this managed entity is for further study.

Instances of this managed entity shall be created and deleted by the OLT based on ATM connection set up.

Relationships

Zero or more instances of the ATM VP Cross-Connection managed entity shall exist for each instance of the ONT 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 instance identifier of the VP Link Termination Point$_{APON}$ at the ANI side of this ATM VP Cross-Connect. (R, Set-by-create) (mandatory) (2 bytes)

Termination Point ANI side: This attribute identifies the instance of the VP Link Termination Point$_{APON}$ managed entity that represents the cross-connected VP Link Termination Points on the ANI side. (R, Set-by-create) (mandatory) (2 bytes)

Termination Point UNI side: This attribute identifies the instance of the VP Link Termination Point$_{APON}$ managed entity that represents the cross-connected VP Link Termination Points on the UNI side. (R, Set-by-create) (mandatory) (2 bytes)

Actions

Create: Create an instance of this managed entity.

Delete: Delete an instance of this managed entity.

Create complete connection: Create two instances of the VP Link Termination Point$_{APON}$ managed entity (ANI-side and UNI-side) and one instance of the ATM VP Cross-Connection managed entity.

Delete complete connection: Delete two instances of the VP Link Termination Point$_{APON}$ managed entity (ANI-side and UNI-side) and one instance of the ATM VP Cross-Connection managed entity.

Get: Get attributes of this managed entity.

Get complete connection: Get all attributes of a connection; this holds the attributes of two instances of the VP Link Termination Point$_{APON}$ managed entity (ANI-side and UNI-side) and the attributes of the corresponding ATM VP Cross-Connection managed entity.

Notifications

None.

7.5 Traffic Management

7.5.1 Priority Queue$_{APON}$

This managed entity specifies the priority queue in ONT that is used for the VP Link Termination Point$_{APON}$.

All the Priority Queues used for the upstream traffic are created by the ONT after initialization. All the Priority Queues used for the downstream traffic are created/deleted by the ONT after the creation/deletion of the Subscriber Line Card.

The following assumption is made in order to simplify the queue management. The maximum number of priority queues supported by an ONT, Subscriber Line Card or PON IF Line Card is 32. If *N* priority queues reside in the ONT, the Subscriber Line Card or PON IF Line Card, *N* priority queue management entities will be automatically created by the ONT following the creation of the related equipment. Note that the OLT will find all the queues by reading the Priority $Queue_{APON}$ 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.

Relationships

One or more instances of this managed entity shall be contained in the ONT_{APON} managed entity to model the upstream direction if the **Traffic Management Option** attribute in ONT is 0x00. One or more instances of this managed entity shall be associated with the Subscriber Line Card managed entity as downstream priority $queue_{APON}$. For the ONT that has one or more fixed user interfaces, one or more instances shall be contained in the ONT managed entity for the downstream direction.

Attributes

Managed Entity id:	This attribute provides a unique number for each instance of this managed entity. The first byte is the slot id of the Subscriber Line Card or PON IF card with which this queue is associated. For integrated Subscriber Line/PON IF interfaces, this byte can be associated with "pseudo" slot ids 0x00, 0x80 (128), respectively. The second byte is the priority of this queue (0x00 indicates the highest priority, and 0x1F (31) the lowest). (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. (R) (mandatory) (2 bytes)
Allocated Queue Size:	This attribute identifies the allocated size of this queue. (R, W) (mandatory) (2 bytes)
Discard-cell-counter reset interval:	This attribute represents the interval in milliseconds that the counter reset itself. (R, W) (optional) (2 bytes)
Threshold value for discarded cells due to buffer overflow:	The threshold for the number of cells discarded on this queue due to buffer overflow. (R, W) (optional) (2 bytes)

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 notification shall identify the attribute that changed and its new value.

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 coding used by this entity. The alarm list for this entity is given in Table 17.

Table 17/G.983.2 – Alarms of Priority Queue$_{APON}$

Coding	Alarm	Description
0	Cell loss	Exceeds threshold
1-255	Reserved	

7.5.2 Traffic Descriptors

ATM transfer capabilities (ATCs) are defined in ITU-T I.371 [7]. These are Deterministic Bit Rate (DBR), Statistical Bit Rate (SBR), ATM Block Transfer with Delayed Transmission (ABT/DT), ATM Block Transfer with Immediate Transmission (ABT/IT), Available Bit Rate (ABR), and Guaranteed Frame Rate (GFR).

[App.V-9] has defined analogous Service Categories. These are Constant Bit Rate (CBR), Real-time Variable Bit Rate (rtVBR), Non-Real-Time VBR (nrtVBR), Unspecified Bit Rate (UBR), Available Bit Rate (ABR), and Guaranteed Frame Rate (GFR).

Both the ITU-T SBR ATC and the ATM Forum VBR service categories may be further subdivided into 3 categories. These are taken to be separate ATCs or Service Categories, and are designated by adding the numeral 1, 2, or 3 to the VBR or SBR acronym. For VBR1 and SBR1, the cell loss ratio (CLR) performance objective is applied to the aggregate traffic in the connection. For VBR2 and SBR2, the CLR objectives are applied only to cells with the cell loss priority (CLP) bit set to 0x00, and there is no tagging of cells. For VBR3 and SBR3, the CLR objective is applied only to cells with the cell loss priority (CLP) bit set to 0x00, and there is tagging of cells.

The plausible approximate correspondence among ITU-T ATC and the service categories as in [App.V-9] as shown in Table 18.

Table 18/G.983.2 – Traffic Descriptors

ITU	[App.V-9]	Traffic Descriptor in G.983.2
DBR [1]	CBR	CBR/DBR Traffic Descriptor
DBR [U]	UBR	UBR Traffic Descriptor
SBR1 [2]	VBR1	SBR1/VBR1 Traffic Descriptor
SBR2 [1]/[3]	VBR2	SBR2/VBR2 Traffic Descriptor
SBR3 [3]	VBR3	SBR3/VBR3 Traffic Descriptor
ABR	ABR	ABR Traffic Descriptor
GFR	GFR	GFR Traffic Descriptor
ABT/DT ABT/IT		ABT/DT/IT Traffic Descriptor

The attribute value units used in the Traffic Descriptors in the following clauses are identical to the ones defined in ITU-T I.751 [9].

7.5.2.1 DBR/CBR Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream DBR/CBR virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

Managed Entity id:	This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)
Service Category/ATC:	Value 0x00 is used for DBR/CBR. (R, Set-by-Create) (mandatory) (1 byte)
Peak Cell Rate:	Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)
Cell Delay Variation Tolerance in relation to the PCR:	Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)
CLR:	Maximum permissible Cell Loss Ratio for the CLP = 0 + 1 traffic flow. (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 of this managed entity.

Notifications

None.

7.5.2.2 UBR Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream UBR virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x01 is used for UBR/DBR[U]. (R, Set-by-create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (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 of more attributes of this managed entity.

Notifications

None.

7.5.2.3 SBR1/VBR1 Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream SBR1/VBR1 virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x02 is used for SBR1, value 0x03 is used for Real-time VBR1, and value 0x04 is used for Non Real-time VBR1. (R, Set-by-Create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Maximum Burst Size: Maximum Burst Size for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

CLR: Maximum permissible Cell Loss Ratio for the CLP = 0 + 1 traffic flow. (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 of this managed entity.

Notifications

None.

7.5.2.4 SBR2/VBR2 Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream SBR2/VBR2 virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x05 is used for SBR2, value 0x06 is used for Real-time VBR2, and value 0x07 is used for Non Real-time VBR2. (R, Set-by-Create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Maximum Burst Size: Maximum Burst Size for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

CLR: Maximum permissible Cell Loss Ratio for the CLP = 0 traffic flow. (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 of this managed entity.

Notifications

None.

7.5.2.5 SBR3/VBR3 Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream SBR3/VBR3 virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x08 is used for SBR3, value 0x09 is used for Real-time VBR3, and value 0x0A is used for Non Real-time VBR3. (R, Set-by-Create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Maximum Burst Size: Maximum Burst Size for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

CLR: Maximum permissible Cell Loss Ratio for the CLP = 0 traffic flow. (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 of this managed entity.

Notifications

None.

7.5.2.6 ABR Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream ABR virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

Managed Entity id:	This attribute provides a unique number for each instance of this managed entity. (R, Set-by-create) (mandatory) (2 bytes)
Service Category/ATC:	Value 0x0B is used for ABR. (R, Set-by-Create) (mandatory) (1 byte)
Peak Cell Rate:	Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)
Cell Delay Variation Tolerance in relation to the PCR:	Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)
Minimum Cell Rate:	Minimum Cell Rate for the CLP = 0 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)
Initial Cell Rate:	Rate at which a source should send initial and after an idle period. The unit is an integer number of cells/second. The value must not exceed PCR, and is usually lower. (R, Set-by-Create) (optional) (2 bytes)
Transient Buffer Exposure:	These parameters are required for ABR traffic. (R, Set-by-Create) (optional) (2 bytes)
Rate Decrease Factor:	Controls the rate decrease which occurs when backward RM cells with CI = 1, are received. Allowed values are: $1/2^k$ with k between 0 and 15. The coding of the attribute is according to the value of k. (R, Set-by-Create) (optional) (1 byte)
Rate Increase Factor:	Controls the rate increases, when a backward RM cell is received with CI = 0 and NI = 0. Allowed values are: $1/2^k$ with k between 0 and 15. The coding of the attribute is according to the value of k. (R, Set-by-Create) (optional) (1 byte)
Fixed Round Trip Time:	The sum of the fixed and propagation delays from the source to the destination and back (R, Set-by-Create) (optional) (2 bytes)
Number RM:	The maximum number of data cells a source may send for each forward RM cell. Allowed values are 2^k, where k is used as the code and is between 1 and 8. (R, Set-by-Create) (optional) (1 byte)

Time RM: Upper bound on the time between forward RM cells for an active source. Allowed values are computed as $100/2^k$, where k is used as the code and is between 0 and 7. The default is k = 0. (R, Set-by-Create) (optional) (1 byte)

Cut-off Decrease Factor: Controls the rate decreases associated with lost or delayed backward RM cells. Allowed values are: $1/2^6$ (value 0x07), $1/2^5$ (value 0x06), $1/2^4$ (value 0x05), $1/2^3$ (value 0x04), $1/2^2$ (value 0x03), 1/2 (value 0x02), 0x01 (value 0x01) and 0x00 (value 0). (R, Set-by-Create) (optional) (1 byte)

ACR Decrease Time Factor: Time permitted between sending RM cells, before the rate decreased to ICR. The range is 10 ms to 10.23 s, increments of milliseconds. (R, Set-by-Create) (optional) (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 of this managed entity.

Notifications

None.

7.5.2.7 ABT/DT/IT Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream ABT/DT/IT virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x0C is used for ABT/DT, value 0x0D is used for ABT/IT. (R, Set-by-Create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Maximum Burst Size: Maximum Burst Size for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Number RM: The maximum number of data cells a source may send for each forward RM cell. Allowed values are 2^k, where k is used as the code and is between 0x01 and 0x08. (R, Set-by-Create) (optional) (1 byte)

Time RM: Upper bound on the time between forward RM cells for an active source. Allowed values are computed as $100/2^k$, where k is used as the code and is between 0x00 and 0x07. The default is k = 0. (R, Set-by-Create) (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.

Notifications

None.

7.5.2.8 GFR Traffic Descriptor

This managed entity specifies traffic and QoS parameters for upstream GFR virtual path connections.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of VP Link Termination $Point_{APON}$ entities through their pointer attribute: Traffic Descriptor Pointer.

Attributes

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

Service Category/ATC: Value 0x0E is used for GFR. (R, Set-by-Create) (mandatory) (1 byte)

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Maximum Burst Size: Maximum Burst Size for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Cell Delay Variation Tolerance in relation to the PCR: Cell Delay Variation Tolerance in relation to the PCR for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Maximum Frame size: Maximum Frame size for GFR traffic. (R, Set-by-Create) (optional)

Minimum Cell Rate: Minimum Cell Rate for the CLP = 0 traffic flow. (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 of this managed entity.

Notifications

None.

7.5.3 Traffic Shaping Descriptor

This managed entity specifies traffic shaping parameters for upstream VP Link Termination Points.

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

Relationships

Zero or more instances of this managed entity may be contained in an instance of ONT_{APON} managed entity.

Each instance of this entity may be related to zero or more instances of the ANI VP Link Termination $Point_{APON}$ through their pointer attribute, with the restriction that all VP Link Termination Points related to the instance of this managed entity must be associated to the same UNI_{APON} (see also Appendix IV).

Attributes

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

Peak Cell Rate: Peak Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (mandatory) (2 bytes)

Sustainable Cell Rate: Sustainable Cell Rate for the CLP = 0 + 1 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Cell Delay Variation Tolerance in relation to the SCR: Cell Delay Variation Tolerance in relation to the SCR for the CLP = 0 traffic flow. (R, Set-by-Create) (optional) (2 bytes)

Configurable Data Value: This is a vendor defined attribute which vendors can use for their own traffic shaping. This attribute can be used as one or more values. (R, W, Set-by-Create) (optional) (24 bytes)

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

None.

7.5.4 UPC Disagreement Monitoring Current Data$_{APON}$

An instance of this managed entity is used to collect and report the last completed 15-minute interval data associated with UPC Disagreement Monitoring functions performed by the ONT on individual VP Link Termination Point$_{APON}$ managed entities in ONT$_{APON}$. The instances of this managed entity are created and deleted by the OLT.

Relationships

One instance of this managed entity may exist for each instance of the VP Link Termination Point$_{APON}$ managed entities instantiated at the UNI side.

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 VP Link Termination Point$_{APON}$. (R, Set-by-Create) (mandatory) (2 bytes)

Interval End Time: This attribute identifies the most recent finished 15-minute interval. It is a cyclic counter (modulo 0xFF (256)) that is incremented each time a new interval is finished and the actual counters are adapted. 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 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$_{APON}$ id: This attribute provides a pointer to an instance of the Threshold Data$_{APON}$ managed entity that contains the threshold values for the performance monitoring data collected by this managed entity. (R, W, Set-by-Create) (mandatory) (2 bytes)

Discarded Cells due to UPC: This attribute provides a raw, thresholded count of the number of discarded cells due to combined CLP = 0 and CLP = 1 UPC policing. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Discarded CLP = 0 Cells due to UPC: This attribute provides a raw, thresholded count of the number of discarded CLP = 0 cells due to CLP = 0 only UPC policing. This counter is only present if CLP = 0 traffic is separately policed. If the actual counter saturates it remains on its maximum value. (R) (mandatory) (2 bytes)

Tagged CLP = 0 Cells: This attribute provides a raw, unthresholded count of the number of cells, which have been tagged. If the actual counter saturates it remains on its maximum value. (R) (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 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 a threshold crossing alert is detected or cleared. The alarm change notification "on" will be sent at the crossing of the threshold; the alarm change notification "off" will be sent at the end of the 15 min period since then the counters are reset to 0x00. Both ONT and OLT should know the alarm list used by this entity. The alarm list for this entity is given in Table 19.

Table 19/G.983.2 – UPC Alarm

Coding	Alarm	Description
0	Discarded Cells due to UPC	Exceeds threshold
1	Discarded CLP = 0 Cells due to UPC	Exceeds threshold
2-255	Reserved	

8 ONT Management and Control Channel (OMCC)

An ATM connection shall be provisioned for the OMCC. ITU-T G.983.1 [3] specifies a PLOAM message that activates a VPI/VCI pair between the OLT and ONT processors. The VPI/VCI value for the management channel of each is programmed by the OLT using this message. The OMCCs of different ONTs should be assigned different VPIs. 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 should be studied further with input from operators:

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

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

c) An upstream OMCC cell should always be put in the high priority queue or be modelled with the CBR service category; the constraints on the downstream OMCC cells are out of the scope of the 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.

9 ONT Management and Control Protocol

9.1 ONT Management and Control Protocol Cell Format

9.1.1 Introduction

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 (3 bytes)	Message Contents (33 bytes)	AAL 5 Trailer (8 bytes)

Figure 12/G.983.2 – ONT Management and Control Protocol Cell format

9.1.2 ATM Header

The header contains the VPI/VCI value of the OMCC for the addressed ONT, see clause 8.

9.1.3 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 Message Flow Control and Error Recovery, 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, which the OLT uses to assign the rest bits of 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 which 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 can be received anymore.

9.1.4 Message Type

The Message Type field is subdivided into four parts. These are given in Figure 13.

8	7	6	5 … 1
DB	AR	AK	MT

Figure 13/G.983.2 – 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 acknowledge is expected, this bit is set to "1". If no acknowledge is expected the coding of this bit is "0". Note that with "acknowledge" a response to an action request is meant 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 are reserved for future use. Codes 4 to 31 are used by this specification. Table 20 lists the message types that are defined.

Table 20/G.983.2 – 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 ATM VP Cross-Connection and two associated VP Link Termination Points	yes	yes
6	Delete	Delete a managed entity instance	yes	yes
7	Delete complete connection	Delete an ATM VP Cross-Connection and two associated VP Link Termination Points	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 ATM VP Cross-Connection and the attributes of the associated VP Link – Termination Points	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 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 reinitialize 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
26-31	Reserved			
NOTE – The "Download section" action is only acknowledged for the last section within a window. See Appendix I.2.15.				

9.1.5 Device Identifier

For systems based on ITU-T G.983.1 [3] this field is defined as 0x0A.

9.1.6 Message Identifier

The message identifier consists of three bytes. The first, most significant, byte of the message identifier field is 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 256. The least significant two bytes of this message identifier field are used to identify the managed entity instance. The maximum number of instances per managed entity is thus 65 536.

Table 21 gives the managed entities and their class value in the OMCI, with their identifier value. Depending on the managed entity, there will be only one (e.g. ONT_{APON}) or several (e.g. VP Link Termination $Point_{APON}$) instances.

Table 21/G.983.2 – Managed Entity Identifiers Table 21/G.983.2 – Managed Entity Identifiers

Managed entity class value	Managed entity
1	ONT_{APON}
2	ONT Data
3	PON IF Line Cardholder
4	PON IF Line Card
5	Subscriber Line Cardholder
6	Subscriber Line Card
7	Software Image
8	UNI_{APON}
9	TC $Adapter_{APON}$
10	Physical Path Termination Point ATM UNI
11	Physical Path Termination Point Native LAN UNI
12	Physical Path Termination Point CES UNI
13	Logical Nx64kbit/s Sub-port Termination Point
14	Interworking VCC Termination Point
15	AAL 1 $Profile_{APON}$
16	AAL 5 $Profile_{APON}$
17	AAL 1 Protocol Monitoring Current $Data_{APON}$
18	AAL 5 Protocol Monitoring Current $Data_{APON}$
19	AAL 2 Profile
20	AAL 3/4 Profile
21	CES Service $Profile_{APON}$
22	LAN Service Profile
23	CES Physical Interface Monitoring Current Data
24	Native LAN Physical Interface Monitoring Current Data
25	VP Link Termination $Point_{APON}$

Table 21/G.983.2 – Managed Entity Identifiers Table 21/G.983.2 – Managed Entity Identifiers (*concluded*)

Managed entity class value	Managed entity
26	ATM VP Cross-Connection
27	Priority Queue$_{APON}$
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 Current Data$_{APON}$
37	Traffic Shaping Descriptor
38	ANI
39	PON TC Adapter
40	PON Physical Path Termination Point
41	TC Adapter Protocol Monitoring Current Data
42	Threshold Data$_{APON}$
43	Operator Specific
44	Vendor Specific
45..255	Reserved

9.1.7 Message Contents

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

9.1.8 AAL 5-trailer

The eight bytes of this field are used as follows:

a) The CPCS-User-to-User-Indication (CPCS-UU) field is set to 0x00 at the transmitter and ignored at the receiver.

b) The CPCS Common Part Indication (CPCS-CPI) field is set to 0x00 at the transmitter and ignored at the receiver.

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

d) The 32-bit CRC is as specified in ITU-T I.363.5 [6].

9.2 Message Flow Control and Error Recovery

The flow control/error recovery procedures for message exchange over the OMCC are based upon a simplex acknowledged transaction stop-and-wait mechanism that can easily be extended to support concurrent execution of multiple transaction requests of different priority levels. These flow-control procedures ensure that a low level acknowledged transaction request transmitted from the OLT has been properly received and processed to completion by the ONT before the next message of the

same priority level is sent by the OLT. The stop-and-wait protocol uses the transaction correlation identifier field, retry counter(s), and applicable transaction request timer(s) to control the message flow rate while relying upon a CRC calculation to verify the data integrity of all received messages.

A Transaction Request Timer T_i with expiration time $Tmax_i$ is started when a transaction request message of priority level "i" is sent to an ONT, and stopped upon receipt of an error-free acknowledgement message containing the same transaction correlation id value. If a valid acknowledgement message is not received by the OLT after timer T_i expires, the OLT re-sends the original transaction request message.

A retransmitted acknowledged transaction request message carries the same correlation ID as the original message. Each time an acknowledged transaction request message is retransmitted by the OLT, the transmitter increments the Retry Counter R_i (the counter associated with priority level "i" acknowledged transaction requests). When a retry counter R_i (initialized to 0x00 upon start-up) reaches the maximum retry value, $Rmax_i$, the transmitter stops re-transmitting the message and declares an OMCC link state error.

Note that these timers (T_i) and retry counters (R_i) are only maintained within the OLT controller and do not exist within the ONT. Furthermore, the default threshold values for timer expiration ($Tmax_i$) and number of retries ($Rmax_i$) are not subject to standardization. It is suggested that the default threshold values of both Tmax and Rmax be independently configurable for each priority level. The default value for $Tmax_1$ (i.e. high priority threshold) should account for the typical message transmission delay plus the command message response time.

These flow control/error recovery procedures are illustrated in Figure 14 for a case where the OMCC link is not permanently broken. First the OLT sends an acknowledged transaction request (Message 1) with priority level 0. Subsequently (i.e. while Message 1 is still outstanding), the OLT issues an additional acknowledged transaction request (Message 2) with priority level 1. Both of these commands are received and executed with the associated response (acknowledgement messages) returned to the OLT by the ONT. The acknowledgement for Message 1 is received by the OLT in time, however the response to Message 2 is lost and never received. The OLT detects that something went wrong because timer T_1 expires and the OLT therefore retransmits the original command (Message 2). Note that the ONT detects that this retransmitted command is identical to the last received command (for priority level 1) and therefore does not re-execute it. The ONT simply retransmits the original response from the previous execution of Message 2, which reaches the OLT in time. Finally, the OLT sends an acknowledged transaction request (Message 3) with priority level 0, but the message itself gets lost and is never properly received by the ONT. After the associated timer (T_0) expires, the OLT retransmits the command and now all goes well.

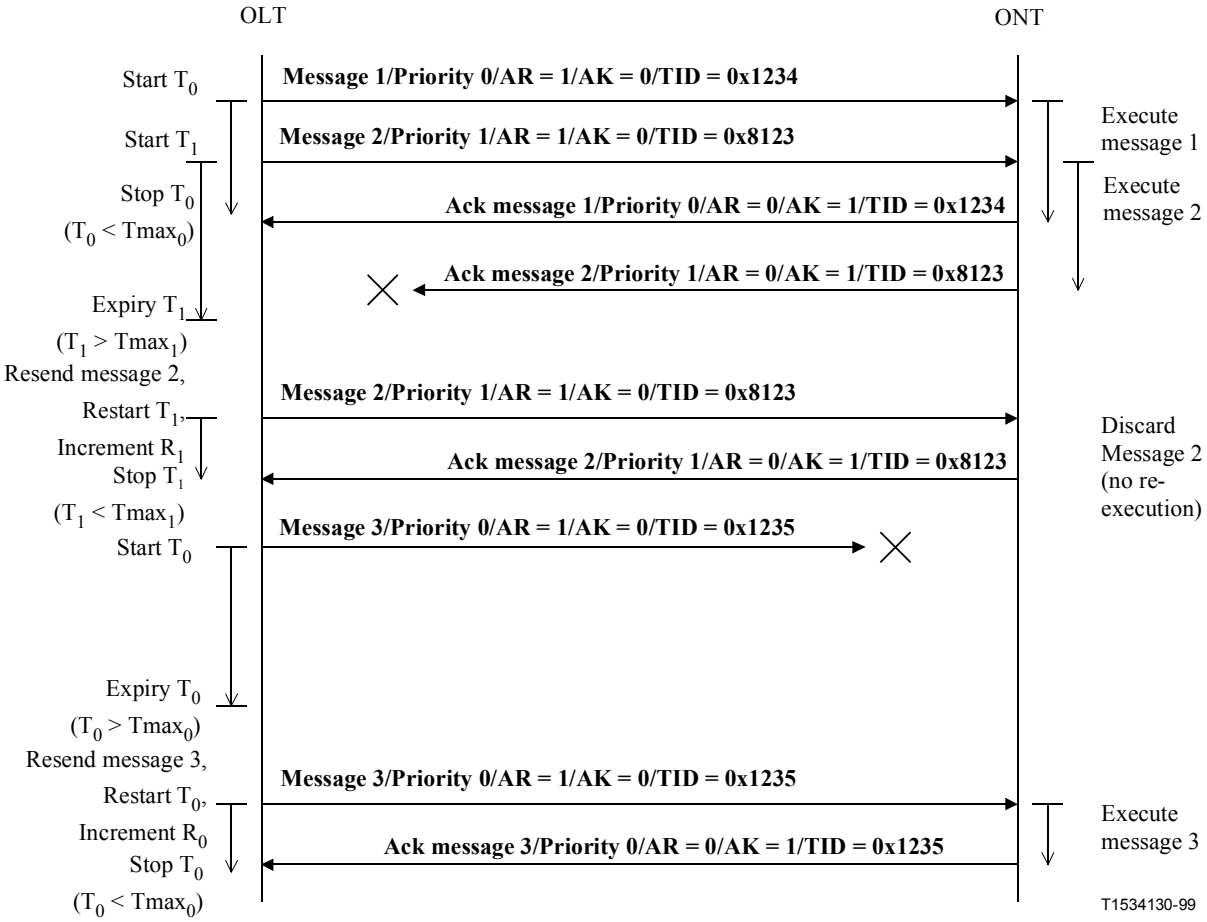


Figure 14/G.983.2 – Concurrent Message Exchange with Error Recovery

The case that the OMCC link is effectively broken (down) is shown in Figure 15.

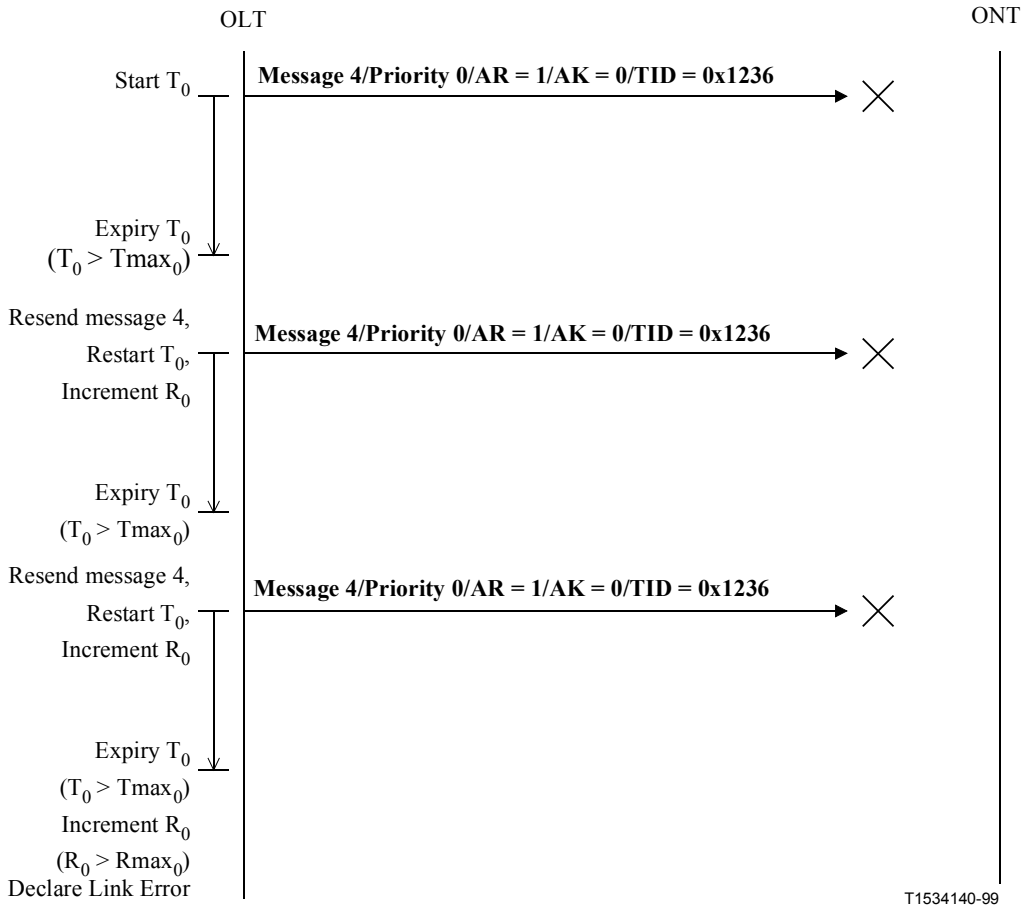


Figure 15/G.983.2 – OMCC Link Error Detection

9.3 OMCI Handling within the ONT

9.3.1 Prioritized Protocol Entities

This clause specifies the behaviour of the ONT more precisely than in the preceding clause in 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 16.

When the ONT receives an ATM cell via the VCC associated with the management channel, it shall calculate the CRC and compare it with the value found in the AAL 5 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 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 AAL 5 trailer to the cell payload, and transmit the message to the OLT.

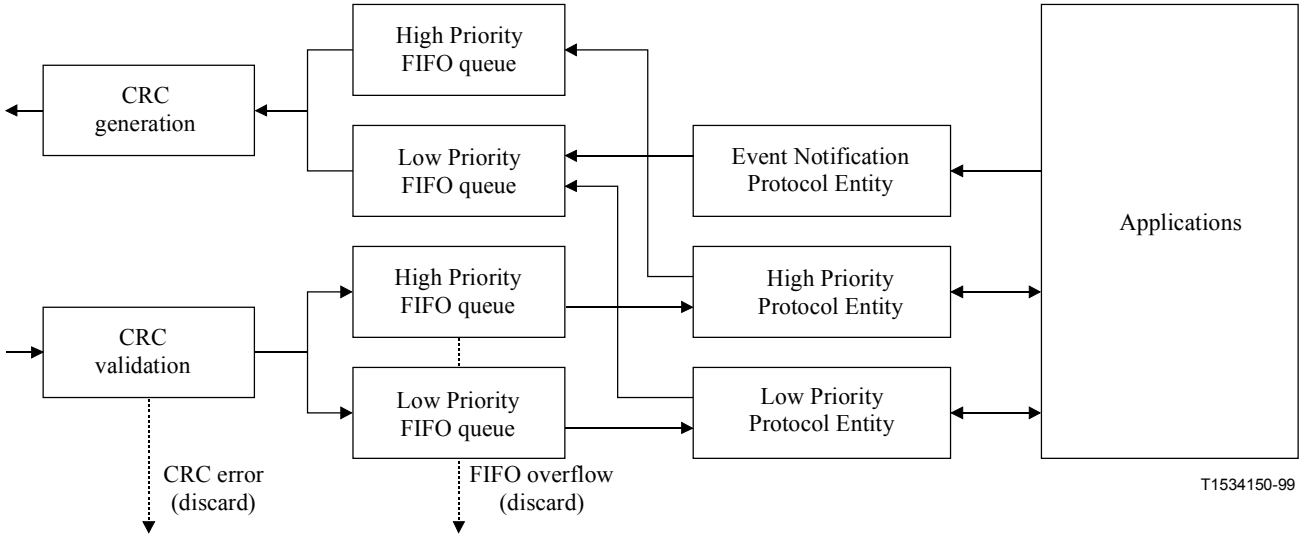


Figure 16/G.983.2 – Protocol Entities within the ONT

9.3.2 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

The common mechanisms consist of:

a) MIB data sync increase.

b) MIB audit and resynchronization.

c) Alarm sequence number increase.

d) Alarm audit and resynchronization.

These common mechanisms will be explained by the use of scenario diagrams.

I.1.1 MIB Data Sync Increase

The MIB at the OLT and the instances of the managed entities in the ONT have to be synchronized at all times. This clause describes the means for achieving this. The "tool" used for this is the MIB data sync attribute of the ONT Data managed entity.

The MIB data sync attribute is a global 8-bit *sequence number*. When auditing the MIB in the ONT, the OLT requests this sequence number. If this number coincides with the corresponding sequence number in the OLT, no further action is needed, as the two MIBs, in ONT and OLT, are thought to be identical. If there is a discrepancy, the OLT either downloads its copy, including the MIB data sync, of the MIB to the ONT, or uploads the MIB of the ONT, compares it with its own MIB, sends the necessary commands to the ONT to correct the differences and downloads its sequence number.

The ONT will be audited in three cases, in respect to its MIB:

a) On loss and re-establishment of the OMCC.

b) Periodically, based on the operator's requirements.

c) On demand of the OpS.

On detecting a newly installed ONT, regardless of the sequence number of its MIB, the OLT will download (configure) a MIB to that ONT.

The MIB data sync counter will be incremented for the creation and deletion of managed entity instances which are the consequence of a command by the OLT. The MIB data sync counter will also be incremented for attribute value changes which are the consequence of a command by the OLT. The MIB data sync counter will be incremented once per executed command (see Figure I.1).

In contrast, the MIB data sync counter will not be incremented for autonomous creation and deletion of managed entity instances by the ONT itself. Neither will the MIB data sync counter be incremented for autonomous changes to attributes of managed entities within the ONT, see Figure I.2.

The order in which the OLT and the ONT will update their MIB and increment the MIB data sync is not imposed. However, both the OLT and the ONT must locally update the MIB and increment the MIB data sync as one atomic action.

When incremented, the sequence number that follows 255 is 1. 0x00 reserved for the following cases:

a) Default MIB with which the ONT left the factory.

b) An ONT which after (re-) initialization cannot restore its MIB.

Note that no mechanisms exist to detect that an autonomous attribute value change notification has been lost. Therefore, the OLT must regularly read the values of the attribute that can change their value autonomously.

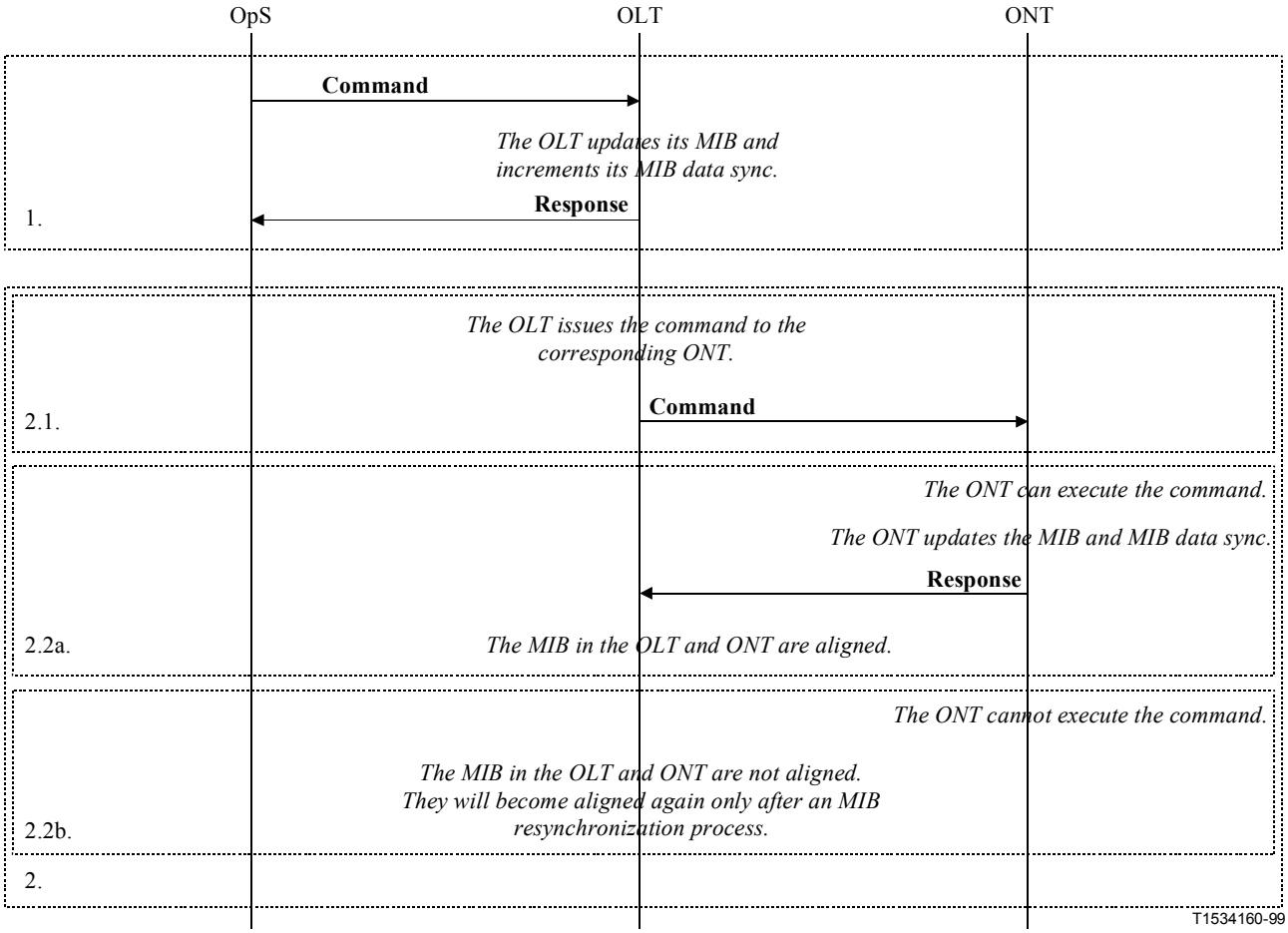


Figure I.1/G.983.2 – Increment of MIB data sync at ONT and OLT under OLT command

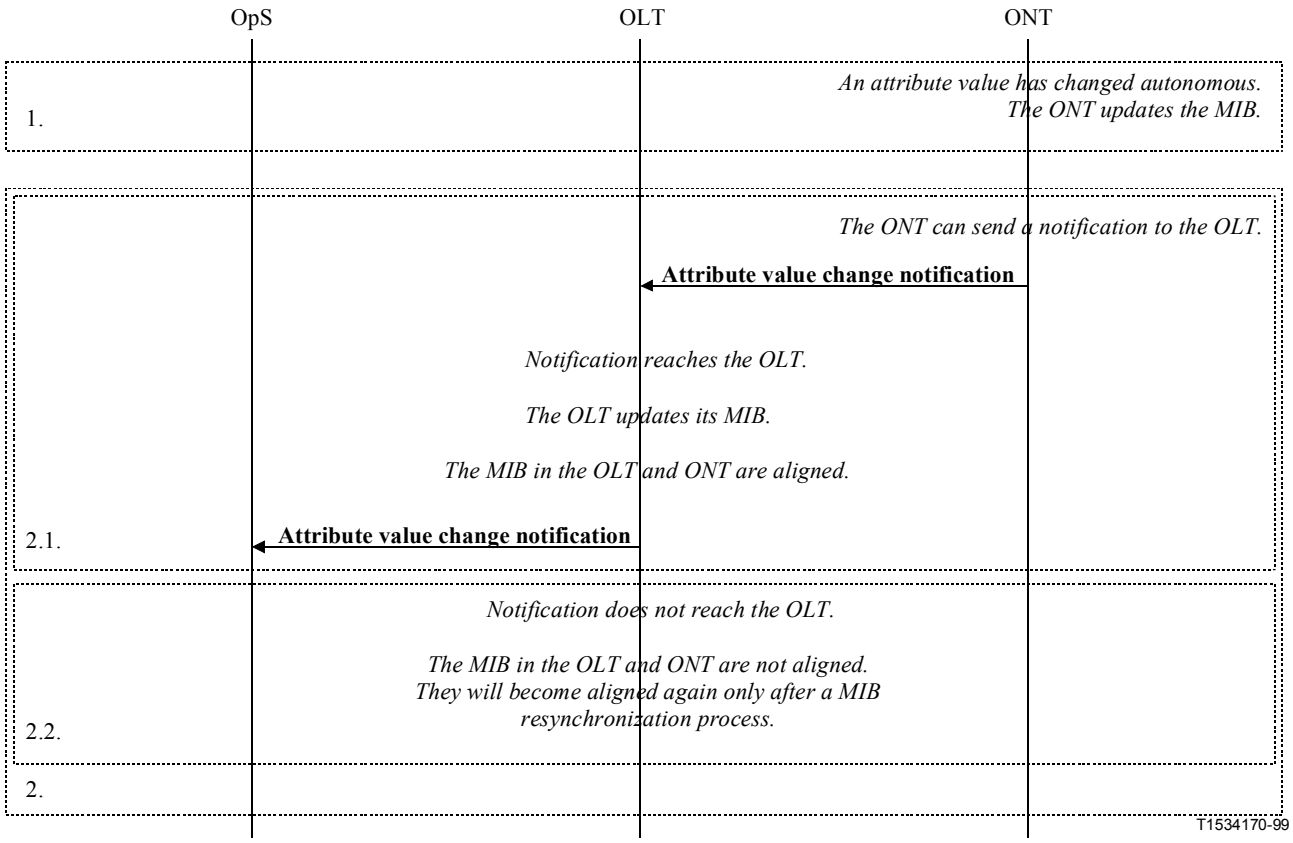
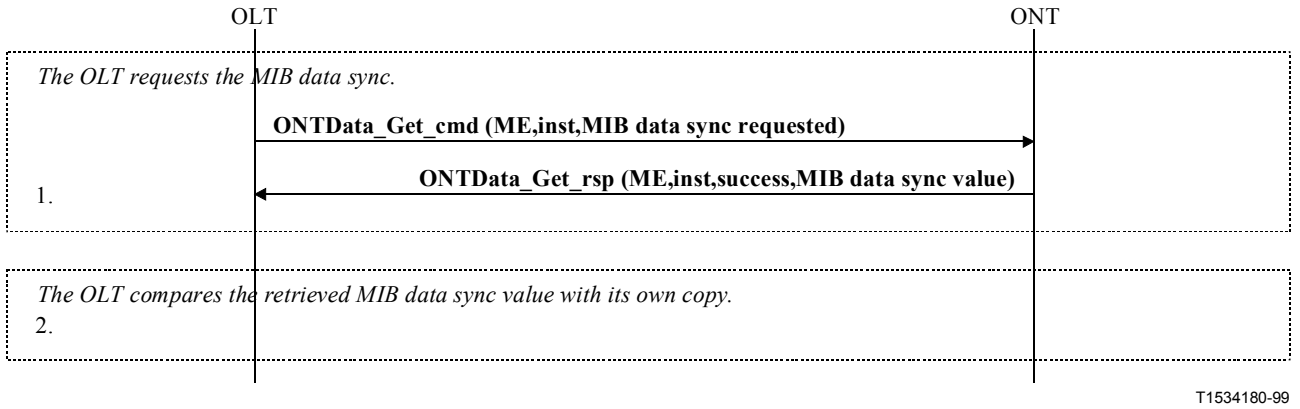


Figure I.2/G.983.2 – No increment of MIB data sync at ONT and OLT in case of attribute value changes

I.1.2 MIB Audit and Resynchronization

Figure I.3 shows the scenario diagram of the MIB audit and MIB resynchronization process.



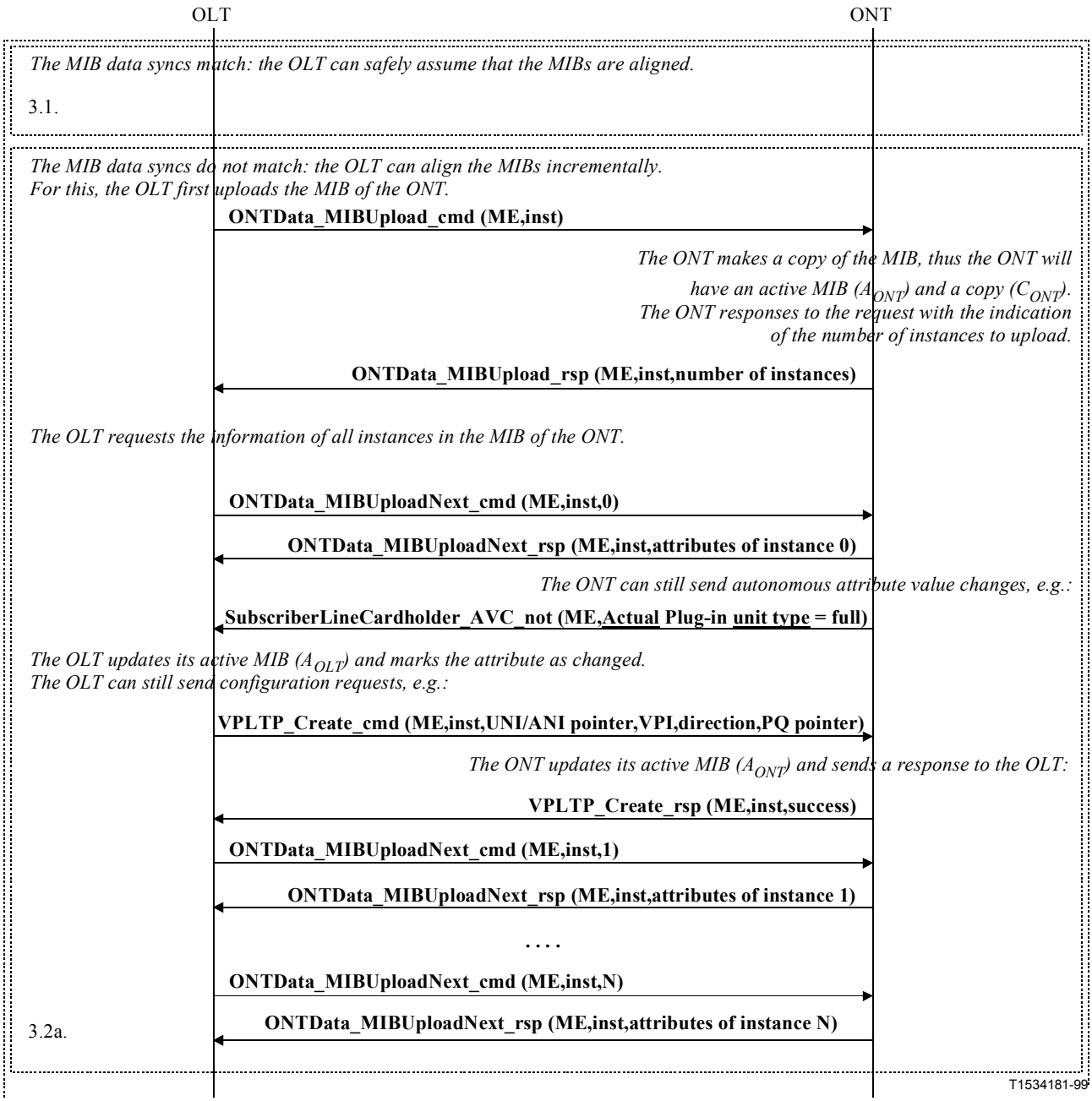


Figure I.3/G.983.2 – Audit and MIB resynchronization

The OLT must issue as many MIBUploadNext requests as the number of instances given in the MIBUpload response. The maximum time between two MIBUploadNext request is 1 minute. If the OLT does not send a MIBUploadNext request within this time after the previous MIBUploadNext request or after the MIBUpload start request, the ONT assumes the MIB upload to be terminated. The ONT can drop the copy of the MIB.

I.1.3 Alarm Sequence Number Increase

The ONT informs the OLT of alarm status changes by sending alarm status change notifications. Note that these notifications are sent in unacknowledged messages that carry an eight bit alarm sequence number for the benefit of the OLT to detect loss of alarm notifications (see Figure I.4 and I.1.4). After a restart of the ONT, the alarm sequence number is reset so that the first alarm notification sent by the ONT will have an alarm sequence number equal to 1. The alarm message

sequence number is incremented for each alarm notification and wraps around from 255 to 1. Consequently, an alarm notification with sequence number 0x00 will never be sent.

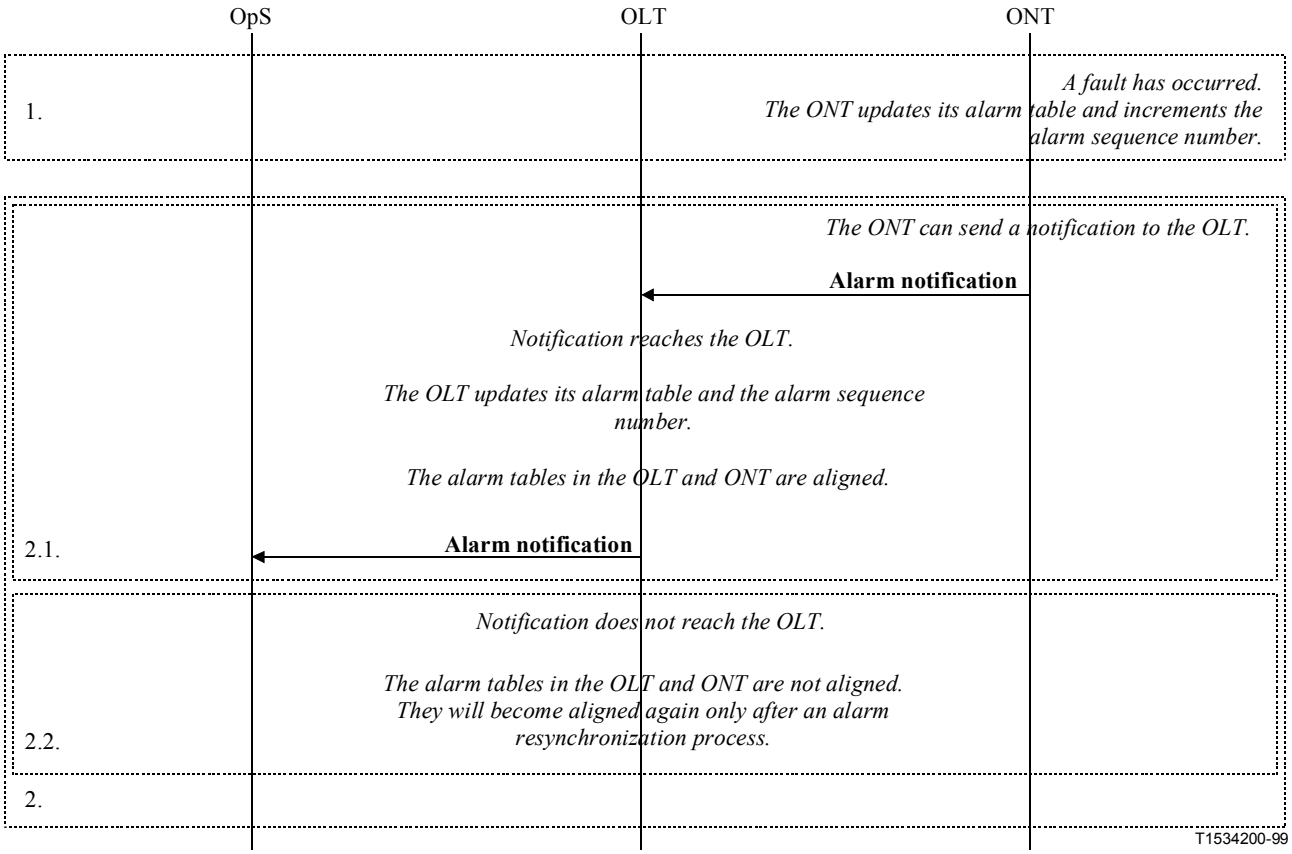


Figure I.4/G.983.2 – Increment of alarm sequence number at ONT and OLT

I.1.4 Alarm Audit and Resynchronization

When the OLT detects a gap in the received sequence, as shown in Figure I.5, it asks the ONT for an alarm status report by sending a "Get All Active Alarms" command. Obviously, this command is acknowledged by a response that contains the number of managed entity instances that have outstanding alarms. The OLT will request the alarm status of all these managed entities instances via the "Get All Alarms Next" command. The OLT will compare these alarm statuses of all these instances with its own and will notify the network manager of the changes. The alarm sequence number is reset by the ONT when it receives the "Get All Active Alarms" request.

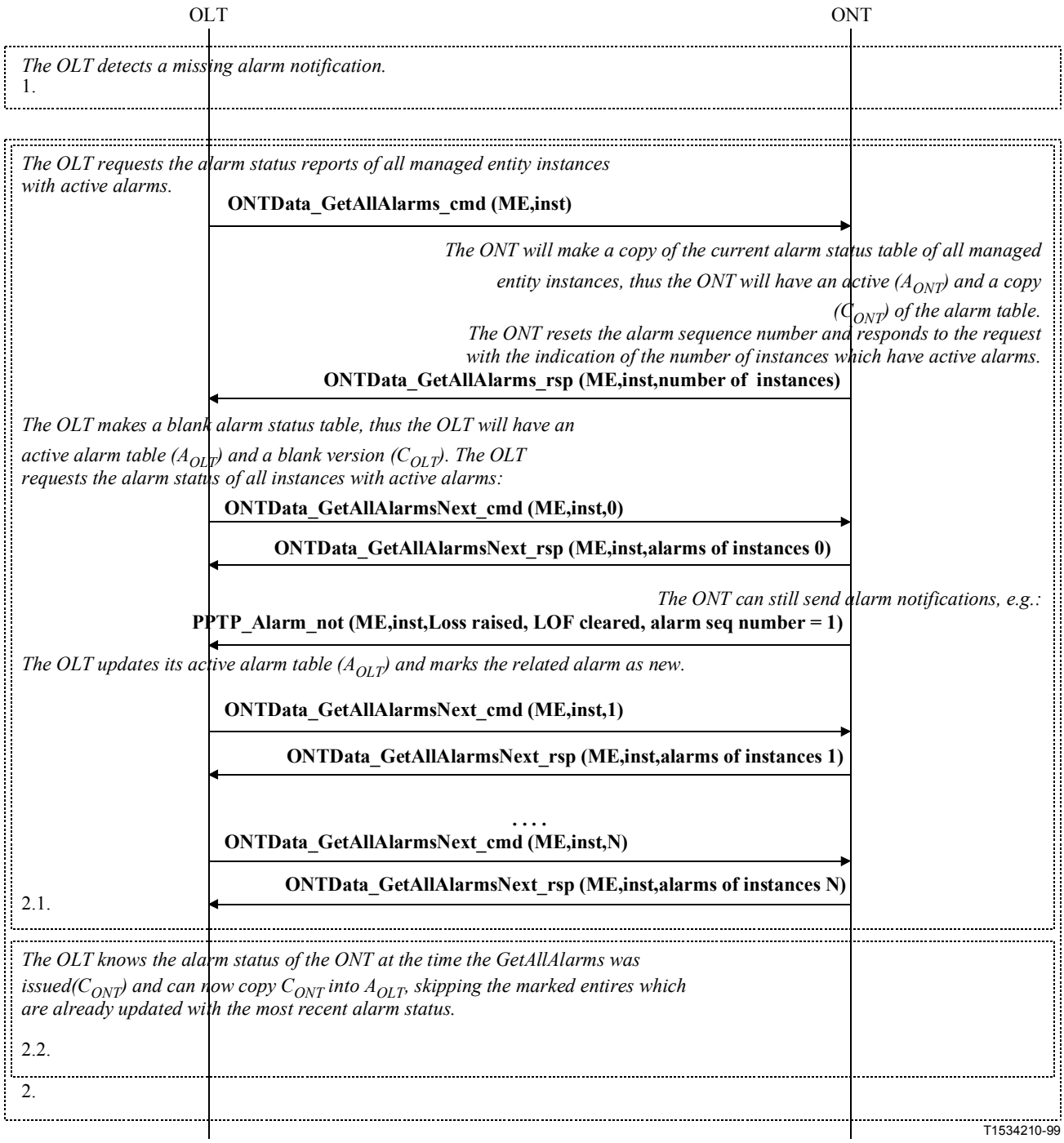


Figure I.5/G.983.2 – Audit and alarm resynchronization

The OLT must issue as many GetAllAlarmsNext requests as the number of instances given in the GetAllAlarms start response. The maximum time between two GetAllAlarmsNext requests is 1 minute. If the OLT does not send a GetAllAlarmsNext request within this time after the previous GetAllAlarmsNext request or after the GetAllAlarms start request, the ONT assumes the alarm upload to be terminated. The ONT can drop the copy of the alarm table.

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 breakdown;

h) software image download;

i) software image changes.

All the listed services will be explained by the use of scenario diagrams.

I.2.1 Start-up phase of ONT

The start-up phase of an ONT, from the OMCI point of view, belongs to one the two cases:

a) the ONT is "new" to the OLT; and

b) the OLT already "saw" this ONT at this PON.

The details of start-up scenarios also vary for ONT with different configurations options, e.g.

a) ONT with cardholders at both PON IF and UNI;

b) ONT with integrated interfaces at both PON IF and UNI;

c) ONT with cardholders at PON IF and integrated interfaces at UNI; and

d) ONT with integrated interfaces at PON IF and cardholders at UNI.

Here the following scenarios will only show cases a) and b) from which the scenarios for cases c) and d) can be deduced.

Figure I.6 shows the start-up phase of a "new" ONT with Cardholders on both sides. Figure I.7 shows the start-up phase of a "new" ONT with integrated interfaces on both sides. Figure I.8 shows the start-up phase of an "old" ONT.

The behaviour of the ONT in respect to inserted Subscriber Line Cards during the start-up phase is not shown in the following figures. This behaviour is subject of I.2.2.

Note that if attribute value changes do not arrive at the OLT, the OLT will not know the number of cardholders or integrated ports that reside in the ONT. The OLT can request the information of the newly created managed entity instances by a sequence of get requests. If a get request is issued on a non-existing instance, the response message to the OLT will indicate the error – Unknown managed entity instance.

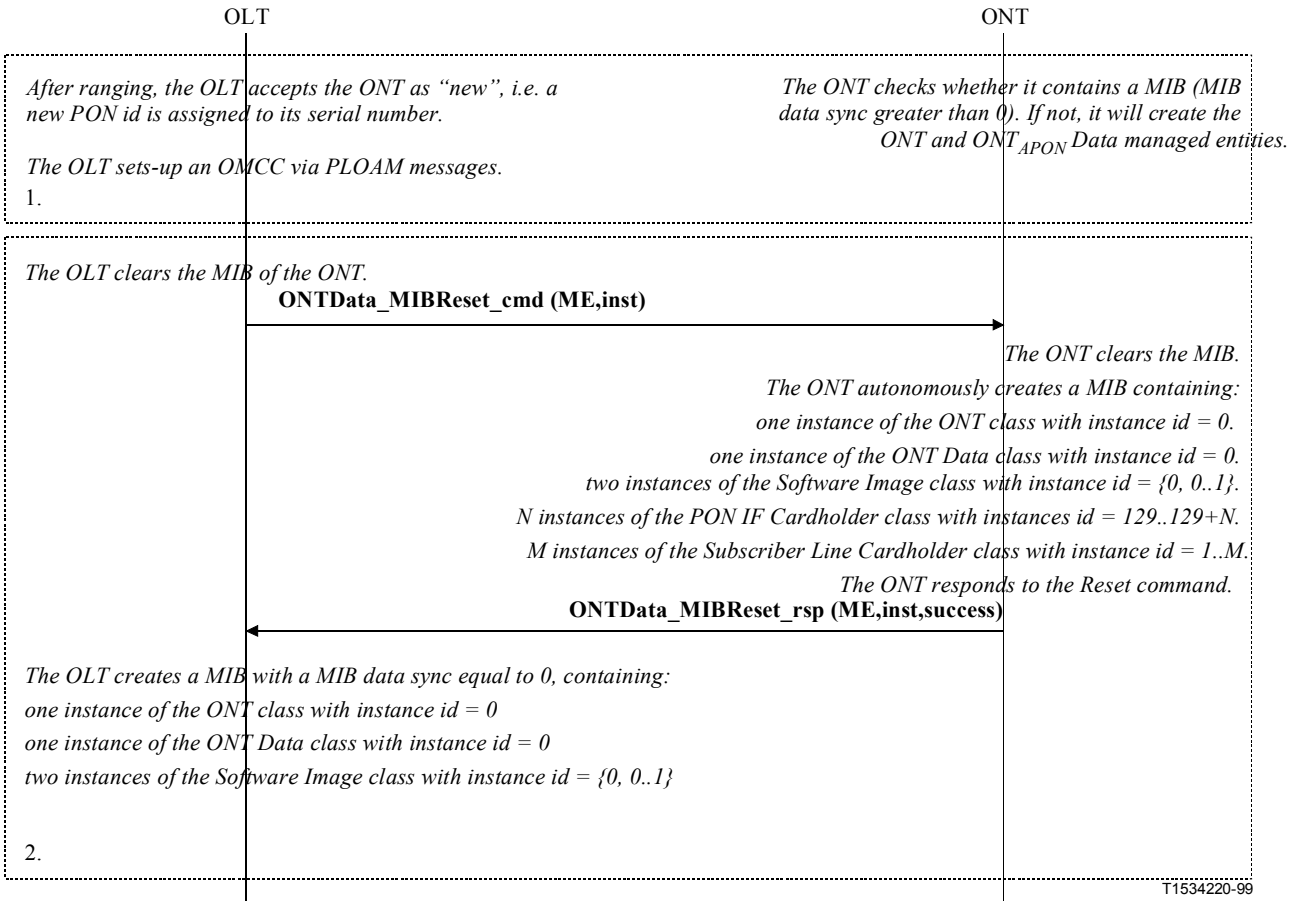
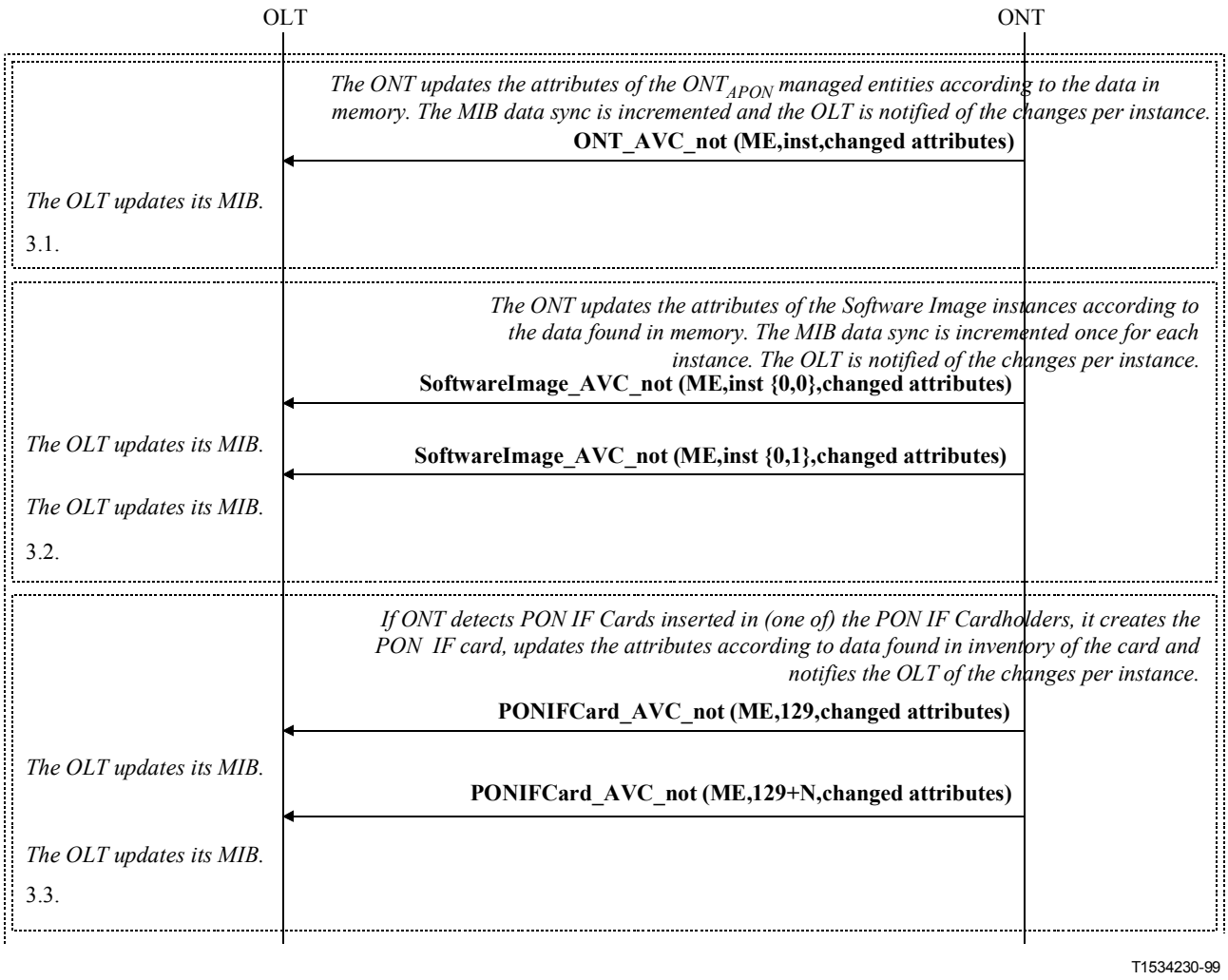


Figure I.6/G.983.2 – Start-up of a "new" ONT with Cardholders on both sides



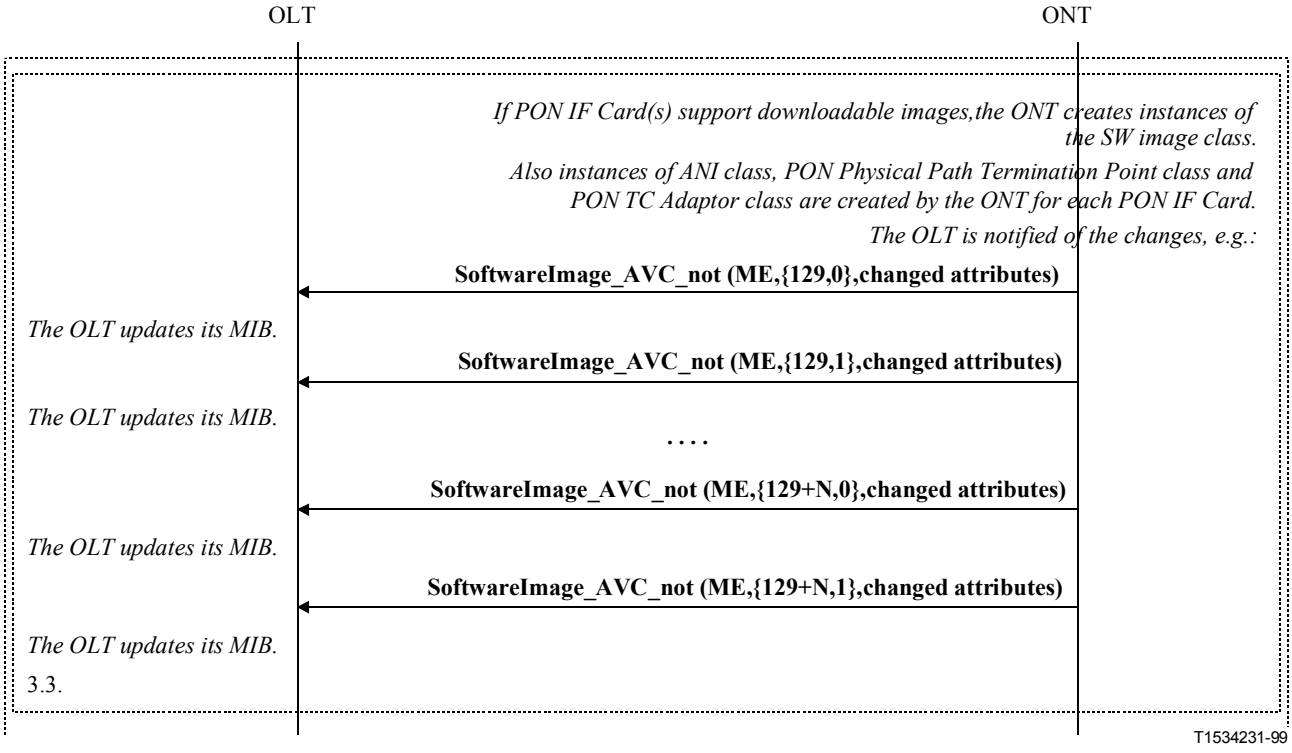


Figure I.6/G.983.2 – Start-up of a "new" ONT with Cardholders on both sides *(continued)*

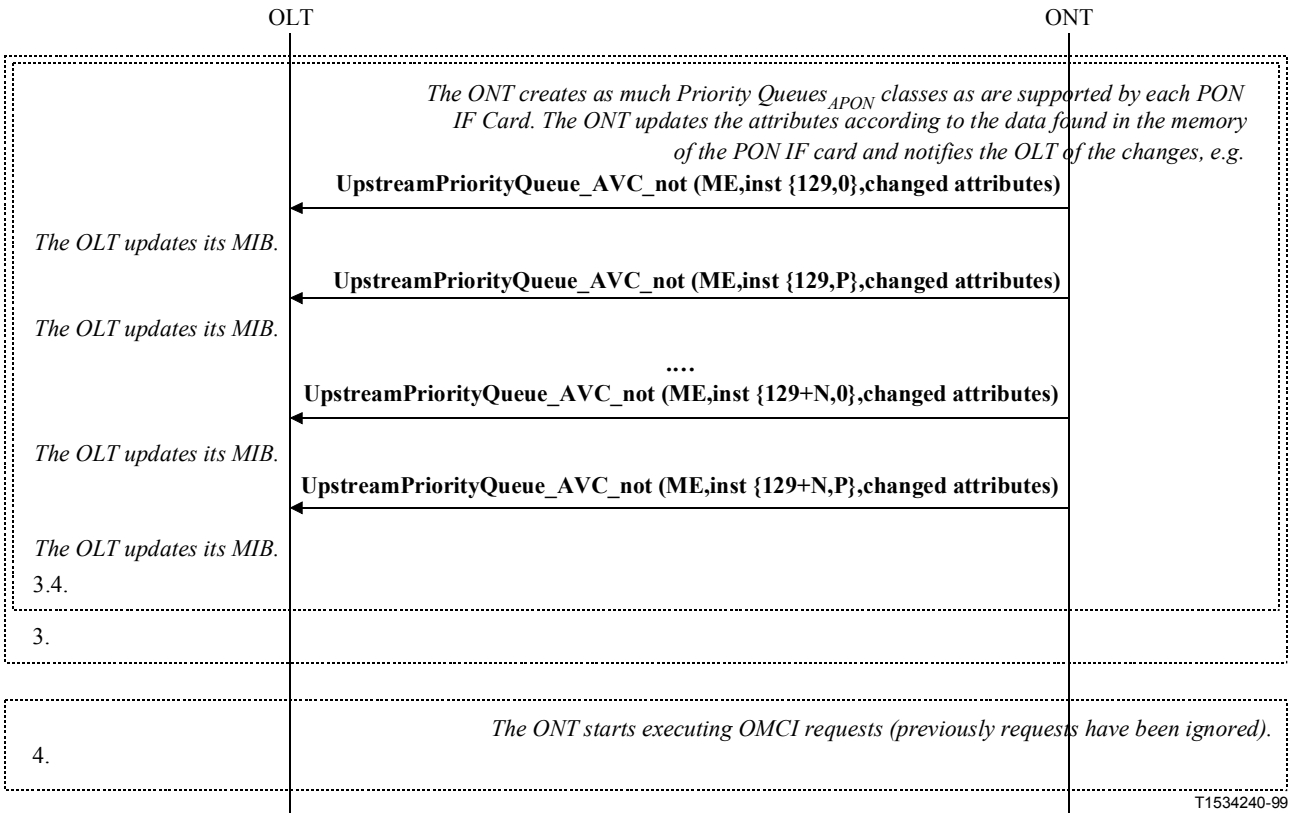
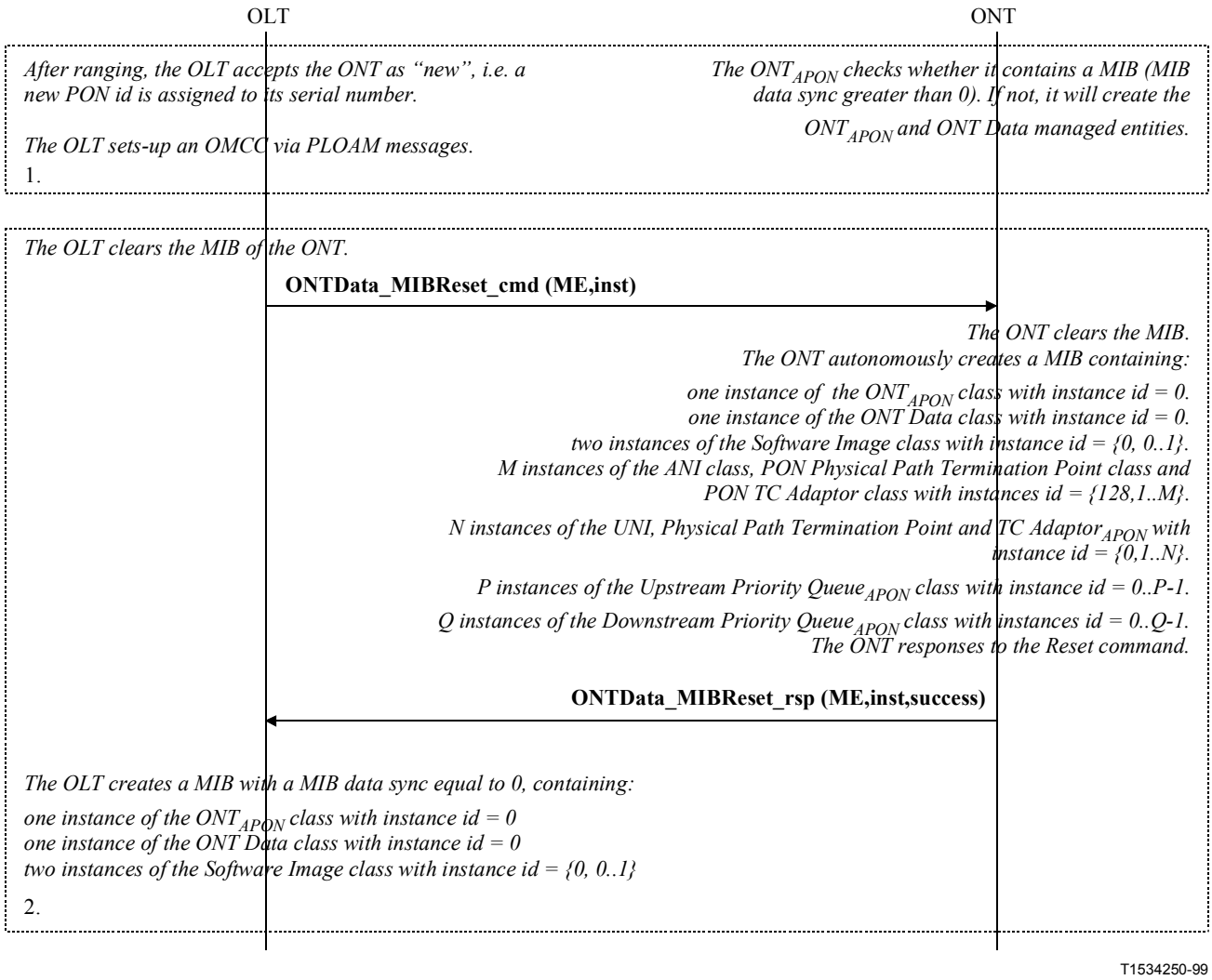


Figure I.6/G.983.2 – Start-up of a "new" ONT with Cardholders on both sides *(concluded)*



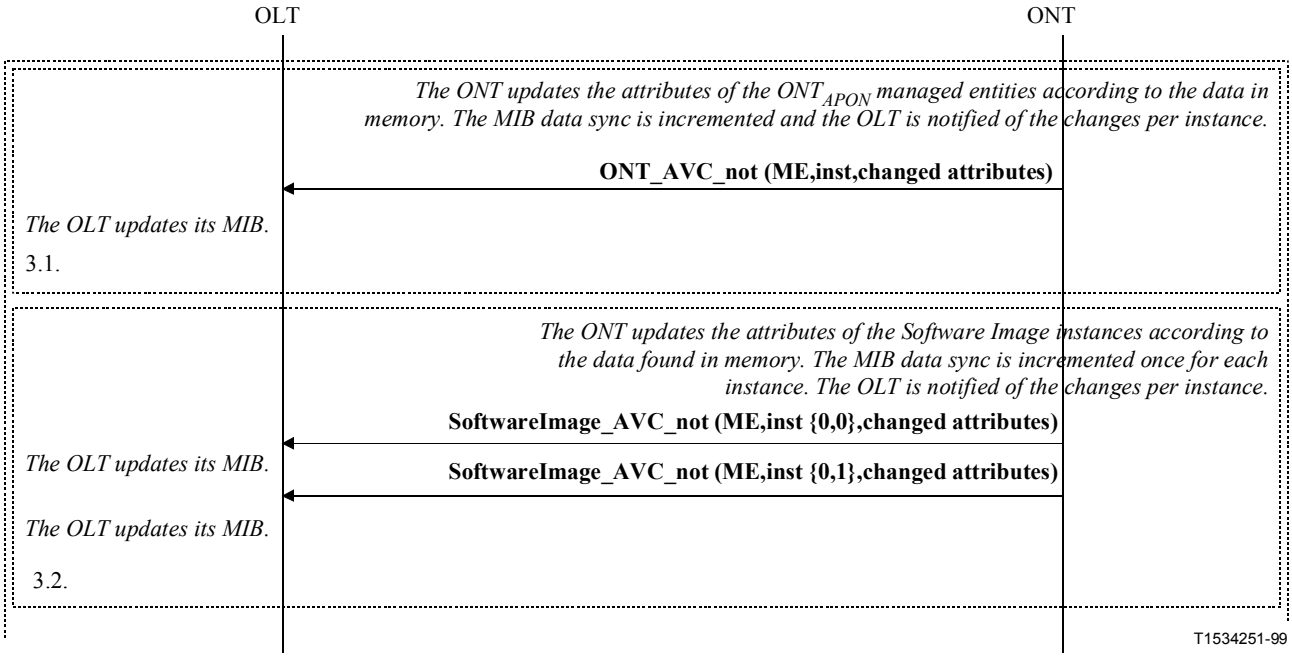


Figure I.7/G.983.2 – Start-up phase of a "new" ONT with integrated interfaces on both sides

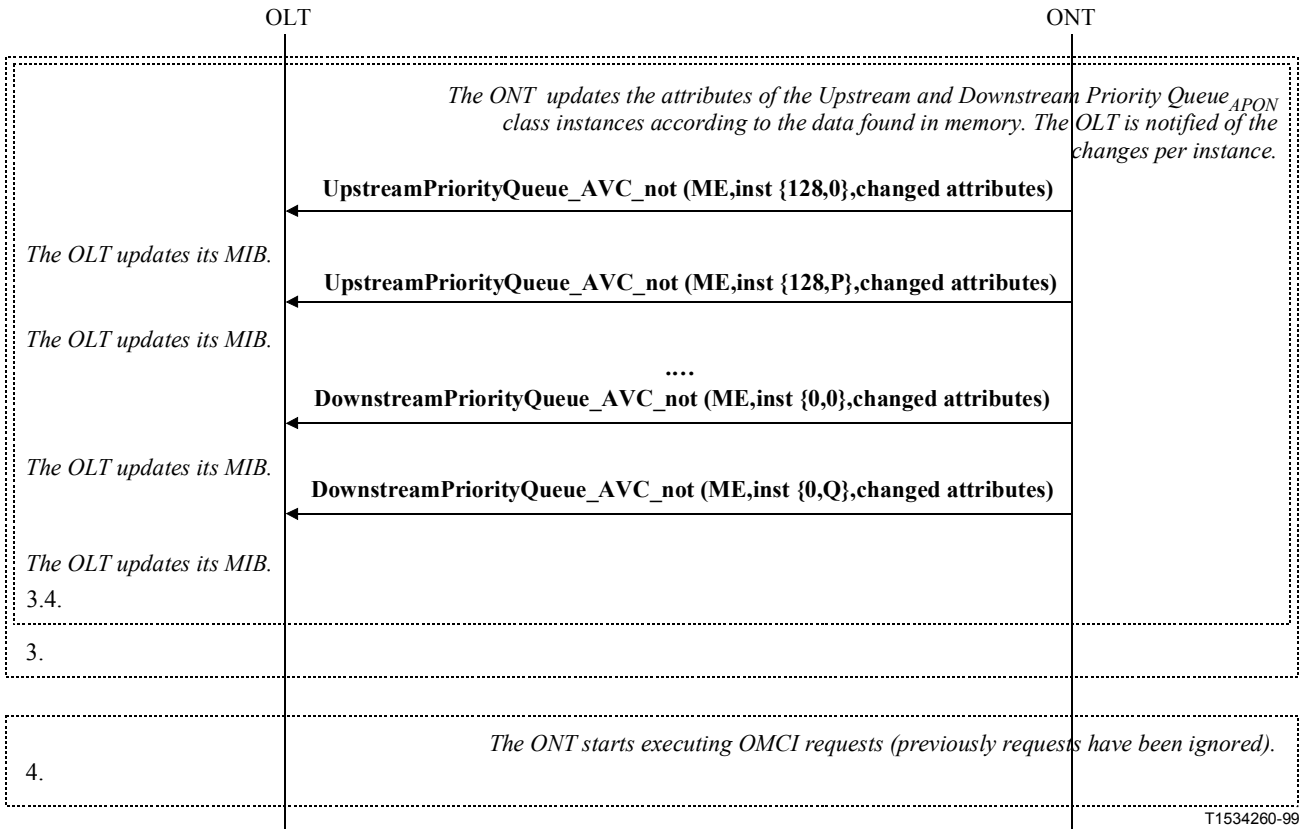


Figure I.7/G.983.2 – Start-up phase of a "new" ONT with integrated interfaces on both sides *(concluded)*

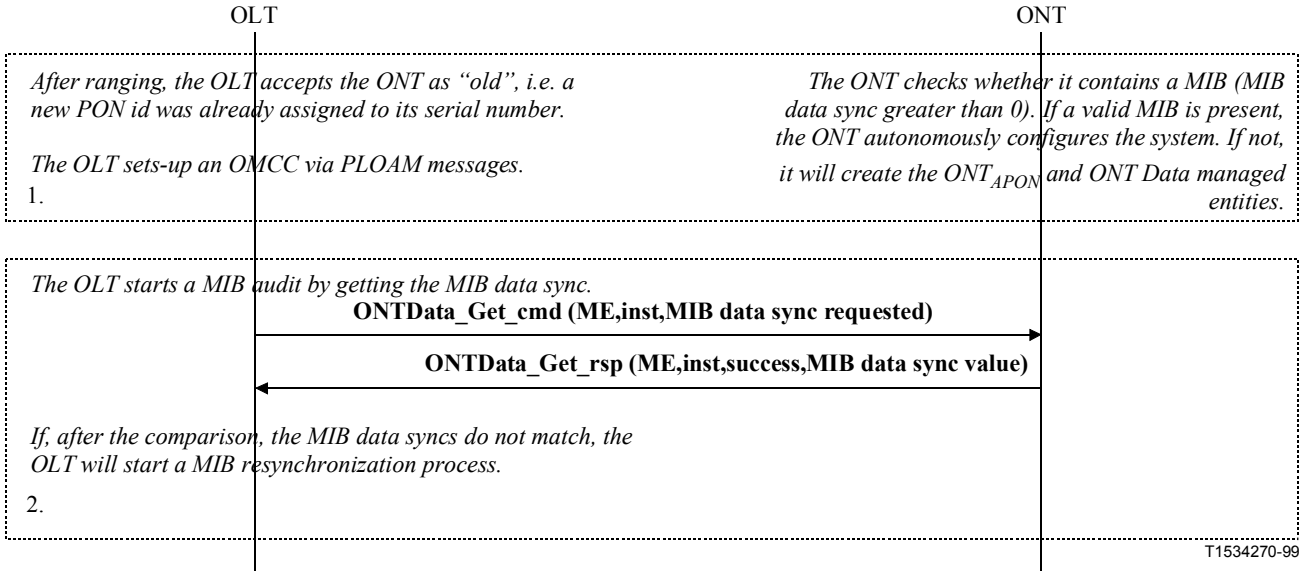


Figure I.8/G.983.2 – Start-up phase of an "old" ONT

I.2.2 Subscriber Line Card Provision/de-provision

The provisioning and de-provisioning of Subscriber Line Card can be triggered in two ways:

a) On demand by the OpS;

b) Plug-and-play, triggered by the detection of the card insertion/removal.

However, this trigger of provisioning and de-provisioning is transparent to the ONT, i.e. the ONT would always be used in the provisioning mode. The difference between plug-and-play mode and on-demand mode would reside in the OLT. In the case of on-demand mode, the OLT will provision (de-provision) the presence of the subscriber line card in the ONT when it has been provisioned (de-provisioned) by the operator, while in the case of plug-and-play mode, the OLT will provision the slot to "plug-and-play" and further provision (de-provision) the presence of the subscriber line card in the ONT as soon as it has received a notification from the ONT that a line card has been plugged in (out).

I.2.3 On-demand Subscriber Line Card Provisioning

NOTE – It is possible to provision a subscriber line card while a subscriber line card of the same or of a different type is provisioned for the subscriber line cardholder. In case a subscriber line card of the same type is already provisioned, the provisioned command will have no effect. In case a subscriber line card of a different type is already provisioned, this subscriber line card will be automatically de-provisioned and only then the system will be configured according to the newly given plug-in unit type. Figure I.9 shows the scenario of provisioning an ATM LIM. Figure I.10 shows the scenario of provisioning a non-ATM LIM.

Use of the attributes "Expected type" and "Sensed type" of the corresponding Physical Path Termination Point ATM/Native LAN/CES UNI.

Case 1

The supporting Subscriber Line Card or the ONT itself (the latter in case of integrated interfaces) only supports a specific type of interface. Notice that in the former case, the attribute "type" of the Subscriber Line Card will be equal to this type.

In this case, on creation of the Physical Path Termination Point managed entity instance, the attributes "Expected type" and "Sensed type" are both set equal to the specific interface type and the ONT sends attributes value change notifications to the OLT with the values of these attributes. It will not be possible for the OLT to change the value of the attribute "Expected type" later on (i.e. any attempt by the OLT to change the value of the attribute will be refused by the ONT).

Case 2

The supporting Subscriber Line Card or the ONT itself (the latter in case of integrated interfaces) supports interfaces of different types.

In this case, on creation of the Physical Path Termination Point managed entity instance, the attribute "Expected type" is set to autosensing (0x00) and attribute "Sensed type" is set to:

- unapplicable or unknown in case the interface does not support autosensing, respectively in case the autosensing fails (actually, the coding is 0x00 in both cases);
- the sensed type in case the interface supports autosensing and the autosensing was successful.

The ONT will send an attribute value change notification with the values of these attributes.

Later on, it will be possible for the OLT to change the value of attribute "Expected type" with the set action. The value of attribute "Sensed type" will be set equal to the value of attribute "Expected type". Notice however that the ONT will only execute the set action if the ONT supports the configured interface type.

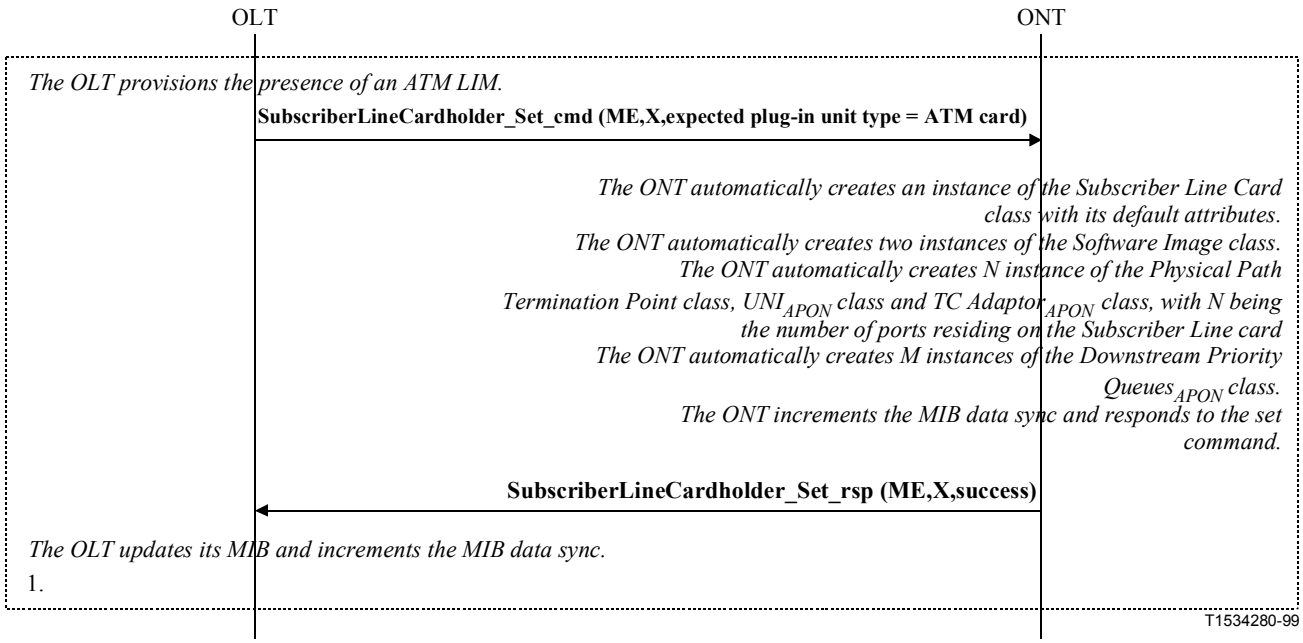
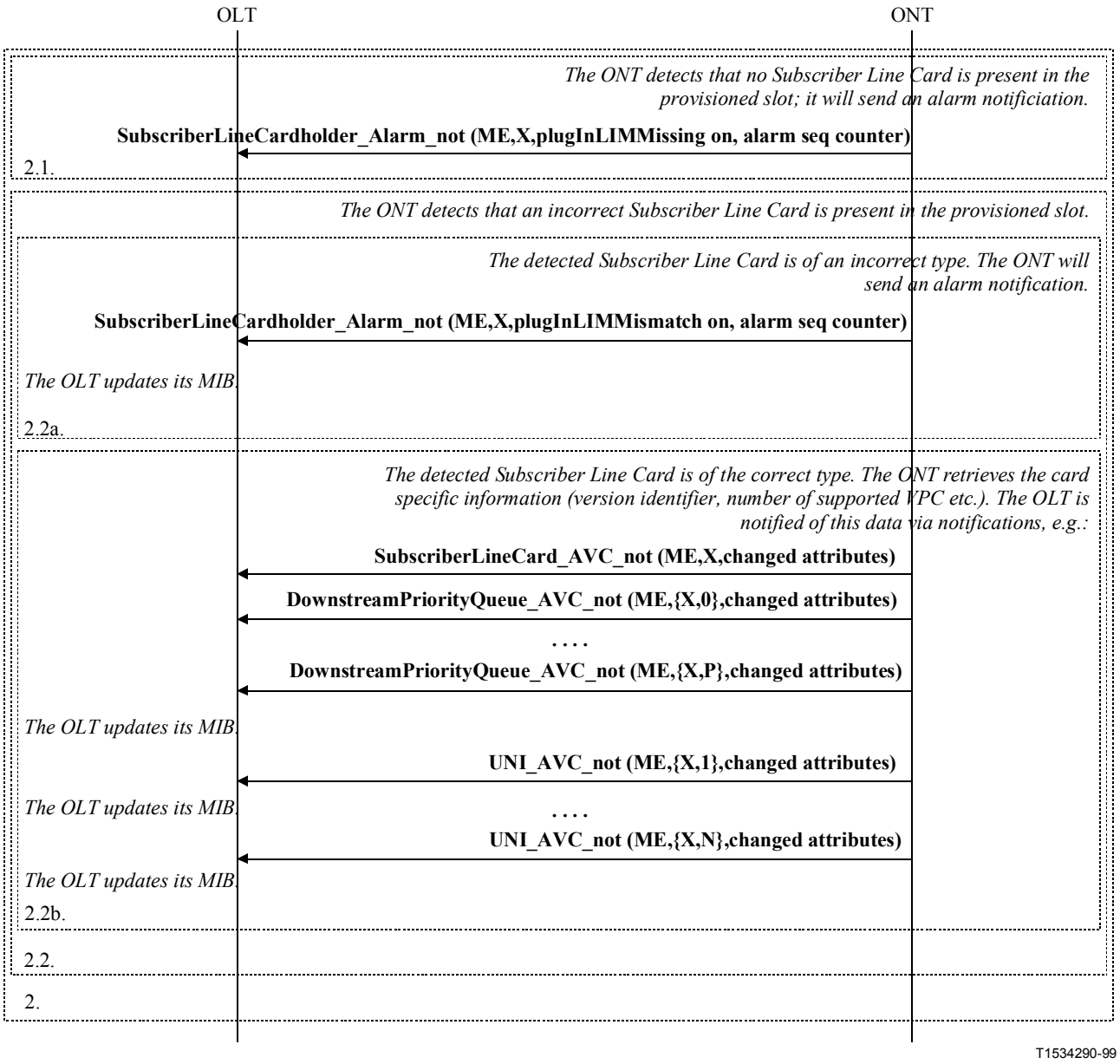


Figure I.9/G.983.2 – ATM Subscriber Line Card provisioning



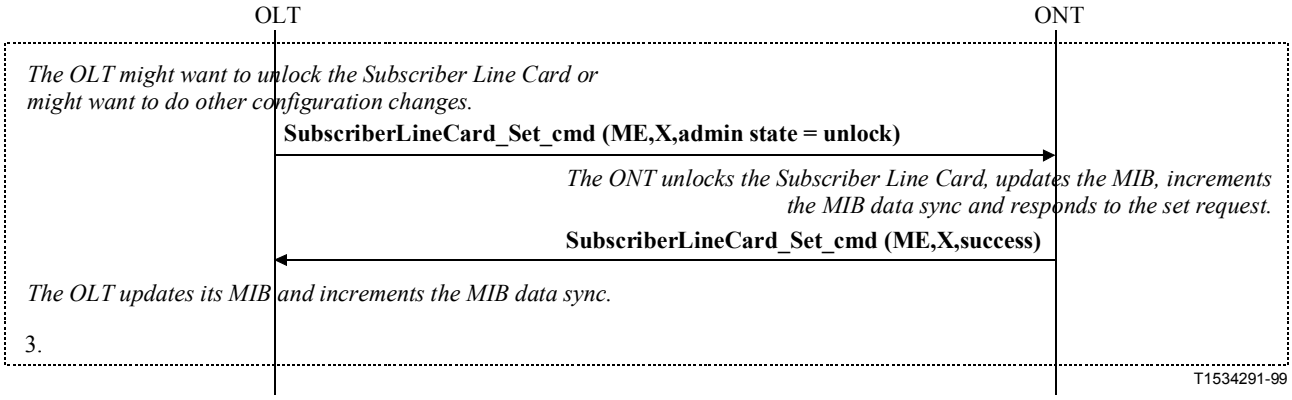
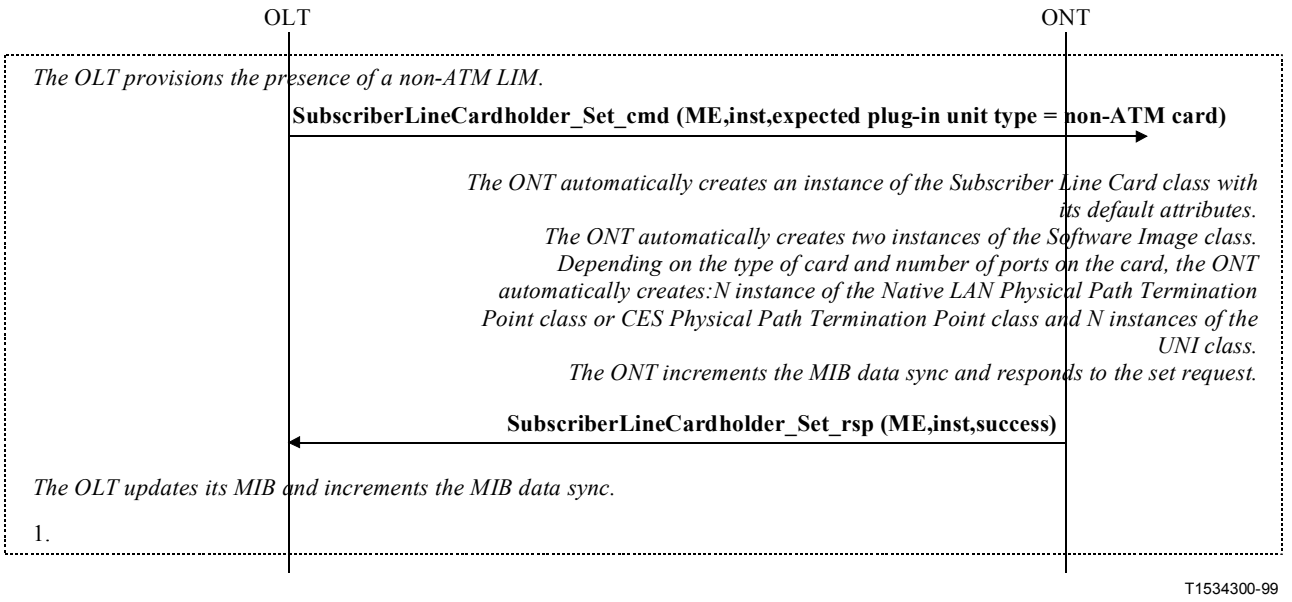


Figure I.9/G.983.2 – ATM Subscriber Line Card provisioning *(concluded)*



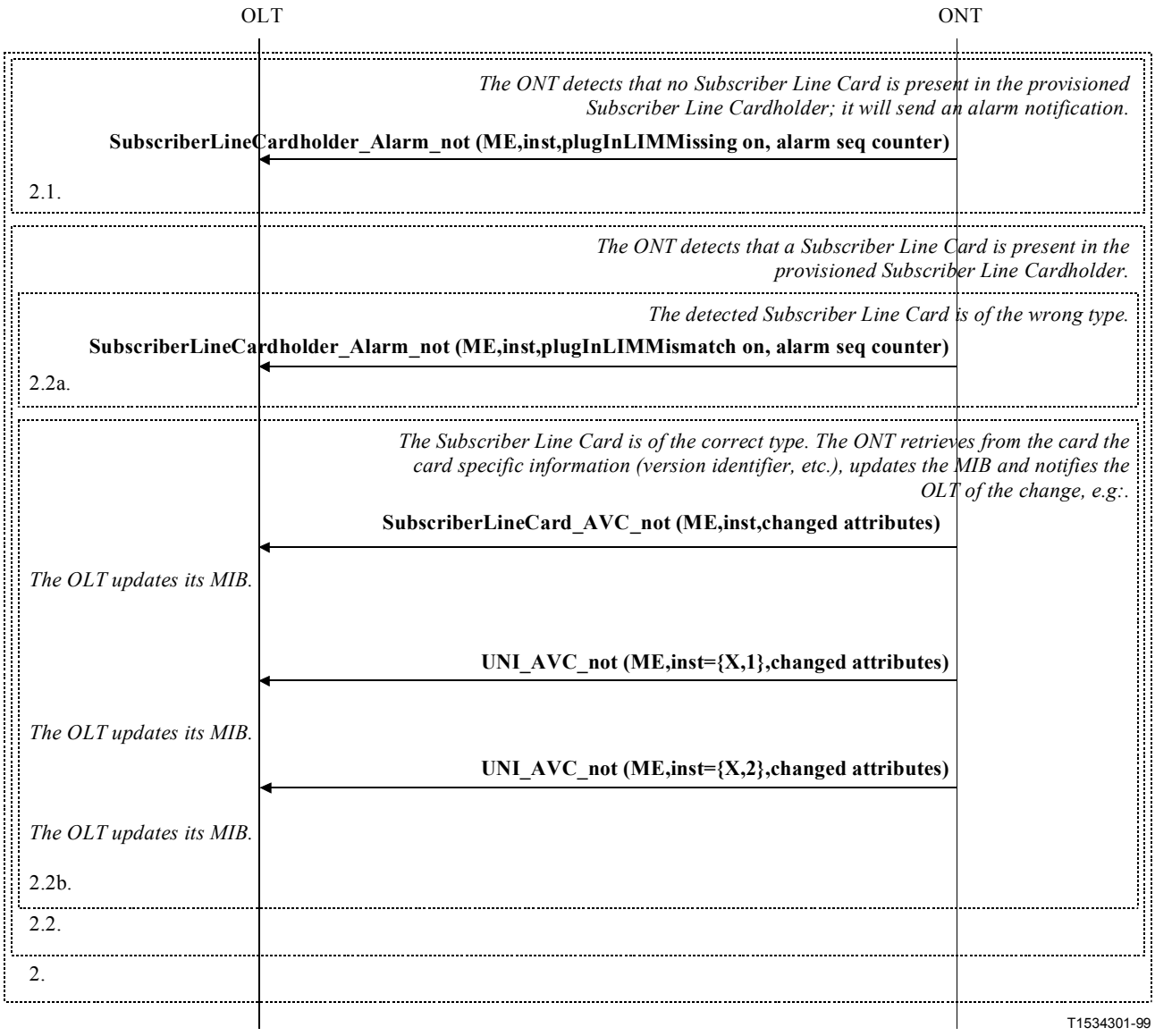


Figure I.10/G.983.2 – Non-ATM card Subscriber Line Card provisioning

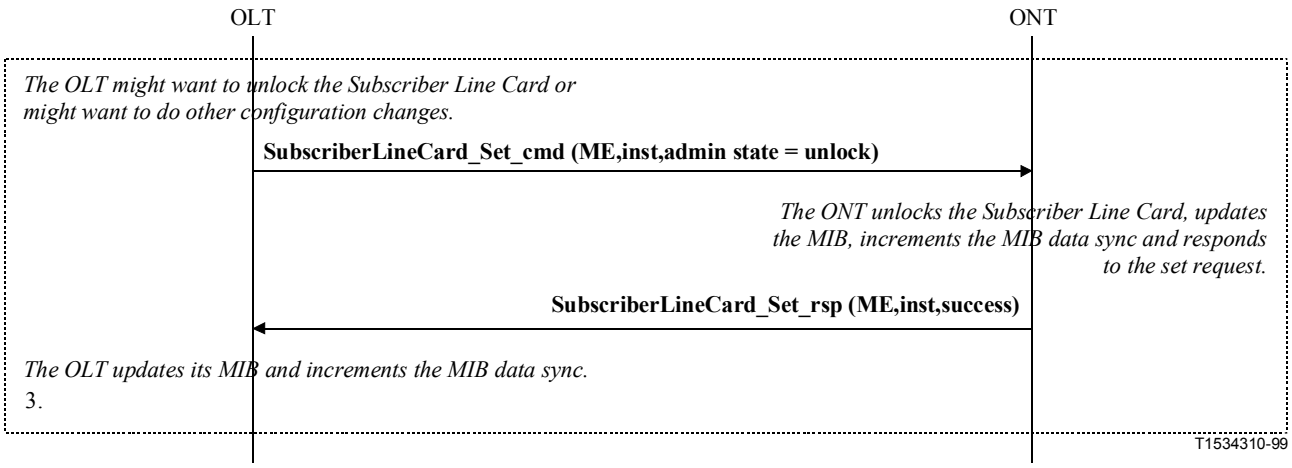


Figure I.10/G.983.2 – Non-ATM card Subscriber Line Card provisioning *(concluded)*

I.2.4 On-demand Subscriber Line Card De-provisioning

The ONT will delete all managed entities that it automatically created during the provision of this subscriber line card form the MIB. On the other hand OLT will be responsible to delete all those managed entities which are associated with this card and are created by the OLT. Figure I.11 shows the process of de-provisioning a Subscriber Line Card.

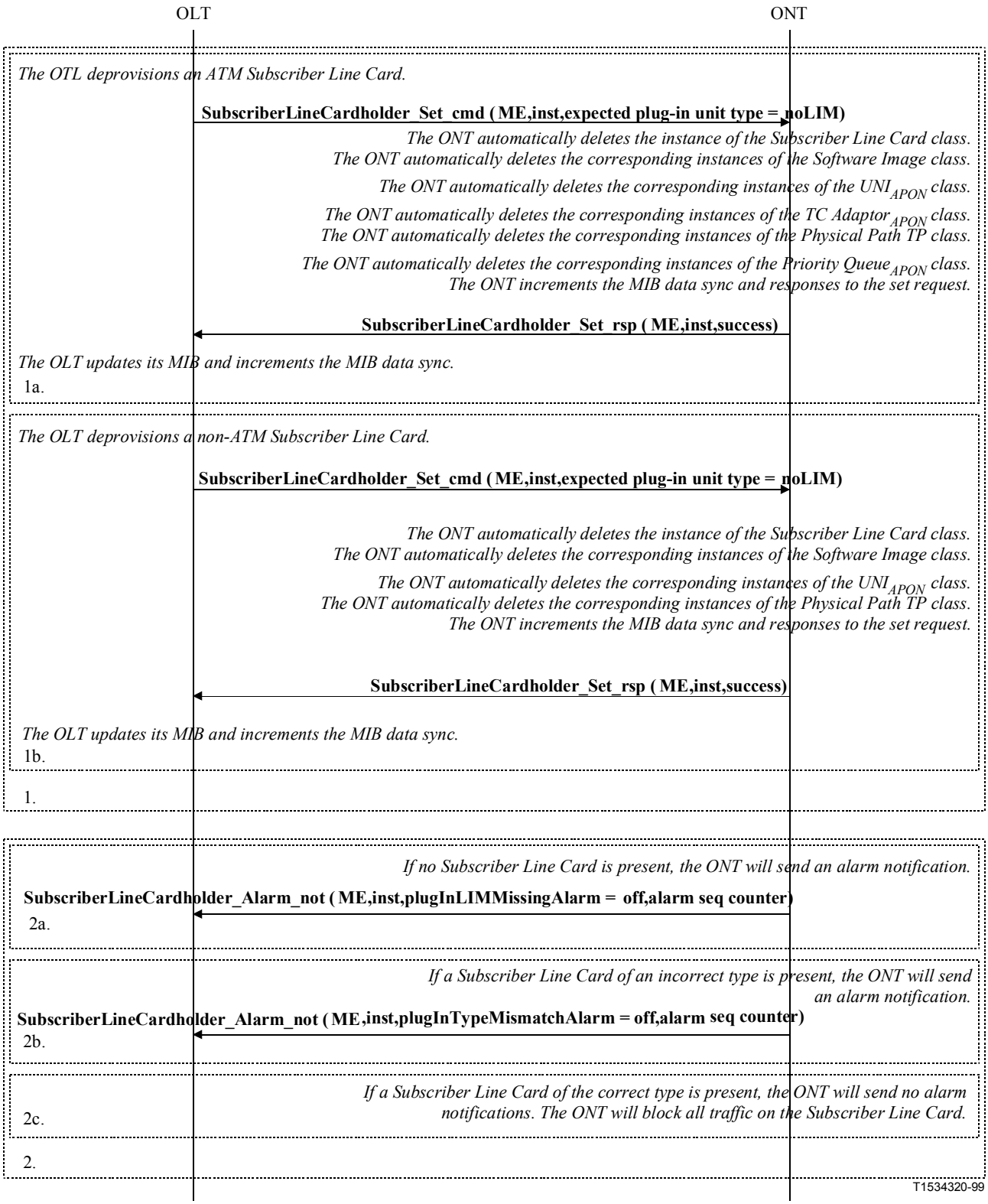


Figure I.11/G.983.2 – Subscriber Line Card de-provisioning

I.2.5 Plug-and-play Subscriber Line Card provisioning

A Subscriber Line Cardholder can be provisioned for a plug-and-play mode of operation (see also Figure 10). Figure I.12 shows the scenario of provisioning a slot for plug-and-play.

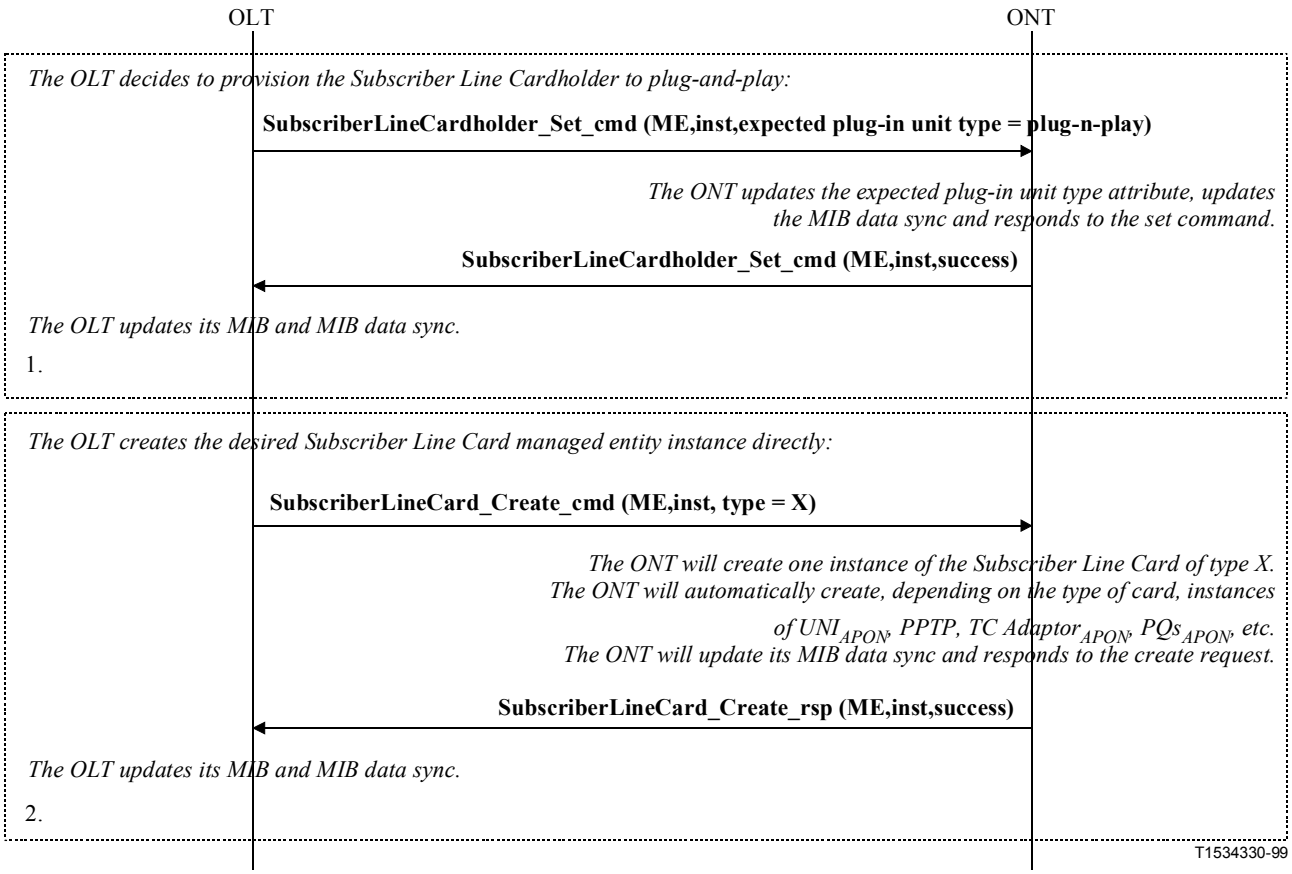


Figure I.12/G.983.2 – Plug-and-play Subscriber Line Card provisioning

Not shown in the scenario diagram given above are the notifications of the ONT due to incorrect inserted Subscriber Line Cards. Figure 10 is given for this purpose.

I.2.6 Plug-and-play subscriber line card de-provisioning

When a Subscriber Line Card is removed from a Subscriber Line Cardholder a notification will be send to the OLT. The OLT will de-provision the Subscriber Line Cardholder upon the receiving of the notification (see Figure I.13).

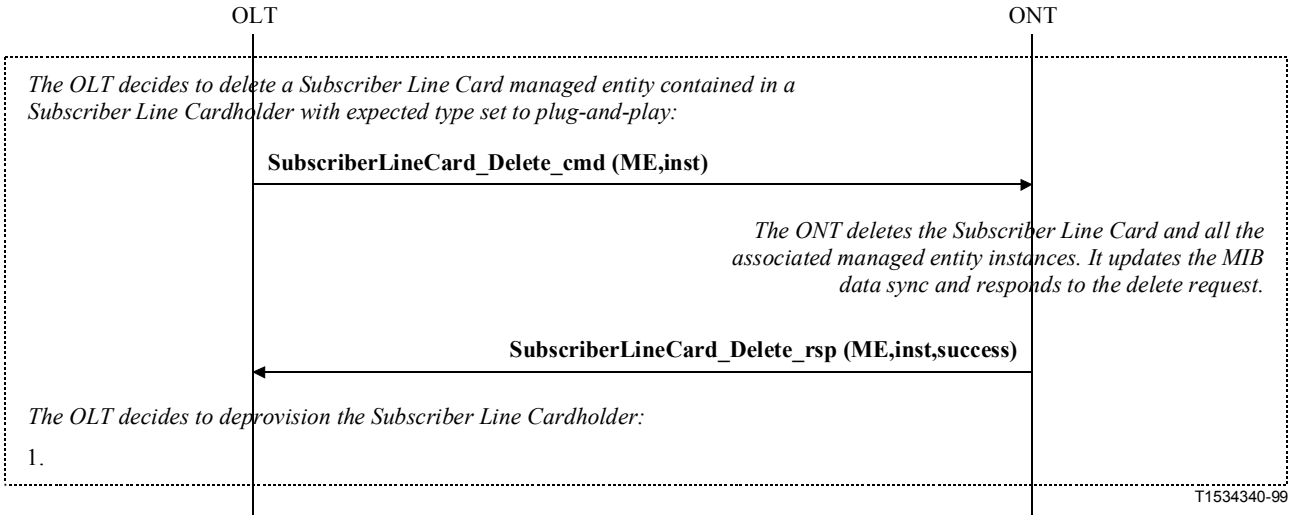


Figure I.13/G.983.2 – Plug-and-play Subscriber Line Card de-provisioning

I.2.7 ATM service set-up

The ATM connections within the ONT can be created in two ways: one consists of consecutive requesting the creation of two VP Link Termination Points$_{APON}$ and one ATM VP Cross-Connection (Figure I.14), whereas the other uses one request which will cause the creation of two VP Link Termination Point$_{APON}$ instances and one instance of the ATM VP Cross-Connection (Figure I.15).

In the given figures for ATM service set-up the assumption is made that Priority Queues are used. If Traffic Descriptors are used, the Traffic Descriptor managed entity instance for the requested service must be created first. Also, the OLT might want to create corresponding Current Data managed entities for the connection.

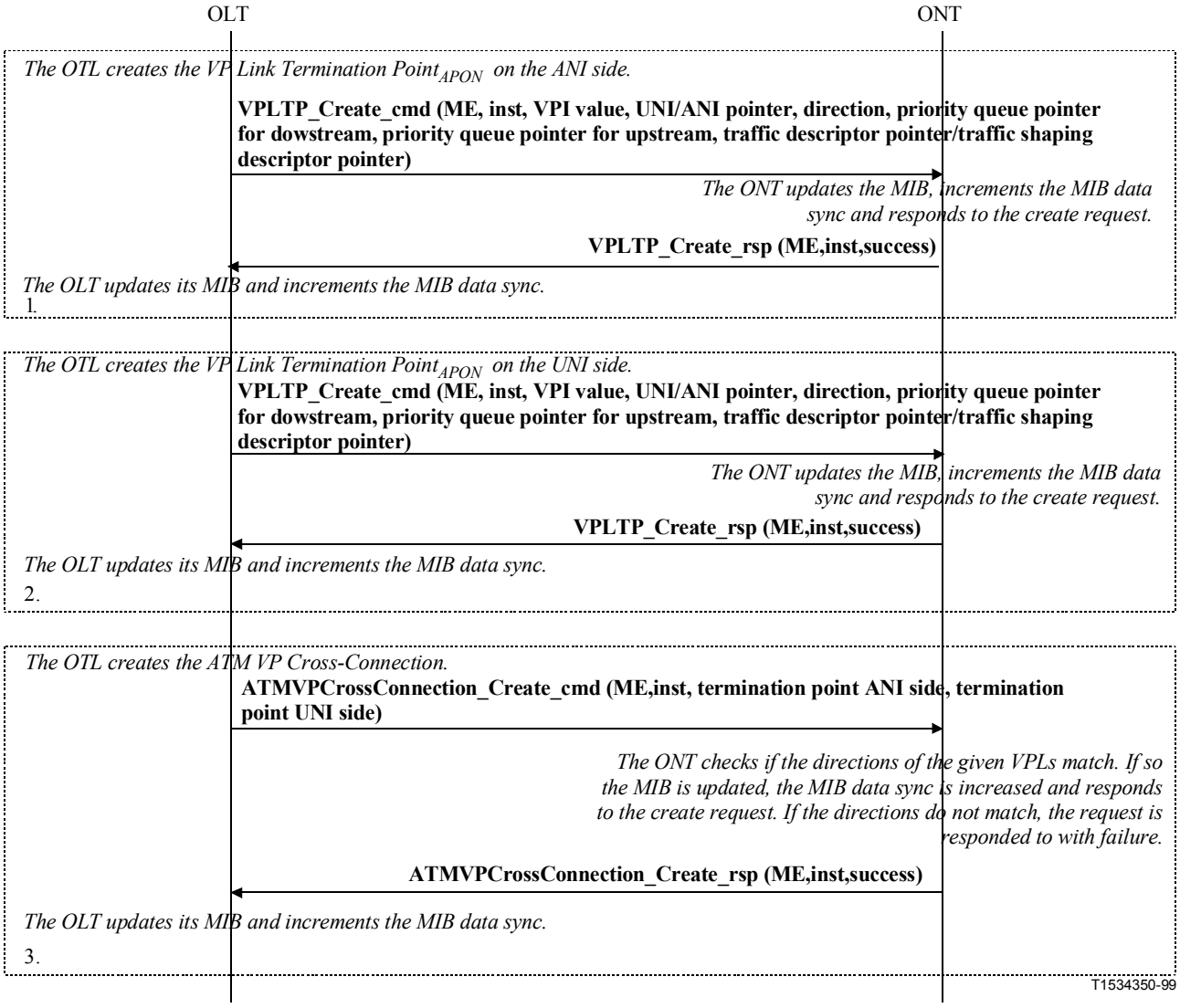


Figure I.14/G.983.2 – VP Cross-Connection set-up (alternative 1)

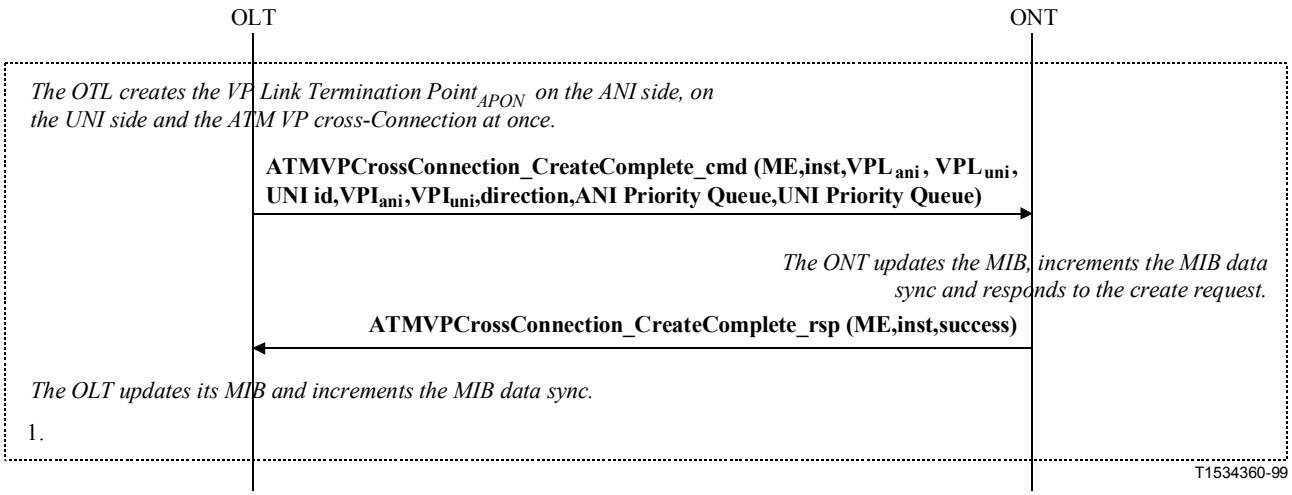


Figure I.15/G.983.2 – VP Cross-Connection set-up (alternative 2)

I.2.8 ATM service take-down

The connections within the ONT can be deleted in two ways: one consist of consecutive deletion of the ATM VP Cross-Connection and the two VP Link Termination Point$_{APON}$ (Figure I.16), whereas the other uses one request which will cause the deletion of one ATM VP Cross-Connection and the two associated VP Link Termination Point$_{APON}$ instances (Figure I.17). The correct order of the deletion of the instances in the first alternative is under control of the OLT. If applicable, the OLT must delete the corresponding Current Data managed entities as well.

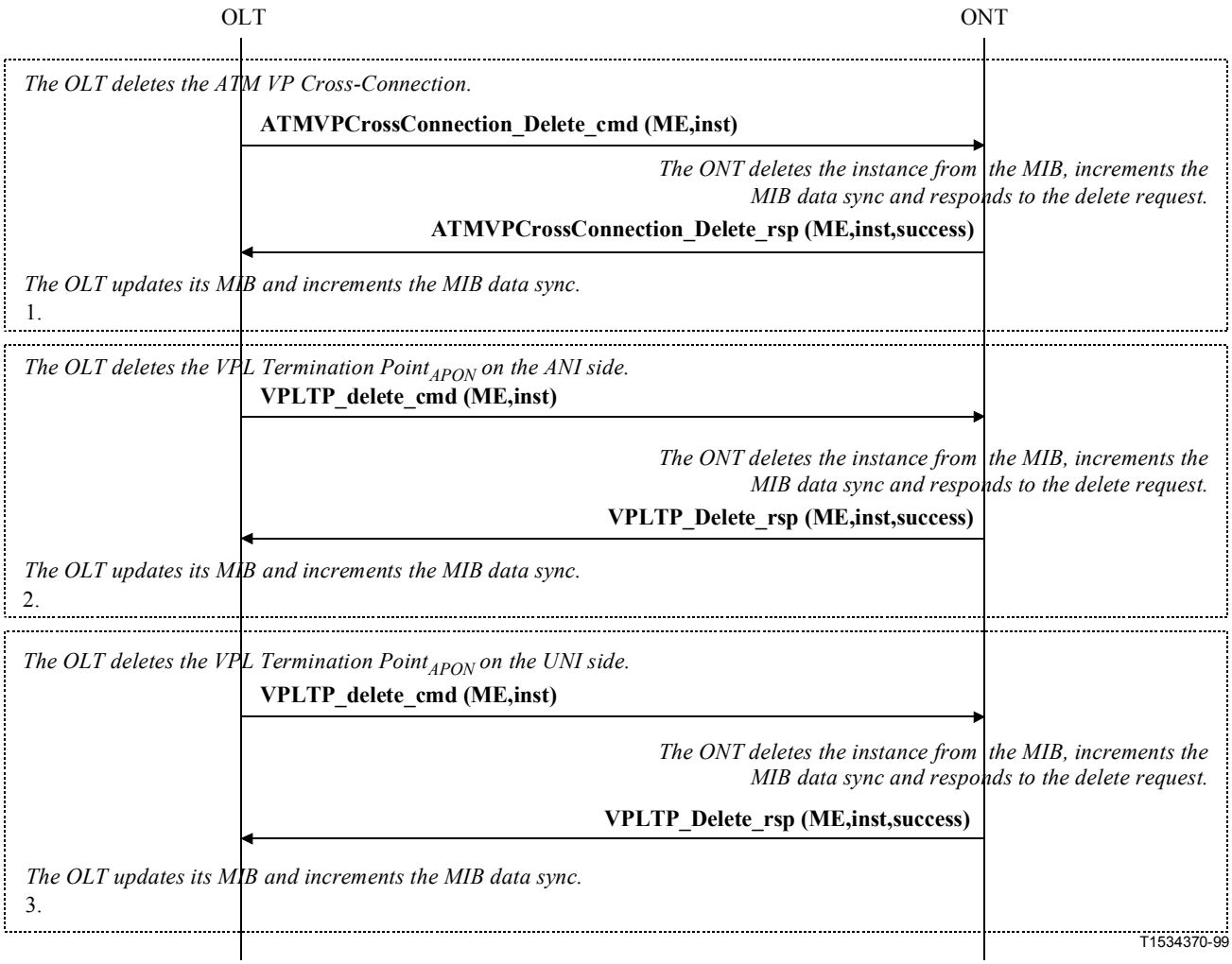


Figure I.16/G.983.2 – VP Cross-Connection deletion (alternative 1)

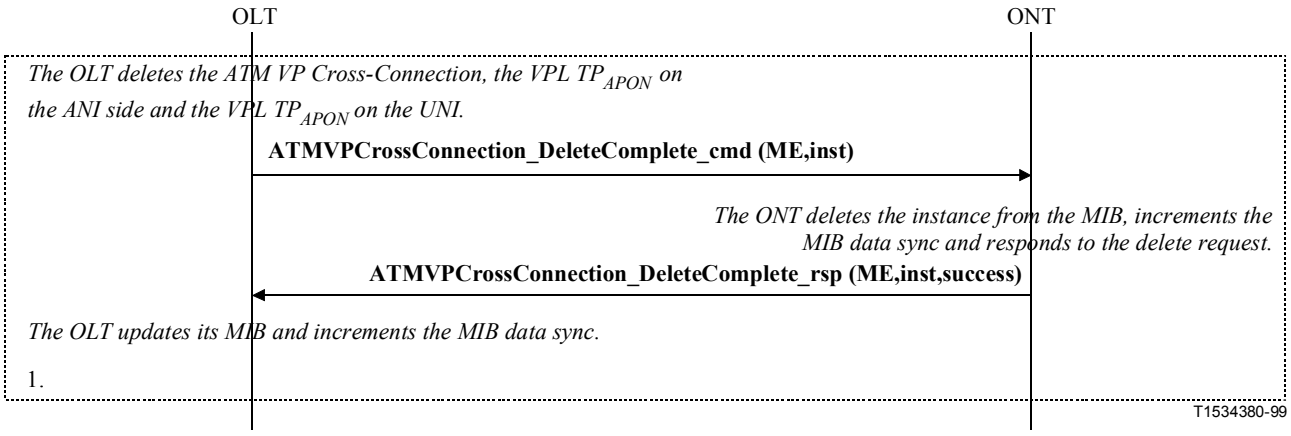


Figure I.17/G.983.2 – VP Cross-Connection deletion (alternative 2)

I.2.9 Structured CES Service Connection set-up

The following scenario of structured CES Service connection set-up is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination Point$_{APON}$ on the ANI side.

Figure I.18 shows the set-up of the first structured CES service on a Subscriber Line Card. Additional services on the same UNI interface, with their interworking VCCTP, AAL 1 and CES Profile, can also share the same VPL Termination Point$_{APON}$.

Note that the AAL 1 and CES profiles can be shared among multiply interworking VCCTPs. No create of profiles is needed if the interworking VCCTP is pointing to an existing profile.

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

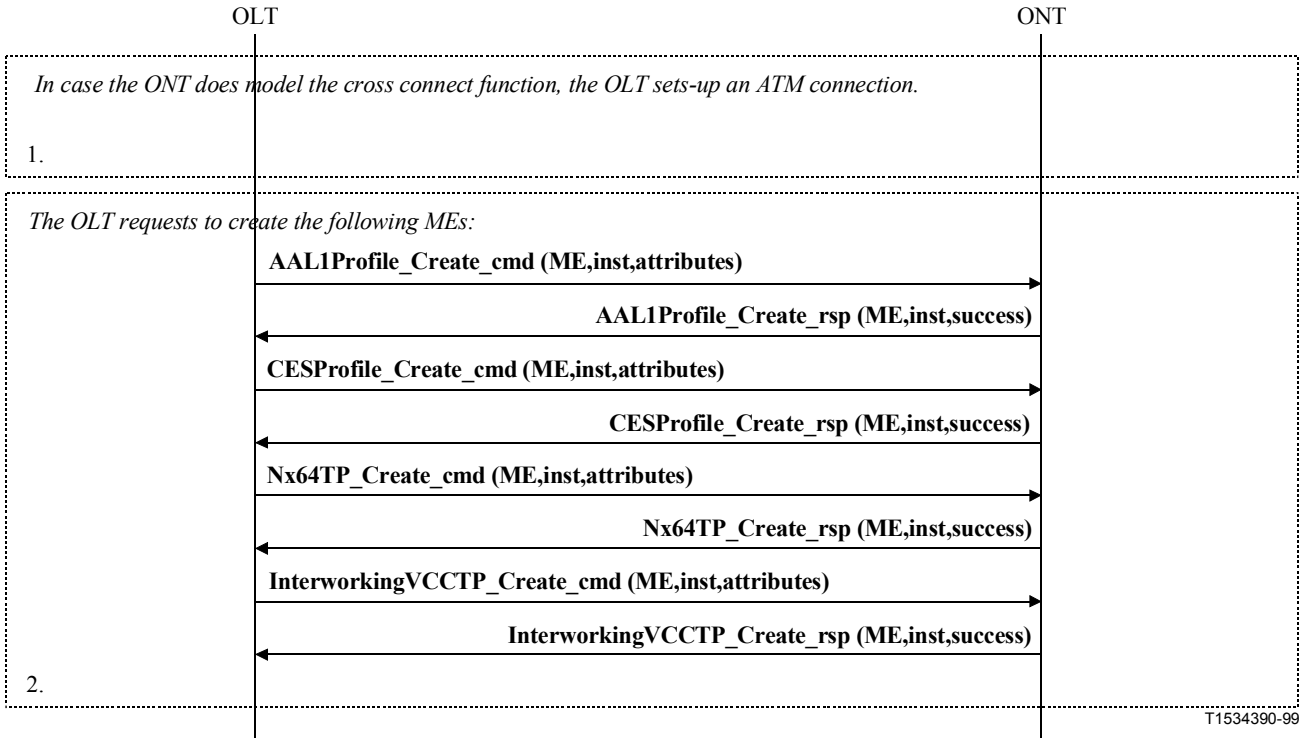


Figure I.18/G.983.2 – Connection set-up of a structured CES

I.2.10 Structured CES Service Connection tear-down

The following scenario, shown in Figure I.19, of structured CES Service connection tear-down is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination Point$_{APON}$ on the ANI side.

Note that the AAL 1 and CES profiles can be shared among multiple interworking VCCTPs. If there are more Interworking VCCTPs associated to these profile managed entities, the OLT may not request to delete them. This holds also for the ATM connection used: if more Interworking VCCTPs are associated to this connection (i.e. VPL TP$_{APON}$), the ATM connection cannot be deleted.

If applicable, the OLT can delete the corresponding Current Data managed entities as well.

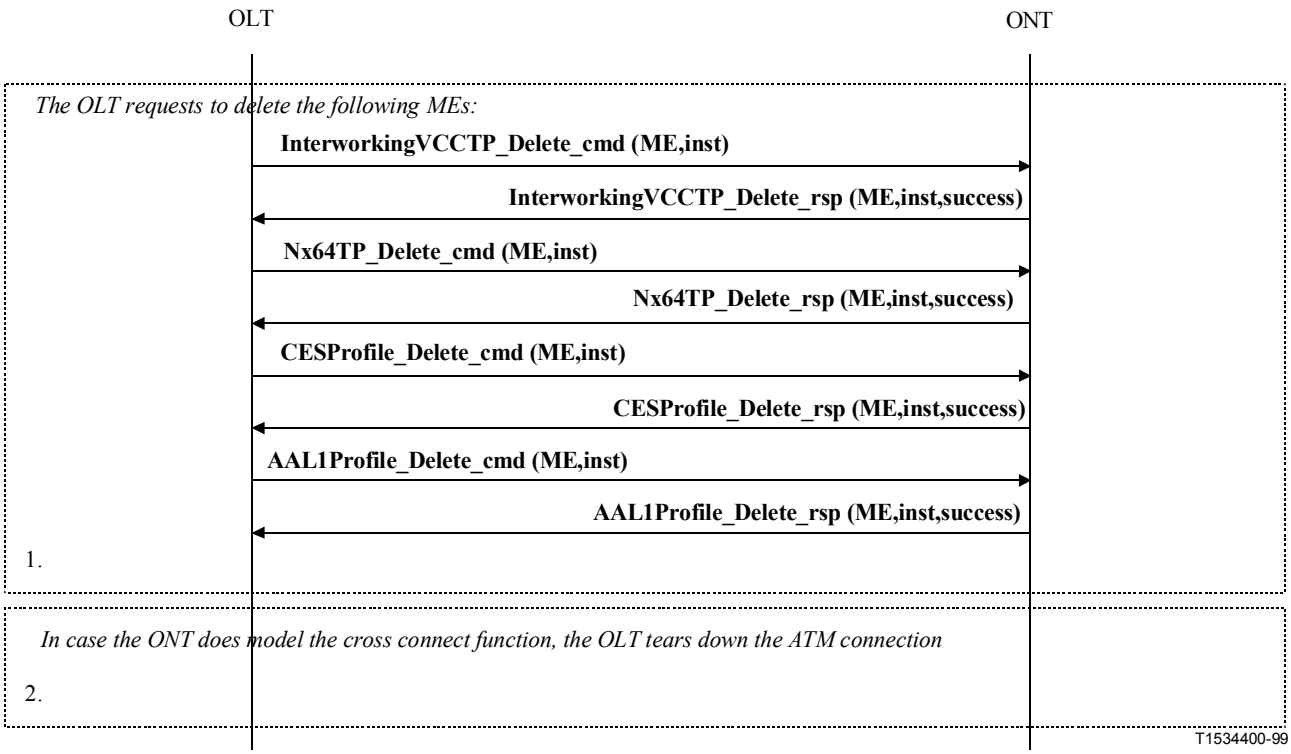


Figure I.19/G.983.2 – Connection tear-down of a structured CES

I.2.11 Unstructured CES Service Connection set-up

The following scenario, shown in Figure I.20, of unstructured CES Service connection set-up is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination Point$_{APON}$ on the ANI side.

Note that the AAL 1 and CES profiles can be shared among multiply interworking VCCTPs. No create of profiles is needed if the interworking VCCTP is pointing to an existing profile.

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

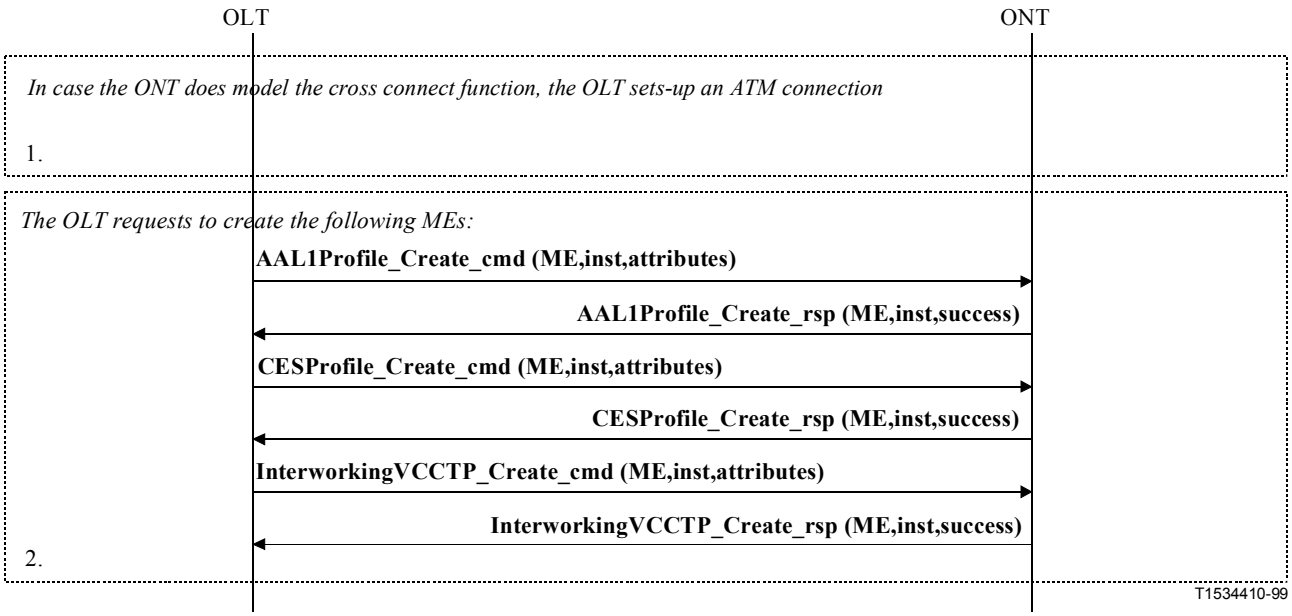


Figure I.20/G.983.2 – Connection set-up of an unstructured CES

I.2.12 Unstructured CES Service Connection tear-down

The following scenario, shown in Figure I.21, of an unstructured CES Service connection tear-down is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination Point$_{APON}$ on the ANI side.

Note that the AAL 1 and CES profiles can be shared among multiply interworking VCCTPs. If there are more Interworking VCCTPs associated to these profile managed entities, the OLT may not request to delete them. This holds also for the ATM connection used: if more Interworking VCCTPs are associated to this connection (i.e. VPL TP$_{APON}$), the ATM connection cannot be deleted.

If applicable, the OLT can delete the corresponding Current Data managed entities as well.

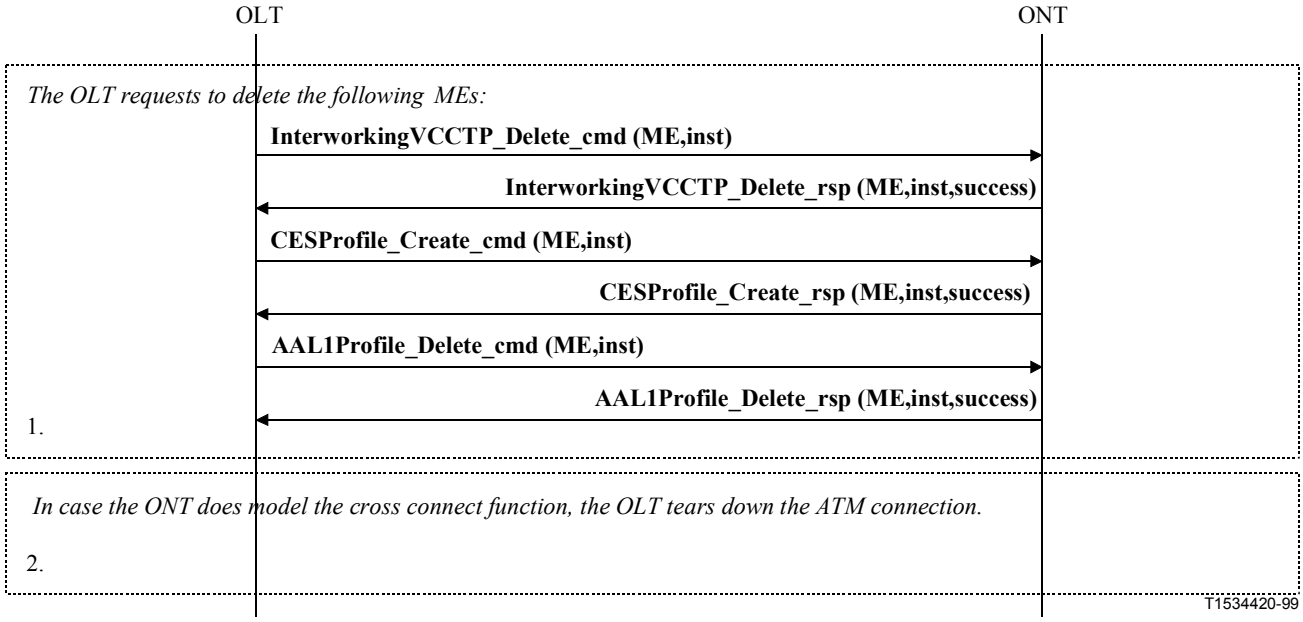


Figure I.21/G.983.2 – Connection tear-down of an unstructured CES

I.2.13 Native LAN Service Connection set-up

The following scenario, Figure I.22, of Native LAN Service connection set-up is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination $Point_{APON}$ on the ANI side.

Note that the AAL 5 and IP profiles can be shared among multiply interworking VCC Termination Points. No create of profiles is needed if the interworking VCCTP is pointing to an existing profile.

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

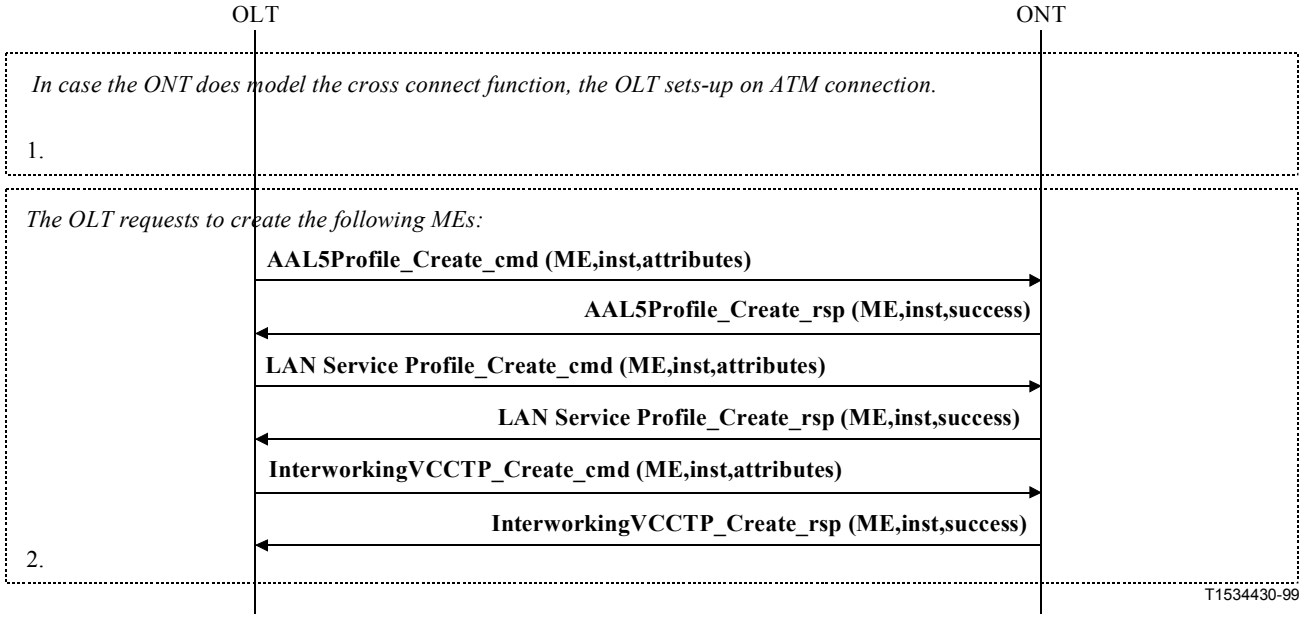


Figure I.22/G.983.2 – Connection set-up Native LAN connection

I.2.14 Native LAN Service Connection tear-down

The following scenario, Figure I.23, of Native LAN Service connection tear-down is given for an ONT with cross-connect function. For the case that an ONT does not model cross-connect function, the Interworking VCC Termination Point is directly associated to the VPL Termination $Point_{APON}$ on the ANI side.

Note that the AAL 5 and IP profiles can be shared among multiply interworking VCC Termination Points. If there are more Interworking VCC Termination Points associated to these profile managed entities, the OLT may not request to delete them. This holds also for the ATM connection used: if more Interworking VCC Termination Points are associated to this connection (i.e. VPL TP_{APON}), the ATM connection cannot be deleted.

If applicable, the OLT can delete the corresponding Current Data managed entities as well.

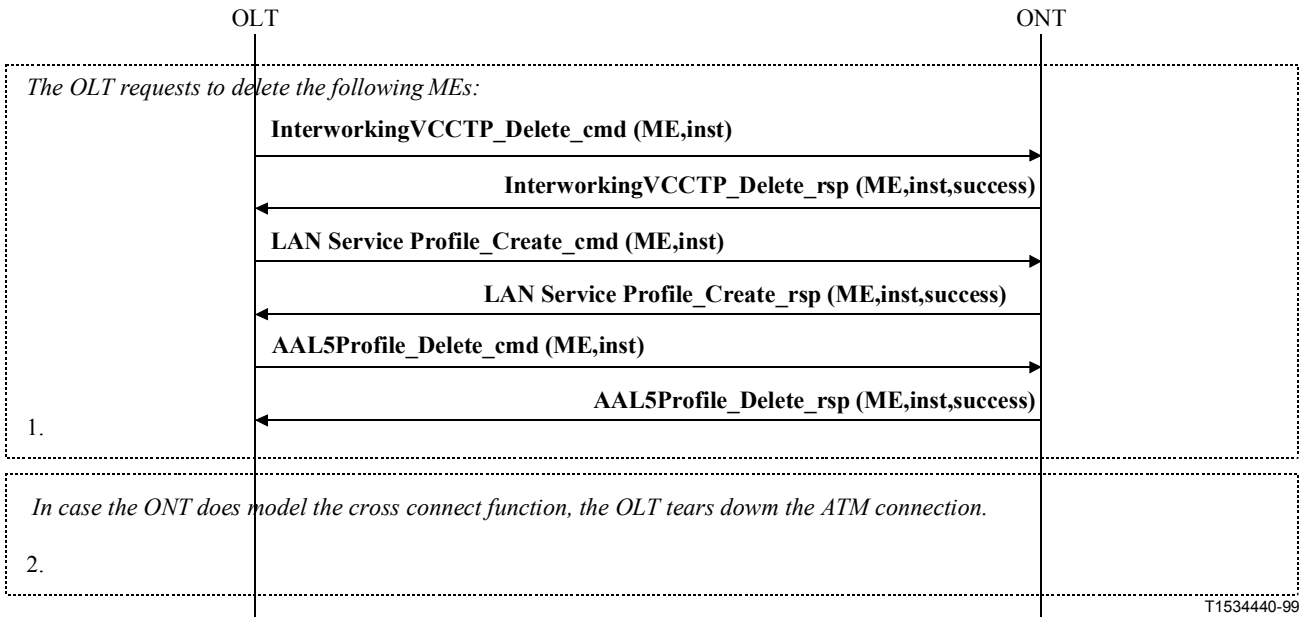


Figure I.23/G.983.2 – Connection tear-down Native LAN connection

I.2.15 Software Image Download

The download of a Software Image is based on a "segmented stop and wait" protocol; thus a next section can only be transmitted to the ONT if the previous segment is positively acknowledged. A Software Image segment (also named window) consists of one of more Software Image sections. Each section is transmitted into one OMCC message.

The number of sections in a segment is negotiated before the actual download: first the OLT proposes a segment size (not greater than 256). The ONT can propose a smaller segment size in the response. If the response indicates a smaller segment size, this is the size to be used in the download. Thus, an image segment consists of N image sections, with N being equal to the segment size. Only the last image section is acknowledged. If the ONT processed all sections of a segment properly, the acknowledgement will be positive, after which the OLT will download the next segment.

Note that the section numbering starts from 0 so that segments of precisely 8 kilobytes can be downloaded.

If an error occurred with a section of a segment (e.g. CRC error or missed section) the last section will be negatively acknowledged, which will result in an entire retransmission of the last segment.

When the last segment transferred is positively acknowledged, the OLT sends a CRC-32 to the ONT in the Software Image end download command. The ONT calculates the CRC-32 and compares it to the CRC received from the OLT. If they equal, the image is considered valid. In Figure I.24 the scenario is given for the software download.

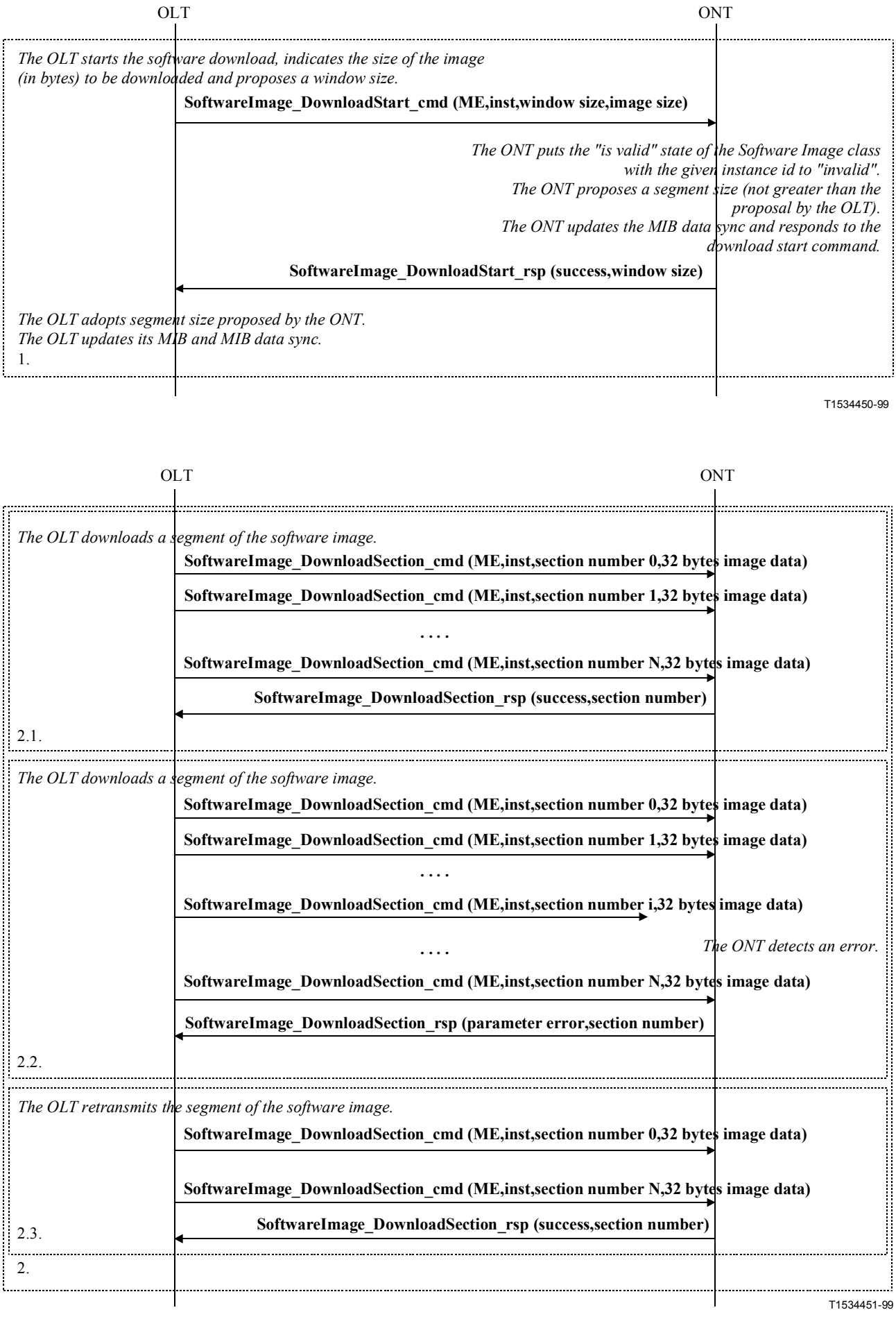


Figure I.24/G.983.2 – Software Download

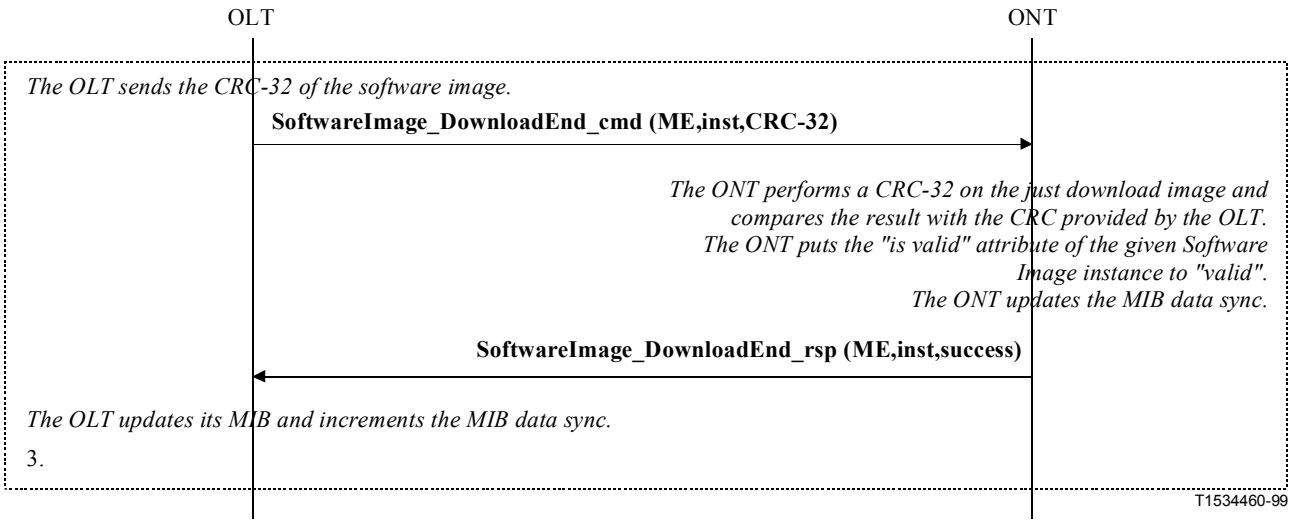


Figure I.24/G.983.2 – Software Download *(concluded)*

I.2.16 Software Image Activate and Commit

See Figure I.25.

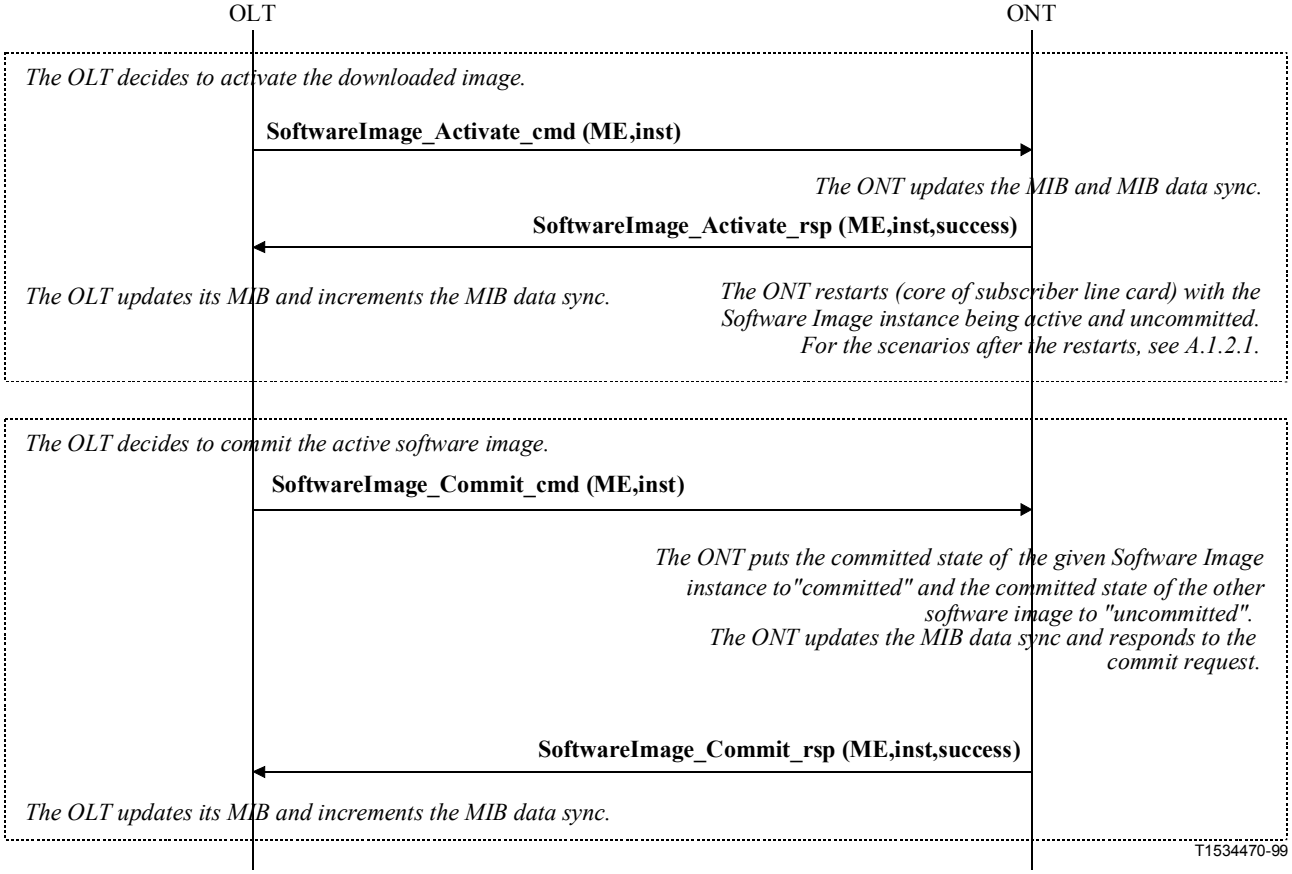


Figure I.25/G.983.2 – Software Activate (above) and Software Commit (below)

APPENDIX II

OMCI Message Set

II.1 General remarks

II.1.1 Message Type Identifier

In 9.1.4, the message types are given. This identifier is omitted in the message set below.

II.1.2 Entity Class Identifier

In 9.1.6, the entity class identifiers are given. This identifier is omitted in the message set below.

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.

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.983.2 – 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 7. 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 has changed status 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 alarms changed status.

The maximum number of alarms that is supported by the OMCI is 240; thus the alarm bitmap uses 30 bytes. The bitmap is composed as follows (see Table II.2):

Table II.2/G.983.2 – 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
…								
30	Alarm 232	Alarm 233	Alarm 234	Alarm 235	Alarm 236	Alarm 237	Alarm 238	Alarm 239

The alarm numbers correspond to the alarm coding in clause 7. Bits in the alarm bitmap that correspond to non-existing alarms shall always be set equal to "0". Bits that correspond to an existing alarm is set to a value of "0" to indicate that the corresponding alarm is cleared and a value of "1" is used 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.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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									attribute value of first attribute (size depending on the type of attribute)
										…
										attribute value of last attribute (size depending on the type of attribute)
	xx-45	0	0	0	0	0	0	0	0	padding

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									entity class
	11									msb entity instance
	12									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	13	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
	14-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									msb ani VPL termination point instance
	14									lsb ani VPL termination point instance
	15									msb uni VPL termination point instance
	16									lsb uni VPL termination point instance
	17									msb uni/ani pointer (= msb corresponding uni instance)
	18									lsb uni/ani pointer (= lsb corresponding uni instance)
	19									msb vpi ani side
	20									lsb vpi ani side
	21									msb vpi uni side (= 0x00)
	22									lsb vpi uni side
	23	0	0	0	0	0	0	x	x	direction 01 = uni-to-ani 10 = ani-to-uni 11 = bidirectional
	24									msb priority queue pointer ani VPL termination point
	25									lsb priority queue pointer ani VPL termination point
	26									msb priority queue pointer uni VPL termination point
	27									lsb priority queue pointer uni VPL termination point

Field	Byte	8	7	6	5	4	3	2	1	Comments
	28									msb traffic shaping pointer ani VPL termination point
	29									lsb traffic shaping pointer ani VPL termination point
	30									msb traffic descriptor pointer uni VPL termination point
	31									lsb traffic descriptor pointer uni VPL termination point
	32-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13	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
	14-45	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	0	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	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	0						DB = 0, AR = 0, AK = 0 bits 5-1: action = delete
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									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
	14-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	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									entity class
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	13	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
	14-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									msb attribute mask
	14									lsb attribute mask
	15									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									entity class
	11									msb entity instance
	12									lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	13	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
	14-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									msb attribute mask
	14									lsb attribute mask
	15-45	0	0	0	0	0	0	0	0	padding

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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13	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
	14									msb attribute mask
	15	0	0	0	0	0	0	0	0	lsb attribute mask

Field	Byte	8	7	6	5	4	3	2	1	Comments
	16									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-45	0	0	0	0	0	0	0	0	padding

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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13	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
	14									msb ani VPL termination point instance
	15									lsb ani VPL termination point instance
	16									msb uni VPL termination point instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
	17									lsb uni VPL termination point instance
	18									msb uni/ani pointer (= msb corresponding uni instance)
	19									lsb uni/ani pointer (= lsb corresponding uni instance)
	20									msb vpi ani side
	21									lsb vpi ani side
	22									msb vpi uni side (= 0x00)
	23									lsb vpi uni side
	24	0	0	0	0	0	0	x	x	direction 01 = uni-to-ani 10 = ani-to-uni 11 = bidirectional
	25									msb priority queue pointer ani VPL termination point
	26									lsb priority queue pointer ani VPL termination point
	27									msb priority queue pointer uni VPL termination point
	28									lsb priority queue pointer uni VPL termination point
	29									msb traffic shaping descriptor ani VPL termination point
	30									lsb traffic shaping descriptor ani VPL termination point
	31									msb traffic descriptor pointer uni VPL termination point or padding
	32									lsb traffic descriptor pointer uni VPL termination point or padding
	33-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									msb of the number of subsequent commands
	14									lsb of the number of subsequent commands
	15-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									msb of the command sequence number
	14									lsb of the command sequence number
	15-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									entity class on which the alarms are reported
	14									msb entity instance on which the alarms are reported
	15									lsb entity instance on which the alarms are reported
	16-45	x	x	x	x	x	x	x	x	bitmap alarms

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

In the case the ONT has received an Get All Alarms Next request message in which the command sequence number is out of range, the ONT shall respond with a message in which bytes 13 to 45 are all set to 0x00. This corresponds to a response with entity class 0x00, entity instance 0x0000, 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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									msb of the number of subsequent commands
	14									lsb of the number of subsequent commands
	15-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									msb of the command sequence number
	14									lsb of the command sequence number
	15-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13									entity class of object
	14									msb entity instance of object
	15									lsb entity instance of object
	16									msb attribute mask
	17									lsb attribute mask

Field	Byte	8	7	6	5	4	3	2	1	Comments
	18									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

In case the ONT has received an MIB Upload Next request message in which the command sequence number is out of range, it shall respond with a message in which bytes 13 to 45 are all set to 0x00. This corresponds to a response with entity class 0x00, entity instance 0x0000, attribute mask 0x0000 and padding from byte 18 to byte 45.

Note that in case 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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance
Message contents	13-45	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									entity class = ONT Data
	11	0	0	0	0	0	0	0	0	msb entity instance
	12	0	0	0	0	0	0	0	0	lsb entity instance

Field	Byte	8	7	6	5	4	3	2	1	Comments
Message contents	13	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
	14-45	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
Message identifier	10									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									alarm mask
										…
	42									alarm mask
	43-44	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									msb attribute mask
	14									lsb attribute mask
	15									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 = 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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	0	0	0	0	0	0	0	0	padding

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									entity class = software image
	11									msb entity instance
	12	0	0	0	0	0	0	x	x	lsb entity instance
Message contents	13	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
	14-45	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. The test results will be sent to the OLT via vendor specific messages.

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									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13									window size – 1
	14-17									image size in bytes
	18-45	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									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13	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
	14									window size – 1
	15-45	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									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13									download section number
	14-45									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									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13	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
	14									download section number
	15-45	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									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13-16									CRC-32
	17-20									image size in bytes
	21-45	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
Message identifier	10									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13	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
	14-45	0	0	0	0	0	0	0	0	padding

II.2.35 Activate Software

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 software
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13-45	0	0	0	0	0	0	0	0	padding

II.2.36 Activate Software 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 software
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13	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
	14-45	0	0	0	0	0	0	0	0	padding

II.2.37 Commit Software

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 software
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13-45	0	0	0	0	0	0	0	0	padding

II.2.38 Commit Software 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 software
Device identifier type	9	0	0	0	0	1	0	1	0	OMCI = 0x0A
Message identifier	10									entity class = software image
	11									msb entity instance 0 = ONT_{APON} 1, 2, ..., 127 = UNI card 129, 130, ..., 255 = ANI card
	12	0	0	0	0	0	0	x	x	lsb entity instance 00 = first instance 01 = second instance
Message contents	13	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
	14-45	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 = 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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									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
	14-45	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 = 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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13-45	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									entity class
	11									msb entity instance
	12									lsb entity instance
Message contents	13									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
	14-45									padding

APPENDIX III

Support of F4/F5 Maintenance Flows in the ONT

III.1 General Principle

The general principle to use F4 and F5 maintenance flows in the ONT is to use the ITU-T I.610 [8] procedures wherever possible and to restrict the OMCI requirements to the strict essential ones. The use of these procedures is largely independent of OMCI. The objective of this appendix is to clarify OMCI related aspects.

III.2 Definition of the F4/F5 Segment and End-to-end applicability

III.2.1 Support of F4/F5 Maintenance Flows with respect to ATM-UNIs

Segment F4 Maintenance Flow

The ONT always behaves as a Segment end point for the F4 segment maintenance flow towards the OLT.

The VP Link Termination Point$_{APON}$ located at the UNI side is by default the Segment end point.

End-to-end F4 Maintenance Flow

By definition the ONT is not involved.

Segment F5 and End-to-end F5 Maintenance Flows

By definition the ONT is not involved.

III.2.2 Support of F4/F5 Maintenance Flows with respect to non-ATM-UNIs

Segment F4 and End-to-end F4 Maintenance Flow

The ONT always behaves as segment end point for the F4 Segment and End-to-end maintenance flow towards the OLT.

The VP Link Termination Point$_{APON}$ which supports the Interworking VCC Termination Point is by default the Segment end point.

Segment F5 and End-to-end F5 Maintenance Flows

The ONT always behaves as segment end point for the F5 Segment and End-to-end maintenance flow towards the OLT.

The Interworking VCC Termination Point is by default Segment and End-to-end point.

III.3 OMCI Support of F4/F5 Flows in the ONT

III.3.1 OMCI Support of AIS and RDI Fault Management

Report of End-to-end VP-AIS and VP-RDI, VC-AIS, VC-RDI receiving and generation alarms on the VP Link Termination Point$_{APON}$ and the Interworking VCC Termination Point respectively.

III.3.2 OMCI Support of F4/F5 Continuity Check Procedures

The activation and deactivation of the continuity check from the OLT as well as towards the OLT is done via in-band ITU-T I.610 [8] activation and deactivation procedures. OMCI supports the reporting of Loss of Continuity alarm on the VP Link Termination Point$_{APON}$ and Interworking VCC Termination Point.

III.3.3 OMCI Support of F4/F5 Loopback Procedures

The ONT supports loopback point functionality. The insertion of the loopback cell and the reporting of the loopback result is not required in the ONT. The OMCI supports setting of the loopback location identifier.

III.3.4 OMCI Support of F4/F5 Performance Monitoring

This is for further study.

APPENDIX IV

Traffic Management Options

Depending on the trade-off between the complexity and the number of supported features, the ONT can have various traffic management options. Examples of traffic management implementation in the ONT are described in the following clauses. This appendix also indicates how the MIB defined in clause 7 is used for each implementation.

It should be pointed out that the ONT traffic management is not limited to these examples. ONT traffic management is likely a place where every vendor searches for a proprietary feature to give it a competitive advantage. However, every proprietary feature required some kind of management that impacts the OMCI. In fact, it is difficult for the specification given in this Recommendation to keep up with the technological and feature innovations. It is envisioned that vendor specific managed entities will be needed to manage the traffic management related functions in the ONT.

IV.1 Priority Queue$_{APON}$

When focus on low complexity implementation, the ONT uses priority controlled upstream traffic method. In this case, the ONT has no traffic contract and QoS awareness. The ONT is configured by the OLT with a priority for each connection for both directions.

Theoretically, UPC is needed at every multiplexing point, including the ONT. A system with the UPC function has to monitor the traffic volume entering the network from all active VP/VC connections to ensure that the agreed parameters are not violated, and to deploy a cell discard or tag policy. In the priority queue implementation the UPC function is moved to OLT, where it protects the core network. The PON is protected by the "UPC-like" MAC. The MAC manages all connections from an ONT as a whole. Essentially the MAC isolates ONTs from each other.

As such, CPEs sharing one ONT may have to regulate their own connection streams to maintain quality. A CPE, sending out more cells on one connection, will do so at the expense of the other connections established at the same ONT.

OMCI requirements:

The traffic management option in the ONT_{APON} managed entity is set to 0x00.

For the VP Link Termination Point at the ANI side:

Priority Queue Pointer for Upstream: using priority $Queue_{APON}$ managed entity id.

IV.2 Policing per connection

Description

This alternative performs traffic management by policing for the upstream traffic. Connection priority assignment is used for the downstream traffic (Figure IV.1).

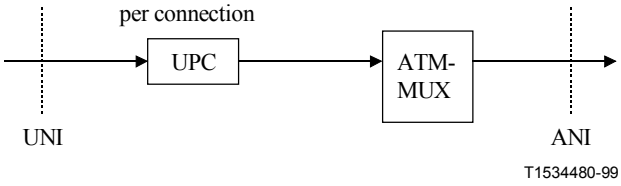


Figure IV.1/G.983.2 – Policing per connection

This alternative is applicable to ATM-UNIs. Policing is performed per VP Connection.

OMCI Requirements

For the VP Link Termination $Point_{APON}$ at the UNIside:

Traffic Descriptor Pointer: using managed entity id (per connection).

Traffic Shaping descriptor Pointer: null.

For the VP Link Termination $Point_{APON}$ at the ANI side:

Traffic Descriptor Pointer: null.

Traffic Shaping descriptor Pointer: null.

IV.3 Traffic shaping per connection or per multiple connections

This alternative is applicable to ATM-UNIs and to non-ATM-UNIs and performs traffic management shaping (Figure IV.2).

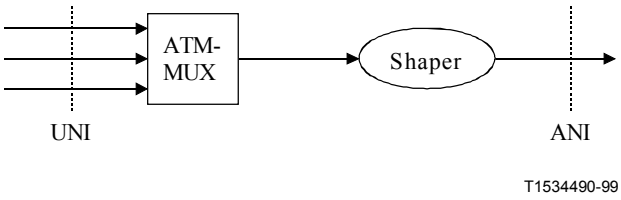


Figure IV.2/G.983.2 – Traffic shaping per connection or per multiple connections

IV.3.1 ATM-UNIs

Description

For ATM-UNIs shaping is performed per VP or for a set of VP connections established for the same UNI.

OMCI Requirements

For the VP Link Termination Point$_{APON}$ at the ANI side:

Traffic Descriptor Pointer: null.

Traffic Shaping Descriptor Pointer: using managed entity id (per connection or multiple connections which the operator chose).

For the VP Link Termination Point$_{APON}$ at the UNI side:

Traffic Descriptor Pointer: null.

Traffic Shaping Descriptor Pointer: null.

IV.3.2 Non-ATM-UNIs

Description

For non-ATM-UNIs, interworking is performed from a non-ATM data stream into VC connections. Various VC connections are multiplexed into one or more VP connections.

Shaping is performed for one or a set of VP connections established for the same UNI.

OMCI Requirements

For the VP Link Termination Point$_{APON}$ at the ANI side:

Traffic Descriptor Pointer: null.

Traffic Shaping Descriptor Pointer: using managed entity id (per connection or multiple connections which the operator chose).

If applicable (ATM VP Cross-Connection is modelled), for the VP Link Termination Point$_{APON}$ at the UNI side:

Traffic Descriptor Pointer: null.

Traffic Shaping Descriptor Pointer: null.

IV.4 Policing and Traffic shaping per connection or per multiple connections

This alternative performs traffic management policing and shaping (Figure IV.3).

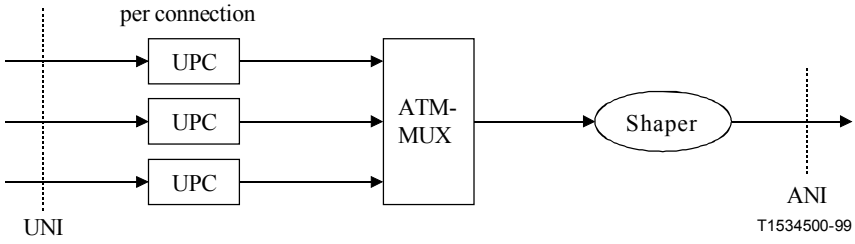


Figure IV.3/G.983.2 – Policing and shaping per connection or per multiple connections

This alternative is applicable to ATM UNIs. Policing is performed per VP connection. Shaping is performed for one or a set of VP connections established at the same UNI.

Traffic Descriptor Pointer: using managed entity id (per connection).

Traffic Shaping Descriptor Pointer: using managed entity id (per connection or multiple connections which the operator chose).

APPENDIX V

Bibliography

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[App.V-3] ATM Forum AF-PHY-0064.000 (1996), E1 Physical Interface Specification.

[App.V-4] ATM Forum AF-PHY-0029.000 (1995), 6,312 Kbps UNI Specification Version 1.0.

[App.V-5] ATM Forum AF-PHY-0040.000 (1995), Physical Interface Specification for 25.6 Mb/s over Twisted Pair Cable.

[App.V-6] ATM Forum AF-PHY-0034.000 (1995), E3 Public UNI.

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[App.V-8] ATM Forum AF-UNI-0010.002 (1994), ATM User-Network Interface Specification, Version 3.1.

[App.V-9] ATM Forum AF-TM-0056.000 (1996), Traffic Management Specification, Version 4.0.

[App.V-10] ITU-T I.371.1 (2000), Guaranteed frame rate ATM transfer capability.

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