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SERIES Q: SWITCHING AND SIGNALLING

Q3 interface

Requirements and analysis for the management interface of Ethernet Passive Optical Networks (EPON)

ITU-T Recommendation Q.838.1

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ITU-T Recommendation Q.838.1

Requirements and analysis for the management interface of Ethernet Passive Optical Networks (EPON)

Summary

This Recommendation is for the management of Ethernet Passive Optical Networks (EPON). The requirements and analysis for the management interface between EPON Element Management System (EMS) and Network Management System (NMS) are provided in this Recommendation, using the TMN interface specification methodology described in ITU-T Rec. M.3020. This interface is for the integrated management at the network layer as well as the element layer as required. In this Recommendation, a network element view combined with a network view of EPON managed entities are modelled according to a protocol-neutral information modelling approach, and the UML use case descriptions, class diagrams and sequence diagrams are also provided for both the requirements and the analysis of this management interface.

Source

ITU-T Recommendation Q.838.1 was approved on 7 October 2004 by ITU-T Study Group 4 (2001-2004) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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NOTE

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

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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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.

CONTENTS

ITU-T Recommendation Q.838.1

Requirements and analysis for the management interface of Ethernet Passive Optical Networks (EPON)

1 Scope

This Recommendation specifies the requirements and analysis for the management interface between the Element Management System (EMS) and the Network Management System (NMS) of Ethernet Passive Optical Networks (EPON). It follows the interface specification methodology described in ITU-T Rec. M.3020. In this Recommendation, the EMS is an Operations System (OS) used to manage the individual network elements supporting EPON technologies as well as the networks between them. One or more systems may be required depending on the different supplier products and geographic distribution of the network elements in the network.

The NMS represents an integrated management OS across different technologies and supplier systems (multi-technology and multi-vendor OS).

The management functions covered in this Recommendation include configuration management, performance measurement parameters management, and loopback test in fault management. These management functions are described and divided by UML use cases in the requirements. The analysis provides the managed entities which support a protocol-neutral information model for EPON management, and also explains the static and dynamic relationships between these managed entities using UML class diagrams and sequence diagrams. This Recommendation does not cover all aspects about Ethernet management. Only those related to EPON management are addressed.

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; users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published. The reference to a document within this Recommendation does not give it, as a stand-alone document, the status of a Recommendation.

[1] ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*.

[2] ITU-T Recommendation M.3020 (2000), *TMN interface specification methodology*.

[3] ITU-T Recommendation M.3100 (1995), *Generic network information model*.

[4] ITU-T Recommendation M.3100 (1999), *Generic network information model, Amendment 1*.

[5] ITU-T Recommendation M.3100 (1998), *Generic network information model, Corrigendum 1*.

[6] ITU-T Recommendation M.3100 (2003), *Generic network information model, Amendment 6*.

[7] ITU-T Recommendation M.3100 (2004), *Generic network information model, Amendment 8*.

[8] ITU-T Recommendation M.3200 (1997), *TMN management services and telecommunications managed areas: Overview*.

[9] ITU-T Recommendation M.3400 (2000), *TMN management functions*.

[10] ITU-T Recommendation X.721 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information*.

[11] ITU-T Recommendation X.731 (1992), *Information technology – Open Systems Interconnection – Systems management: State management function*.

[12] ITU-T Recommendation X.744 (1996), *Information technology – Open Systems Interconnection – Systems management: Software management function*.

[13] ITU-T Recommendation X.745 (1993), *Information technology – Open Systems Interconnection – Systems management: Test management function*.

[14] ITU-T Recommendation Q.827.1 (2004), *Requirements and analysis for the common management functions of NMS-EMS interfaces*.

[15] ITU-T Recommendation Q.834.1 (2004), *ATM-PON requirements and managed entities for the network and network element views*.

[16] ITU-T Recommendation Q.834.3 (2004), *A UML description for management interface requirements for broadband Passive Optical Networks*.

[17] ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.

[18] ITU-T Recommendation G.809 (2003), *Functional architecture of connectionless layer networks*.

[19] ITU-T Recommendation G.8010/Y.1306 (2004), *Architecture of Ethernet layer networks*.

[20] ITU-T Recommendation G.982 (1996), *Optical access networks to support services up to the ISDN primary rate or equivalent bit rates*.

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

[22] IEEE 802.3ah-2004, *IEEE Standard for information technology – Telecommunications and information exchange between systems – Local and metropolitan area networks – Specific requirements – Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) access method and physical layer specifications – Amendment: Media access control parameters, physical layers, and management parameters for subscriber access networks*.

[23] IEEE 802.1D-2004, *IEEE standard for local and metropolitan area networks: Media Access Control (MAC) bridges*.

[24] IEEE 802.1Q-2003, *IEEE standard for local and metropolitan area networks: Virtual bridged local area networks*.

[25] IETF RFC 1493 (1993), *Definitions of managed objects for bridges*.

[26] IETF RFC 2233 (1997), *The Interfaces Group MIB using SMIv2*.

[27] IETF RFC 2358 (1998), *Definitions of managed objects for the Ethernet-like interface Types*.

[28] IETF RFC 2495 (1999), *Definitions of managed objects for the DS1, E1, DS2 and E2 interface types*.

[29] IETF RFC 2674 (1999), *Definitions of managed objects for bridges with traffic classes, multicast filtering and virtual LAN extensions*.

3 Terms and definitions

This Recommendation uses the following terms.

3.1 Definitions imported from ITU-T Rec. G.805

The following terms from ITU-T Rec. G.805 [17] are used in this Recommendation:

– bidirectional reference point;
– connection;
– connection point;
– link;
– link connection;
– termination connection point;
– trail;
– trail termination;
– trail termination sink;
– trail termination source.

3.2 Definitions imported from ITU-T Rec. G.809

The following terms from ITU-T Rec. G.809 [18] are used in this Recommendation:

– characteristic information;
– client/server relationship;
– connectionless trail;
– flow;
– flow domain;
– flow domain flow;
– flow point;
– flow point pool;
– flow point pool link;
– flow termination;
– flow termination sink;
– flow termination source;
– layer network;
– link flow.

3.3 Definitions imported from ITU-T Rec. G.982

The following terms from ITU-T Rec. G.982 [20] are used in this Recommendation:

– Optical Access Network (OAN);
– Optical Distribution Network (ODN).

3.4 Definitions imported from ITU-T Rec. G.983.1

The following term from ITU-T Rec. G.983.1 [21] is used in this Recommendation:

– Optical Network Termination (ONT).

3.5 Definitions imported from ITU-T Rec. Q.834.1

The following term from ITU-T Rec. Q.834.1 [15] is used in this Recommendation:

– Network Termination (NT).

3.6 Definitions imported from IEEE 802.3ah

The following terms from IEEE Standard 802.3ah [22] are used in this Recommendation:

– Optical Line Terminal (OLT);
– Optical Network Unit (ONU);
– Ranging;
– P2MP Discovery.

4 Abbreviations

This Recommendation uses the following abbreviations:

ASAP	Alarm Severity Assignment Profile
BER	Bit Error Rate
CFI	Canonical Format Indicator
cLink	component Link
CM	Configuration Management
CRC	Cyclic Redundancy Check
CTP	Connection Termination Point
E1	Digital signal level 1 at 2048 kbit/s
EMS	Element Management System
EPON	Ethernet Passive Optical Network
ETH	Ethernet MAC layer network
ETYn	Ethernet physical layer network of order n
FCS	Frame Check Sequence
FD	Flow Domain
FDF	Flow Domain Flow
FDFr	Flow Domain Fragment
FM	Fault Management
FP	Flow Point
FPP	Flow Point Pool
FS	Function Set
FTP	Flow Termination Point
HDB3	High Density Bipolar 3 code
ID	Identifier
ISDN	Integrated Services Digital Network
ITU-T	International Telecommunication Union – Telecommunication Standardization Sector

MAC	Media Access Control
MIB	Management Information Base
NE	Network Element
NMS	Network Management System
NNI	Network-to-Network Interface
NRZ	Non Return to Zero
NT	Network Termination
ODN	Optical Distribution Network
OLT	Optical Line Terminal
OMG	Object Management Group
ONT	Optical Network Termination
ONU	Optical Network Unit
OS	Operations System
P2MP	Point to Multi-Point
PHY	Ethernet Physical Layer Entity
PM	Performance Management
PON	Passive Optical Network
POTS	Plain Old Telephone Service
SBA	Static Bandwidth Assignment
TCI	Tag Control Information
TMN	Telecommunications Management Network
TP	Termination Point
TTP	Trail Termination Point
UML	Unified Modelling Language
UNI	User Network Interface
VID	VLAN ID
VLAN	Virtual Local Area Network
VPN	Virtual Private Network

5 General overview

Figure 5-1 illustrates the EPON system architecture. EMS is the management system linked to the OLT in this figure. This system is provided, along with the equipment, to a network owner operator. The OLT is a head-end digital terminal commonly located in the central office or some controlled environment structure. The ODN is a point-to-multipoint fibre infrastructure employing a passive splitter or coupler device for the fan out. The ONU provides the access network line termination function. The NT provides the user network interface line termination function. The ONT combines the functions of the ONU and NT in one piece of equipment. The reference point, indicated by the term UNI, denotes the user network interface.

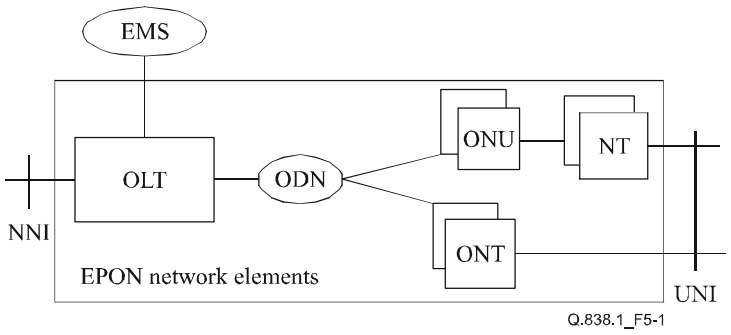
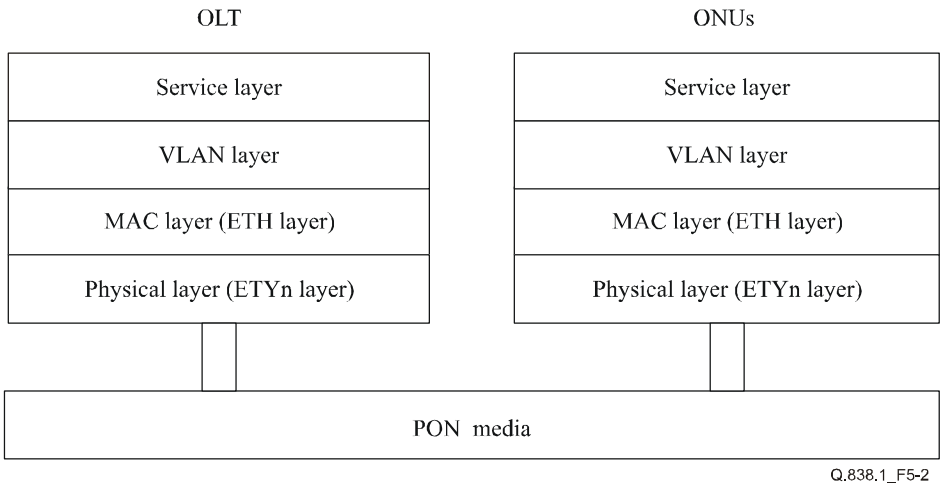


Figure 5-1/Q.838.1 – EPON system architecture

NOTE 1 – The terms OLT and ONU come from IEEE 802.3ah, while the term ONT comes from ITU-T Rec. G.983, and the term NT comes from ITU-T Rec. Q.834.1.

Figure 5-2 illustrates the layering model of EPON.



PON media	Passive Optical Network Media
Physical layer	Physical Layer of EPON, and it is named ETYn Layer in ITU-T Rec. G.8010/Y.1306
MAC layer	Media Access Control Layer of EPON, and it is named ETH Layer in ITU-T Rec. G.8010/Y.1306
VLAN layer	Virtual Local Area Network Layer (see Note 2)
Service layer	Service layer of EPON, such as IP, POTS, ISDN, and so on. (However, in the current version of this Recommendation, only E1 service is covered.)

Figure 5-2/Q.838.1 – EPON layering model

NOTE 2 – The notion of "VLAN Layer" is preliminary and will be deprecated in a subsequent amendment or correction of this Recommendation. According to ITU-T Rec. G.8010/Y.1306 there does not exist a separate VLAN characteristic information, and hence no VLAN layer in the sense of ITU-T Rec. G.809, but VLAN refers to a flow of ETH traffic units, at the MAC Layer, where each traffic unit has a VLAN Tag which includes a VLAN ID to identify the ETH VPN these frames belong to (see 6.3.2.5.3, 6.5.2 and Appendix III of G.8010/Y.1306).

Moreover, ITU-T Rec. G.8010/Y.1306 specifies the fragmentation of an ETH flow domain into ETH flow domain fragments (FDFr) and the partitioning of an ETH FPP link into ETH FPP component links (cLink) (see 6.3.2.5/G.8010/Y.1306). As a consequence, VLAN flow domains do not exist and VLAN ports are ETH flow points. Also, the FDFr should be considered the appropriate unit of connectivity within an ETH flow domain (a maximum flow aggregation so to say), and not the flow domain flow (FDF) which could be as tiny as a single traffic unit (i.e., an ETH frame).

When the VLAN Layer is deprecated, all VLAN layer-related managed entities will be replaced by corresponding G.8010/Y.1306-compliant, FDFr- or cLink-based managed entities.

The EMS shown in Figure 5-3 is used to manage the individual network elements supporting EPON technologies. One or more systems may be required depending on the different supplier products and geographic distribution of the elements in the network. The network layer management system shown as NMS in Figure 5-3 represents an integrated management OS across the different technologies and supplier systems. The logical representation shown by NMS may be realized by one or more physical interfaces. Figure 5-3 shows the Q interface addressed in this Recommendation.

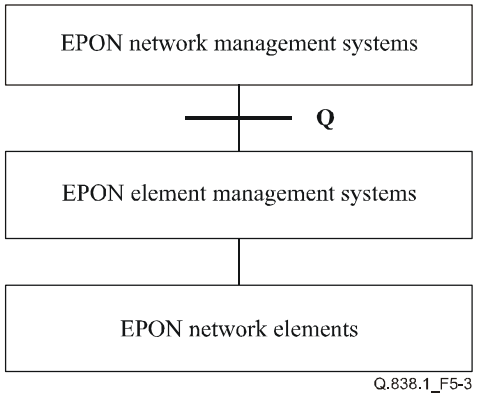


Figure 5-3/Q.838.1 – Reference interface

6 Requirements

6.1 Business level requirements

This Recommendation only focuses on the management interface between NMS and EMS for EPON, and the interface management functions associated with them. Through the interface, NMS can query and modify configuration information, and EMS can report changes in configuration, performance data, and fault information to NMS.

6.1.1 Actor roles

The actor in this Recommendation is NMS. NMS is the EPON network management system that manages the whole EPON systems by interacting with the suppliers' EMSs.

6.1.2 Telecommunications resources

Both the suppliers' EMSs and the managed EPON equipments are viewed as relevant telecommunications resources in this Recommendation.

6.1.3 High-level use case diagrams

This clause contains high-level UML use case diagrams that summarize the functionality and interfaces of EMS.

The first overview use case diagram (Figure 6-1) shows the main management function sets (FS) involved in the EPON management interface.

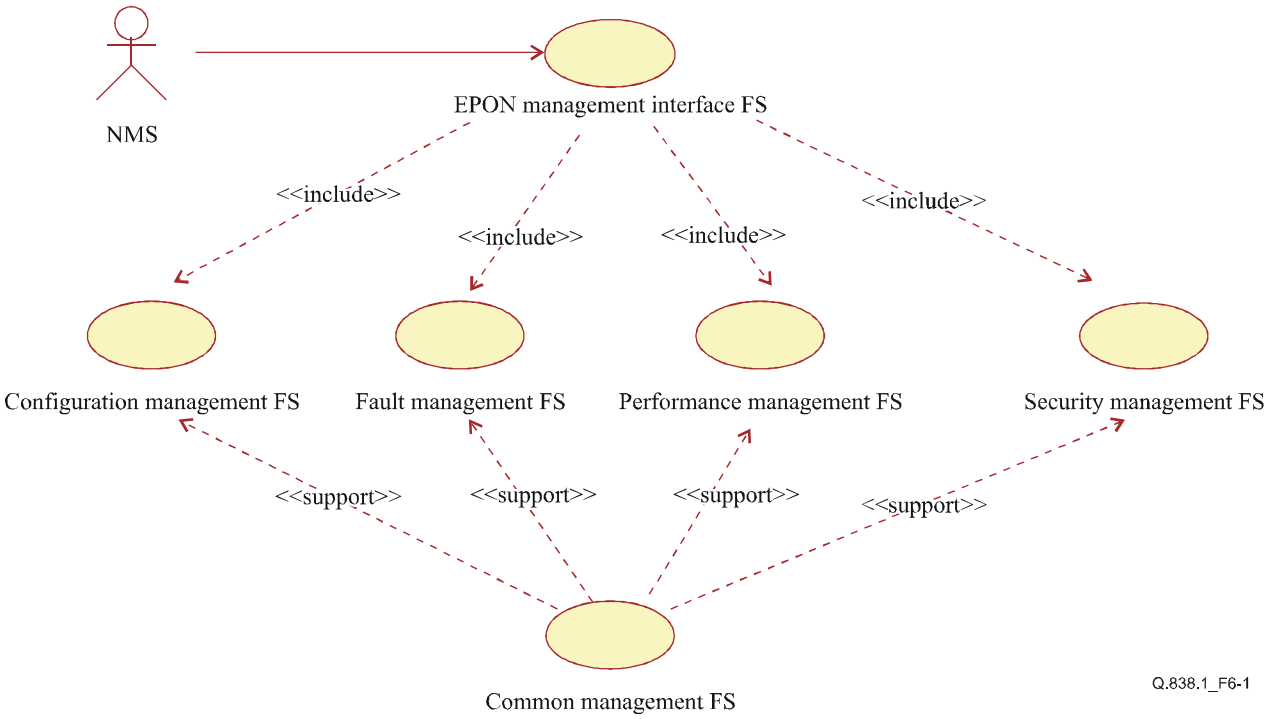


Figure 6-1/Q.838.1 – EPON management interface function set

The diagrams for common management can be found in 6.1.3/Q.827.1 [14]. See Figures 6-2, 6-3, 6-4, 6-5 in ITU-T Rec. Q.827.1 for details.

Figure 6-2 shows the functions involved in the Configuration management function set.

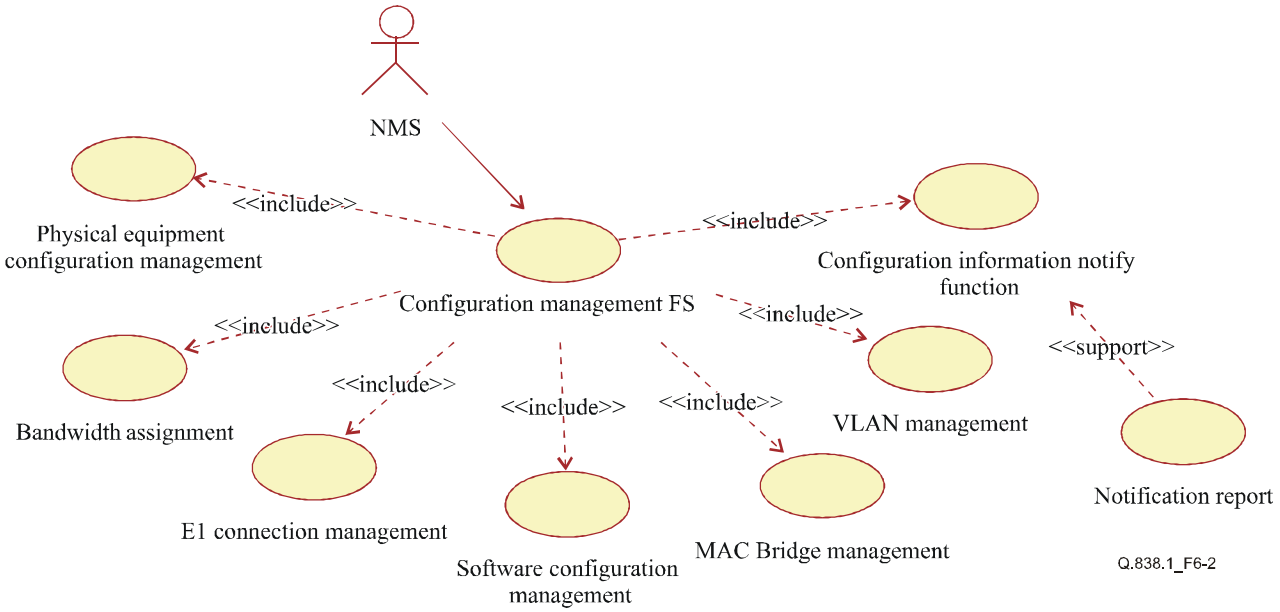


Figure 6-2/Q.838.1 – Configuration management function set

The use case diagrams for performance management function set can be found in 6.1.3/Q.827.1. See Figures 6-6, 6-7, 6-8 in ITU-T Rec. Q.827.1 for details.

The use case diagrams for Fault management function set can be found in section 6.1.3/Q.827.1. See Figures 6-9, 6-10 in ITU-T Rec. Q.827.1 for details. Besides, in this interface, the Loopback test management FS is also a subfunction set included in Fault management FS defined in ITU-T Rec. Q.827.1. Figure 6-3 shows the Loopback related functions.

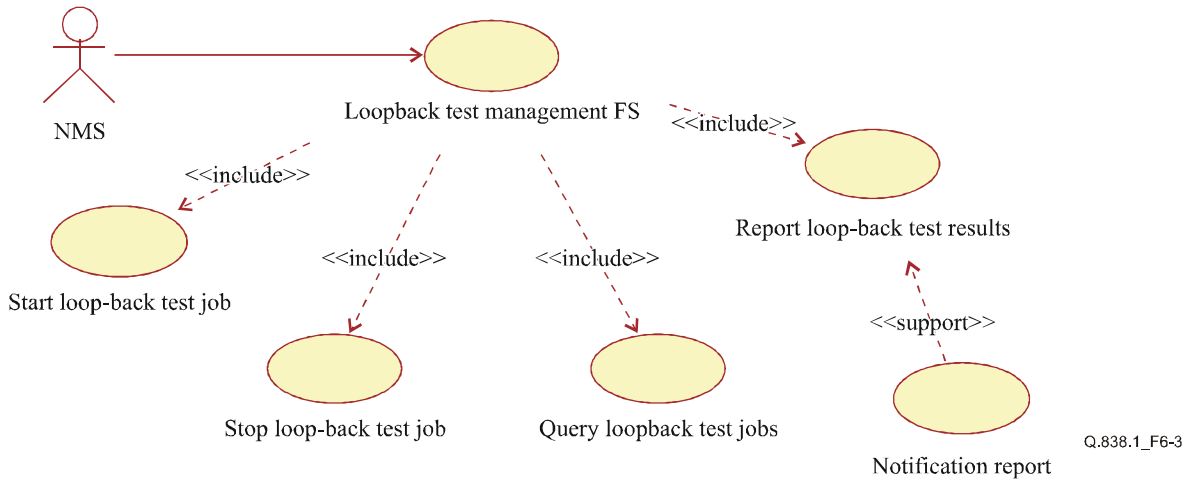


Figure 6-3/Q.838.1 – Loopback test management function set

6.2 Specification level requirements

This clause contains textual details for each of the use cases shown in the high-level use case diagrams of the previous clause. The details are provided to clarify the roles of external actors and telecommunications resources, to establish the basis for interactive diagrams in the analysis part, and to refine the previous high-level use case diagrams to a specification level. The conventions for use case details can be found in 6.2/Q.827.1.

The use case details are listed by the use case title shown in the use case diagrams of the previous clause.

6.2.1 Common management function set

The specification level requirements for Common management are described in 6.2.1/Q.827.1, which will be reused in this Recommendation.

6.2.2 Configuration management function set

6.2.2.1 Overview

Configuration management (CM) of EPON system contains physical equipment configuration management, bandwidth assignment, E1 connection management, software configuration management, MAC bridge configuration management and VLAN configuration management.

The basic CM functions involve creating or deleting configuration related managed entities (if applicable), querying or modifying configuration information of them, managing their relationships, and configuration information change notification functions.

6.2.2.2 Basic configuration management function set

6.2.2.2.1 Create managed entity

Summary: NMS can create a CM related managed entity through the management interface.

Assumptions: The communication between NMS and EMS is available. EMS supports the function of creating the specified managed entity.

Actors: NMS.

Preconditions: NMS needs to create a managed entity instance in EMS.

Description: NMS can send a request to EMS to create an instance of some specific managed entities. Usually, these managed entities represent some logical resources that can be dynamically created and configured, such as E1 connection or VLAN related entities. Those that are instantiated when EMS is initialized are not supposed to be created by NMS at the management interface. The parameters in the request include the class name of the managed entity, and a list of the attribute name and value pairs of the specified managed entity for creation. If the managed entity has been created successfully, EMS will then return the identifier of the managed entity and may send a corresponding object creation notification to NMS. If the creation fails, EMS will return error information.

Exceptions: Unknown Class Name; Creation Unsupported; Invalid Parameter; EMS Processing Error; Communication Error.

Post-conditions: The managed entity is created by EMS on the request of NMS. EMS may send the corresponding object creation notification to NMS.

6.2.2.2.2 Delete managed entity

Summary: NMS can delete a CM related managed entity(s) through the management interface.

Assumptions: The communication between NMS and EMS is available. EMS supports the function of deleting the specified managed entity(s).

Actors: NMS.

Preconditions: NMS no longer needs the specified managed entities in EMS. The specified managed entity(s) exists in EMS, and is not associated with or containing any other managed entities.

Description: NMS can send a request to delete a managed entity(s) in EMS. Usually, these managed entities represent some logical resources that can be dynamically created, deleted and configured, such as E1 connection or VLAN related entities. Those that are instantiated when EMS is initialized are not supposed to be deleted by NMS at the management interface. The parameter in the request is the list of IDs of the managed entities. The deletion will be carried in a nested and best effort way, that is, when a managed entity is specified for deletion, the managed entities it contains directly or indirectly are also to be deleted. If some of the contained managed entities cannot be deleted, their containing entity cannot be deleted either, which means no managed entity will exist as an isolated node. But all the deletable managed entities are deleted. If the managed entity(s) has been deleted successfully or partially successfully (not all the specified managed entities are deleted), EMS will return success or partial success information and may then send the corresponding object deletion notification(s) to NMS. EMS also specifies the list of undeleted managed entities and the corresponding reason for deletion failure. If the deletion fails completely or partially, EMS will return error information.

Exceptions: Unknown Managed Entity; Deletion Unsupported; EMS Processing Error; Communication Error.

Post-conditions: The specified managed entity(s) are deleted by EMS on the request of NMS, and the correlated network resources are also released. EMS may send the corresponding object deletion notification(s) to NMS.

6.2.2.2.3 Modify managed entity

Summary: NMS can modify the attribute values of one or more CM related managed entities in EMS through the management interface.

Assumptions: The communication between NMS and EMS is available. EMS supports the function of modifying the specified managed entity(s).

Actors: NMS.

Preconditions: NMS needs to change some parameter values of a managed entity(s) in EMS. The specified managed entity(s) exists in EMS. The specified attributes are modifiable.

Description: In this use case, NMS sends a request to EMS to modify one or more managed entities of the same class. The input parameters contain the class name of the managed entity(s), a list of entity IDs of the instances to be modified, and a list of the attribute names, the corresponding new values, and the operation type for modification (replace, add, remove, or set to default). If the modification succeeds, EMS will return success information and may send the corresponding attribute value change or state change notification(s). If the modification fails, EMS will return error information.

Exceptions: Unknown Managed Entity; Invalid Parameter; Attribute Not Modifiable; EMS Processing Error; Communication Error.

Post-conditions: The specified managed entity(s) is modified by EMS on the request of NMS. EMS may send the corresponding attribute value change or state change notification(s) to NMS. The new attribute values will take effect after the modification.

6.2.2.2.4 Query managed entity

Summary: NMS can query the attribute values of one or more CM related managed entities in EMS through the management interface.

Assumptions: The communication between NMS and EMS is available. EMS supports the function of querying the specified managed entity(s).

Actors: NMS.

Preconditions: NMS needs to query the attribute value information of a CM related managed entity(s) in EMS. The specified managed entity(s) exists in EMS.

Description: NMS can query the attribute values of one or more managed entities. The attributes that can be queried vary for different managed entities. In this use case, NMS sends a request to query one or more managed entities. The parameter in the request is the list of the managed entities to be queried. If the function succeeds, EMS will return the attribute values for the specified managed entities. Or else, EMS will return error information.

Exceptions: Unknown Managed Entity; EMS Processing Error; Communication Error.

Post-conditions: EMS returns all the attribute values of the specified managed entities.

6.2.2.3 Configuration information notify function

Summary: After a managed object has been created or deleted, or the attributes values or state of a managed object has changed, EMS may send a corresponding notification to NMS, in order to notify NMS what have changed within the equipment. This use case uses the notification report function included in the common management function set. The use case involves object creation notification, object deletion notification, attribute value change notification and state change notification. For details, please refer to "Notification Report" in 6.2.1.2.1/Q.827.1.

6.2.2.4 Physical equipment configuration management

Summary: NMS can query or modify the configuration information of physical equipments.

Assumptions: The communication between NMS and EMS is available. NMS has the authority to query or modify the configuration information of the physical equipments.

Actors: NMS.

Preconditions: NMS needs to query or modify the configuration information of the physical equipments.

Description: NMS can query or modify configuration attributes of EPON physical equipments, such as OLT, ONU, ONT, NT, Splitter, rack, shelf, circuit pack, physical ports in OLT, ONU or ONT. The configuration attributes of OLT, ONU, ONT and NT contain administrative state, operational state, location name, supplier name, alarm status, and alarm severity assignment profile pointer, etc. The configuration attributes of OLT, ONU or ONT, NT and splitter also contain pointer attributes indicating the downstream NEs and the upstream NE (if applicable). The splitter includes an attribute describing the number of branches. When querying the configuration information of physical equipments, the input parameter is the equipment ID and the attribute names to be retrieved. Then EMS processes the query request and returns the queried result. When modifying configuration information, the input parameters contain the equipment ID, the attribute names to be modified and the corresponding values. EMS then returns the results that indicate whether the operation succeeds or not.

Exceptions: Unknown Managed Entity, Invalid Parameter, EMS Processing Error, Communication Error.

Post-conditions: The configuration information of the physical equipments is returned or modified.

6.2.2.5 Bandwidth assignment

Summary: Bandwidth can be assigned dynamically or statically. The bandwidth assignment type can be chosen by setting a parameter of OLT. In the dynamic assignment procedure, OLT sets the upstream bandwidth for each ONU or ONT according to the request from ONUs or ONTs. The static assignment can be divided into upstream and downstream bandwidth assignment. Only static bandwidth assignment is addressed in this use case.

Assumptions: OLT, ONU or ONT have already been installed in the system. The Ranging procedures of ONUs or ONTs have finished. The communications between NMS and EMS, EMS and OLT, OLT and ONU/ONT are available.

Actors: NMS.

Preconditions: When EPON network is initialized, or some customer wants to change the bandwidth value to or from the customer's ONT/ONU, NMS needs to statically assign the bandwidth from or to ONUs or ONTs. The specified managed entities exist in EMS.

Description: In this use case, NMS sends a static bandwidth assignment request to EMS, which contains the following parameters: the type of assignment, the ID of OLT, the ID of ONU or ONT equipment, and the related bandwidth value. On receiving this request, EMS validates that the requested equipments exist and the corresponding resources are abundant to allocate the bandwidth. Then EMS will work out and modify the corresponding parameter values of the entities related to the bandwidth assignment. The static bandwidth assignment is divided into two types: the upstream bandwidth assignment and the downstream bandwidth assignment.

Exceptions: Unknown Managed Entities, Bandwidth Not Enough, Communication Error, EMS Processing Error.

Post-conditions: The upstream or downstream bandwidth of an ONU or an ONT has been statically allocated or changed. The corresponding attribute value change notifications may be sent to NMS.

6.2.2.6 E1 connection management

Summary: NMS can create or delete a connection between an E1 port on OLT and an E1 port on ONU or ONT equipment according to customers' requirements.

Assumptions: OLT, ONU or ONT support E1 port. OLT, ONU or ONT have already been installed in the system. The Ranging procedures of ONU or ONT have finished. The communications between NMS and EMS, EMS and OLT, OLT and ONU/ONT are available.

Actors: NMS.

Preconditions: NMS needs to create or delete a connection relationship between an E1 port on OLT and an E1 port on ONU or ONT equipment. The E1 ports involved in the request exist in EMS and are available.

Description: In this use case, NMS sends a request to EMS to create an E1 connection, which contains the following parameters: the ID of E1 port on OLT equipment, and the ID of E1 port on ONU or ONT equipment. On receiving this request, EMS will check whether the E1 ports both of ONU/ONT, and OLT are available, and whether the bandwidth resource is enough. If the resources are not available or any exception occurs, EMS will inform NMS that the connection creation operation fails along with the possible causes. Or else, EMS will then create the relationship between the two E1 ports and related managed entities.

NMS can also request to remove an E1 connection. In this case, the deletion request includes the E1 Connection Id. EMS makes resources formerly assigned to the connection available for use by any subsequent connection request, modifying managed entities tracking these resource values. It also removes logical managed entities associated with the connection.

Exceptions: Unknown E1 Port; E1 Port Not Available; Bandwidth Not Enough; Communication Error; EMS Processing Error.

Post-conditions: An E1 connection is created or deleted. And the related managed object instances are created, modified or deleted on the request.

6.2.2.7 Software configuration management

Summary: NMS can query the software information of NEs through the management interface.

Assumptions: EMS stores NE software information. The communication is available.

Actors: NMS.

Precondition: NMS needs to query the software information of one or more NEs. The specified software in EPON equipment exists in EMS.

Description: NMS sends a request to EMS to query the software information of NEs, which contains software ID, software version, user label, supplier name, operational state, administrative state, etc. The input parameter is the IDs of the NEs whose software information is to be queried. On receiving this request, EMS starts to process it. If the operation succeeds, EMS will return the corresponding software attributes information. If the operation fails, it will return error information. In addition, EMS is responsible to maintain the consistency of software information with the NEs. That is, when new software has been installed on a NE, or there are any changes in the software, such as software version upgrading, EMS shall update the corresponding NE software information in its database.

Exceptions: Unknown Managed Entity; EMS Processing Error; Communication Error.

Post-conditions: NE software information is returned by EMS.

6.2.2.8 MAC bridge configuration management

Summary: NMS can query or modify the information of a MAC bridge in an EPON NE, which involves the MAC bridge itself, MAC bridge ports, MAC bridge spanning tree protocol, and MAC bridge port spanning tree protocol.

Assumptions: The managed system supports the MAC bridge functionality for the specified NE. The communication is available.

Actors: NMS.

Preconditions: NMS needs to query or modify the MAC bridge information on a specified NE. The specified NE exists in EMS, and the NE supports the MAC bridge functionality.

Description: NMS sends a request to EMS to query or modify the MAC bridge information. It includes the information about MAC bridge, MAC bridge port, MAC bridge spanning tree protocol, and MAC bridge port spanning tree protocol. Where, the information of MAC bridge contains the attributes related to the MAC bridge of an equipment which supports MAC bridge functionality, such as the number of MAC ports, and whether the MAC bridge supports spanning tree protocol or not, etc. The information of MAC bridge port contains attributes such as port number, the list of MAC address for which this port serves, and whether this MAC bridge port supports spanning tree protocol or not, etc. The information of MAC bridge spanning tree protocol contains the detailed protocol information associated with the bridge, such as priority, the number of root port, and some time and numerical parameters which support the operation of this spanning tree protocol, for instance, root path cost, max age, and hello time, etc. The information of MAC bridge port spanning tree protocol contains the detailed protocol information associated with each MAC bridge port, such as port priority, port state, designated bridge root cost port and port path cost. On receiving this request, EMS starts to process it. If the operation succeeds, EMS will return or modify the corresponding MAC bridge attributes information. If the operation fails, it will return error information.

MAC bridge information entities exist in the EPON equipments which support MAC bridge functionality.

Exceptions: Unknown Managed Entity; Invalid Parameter; EMS Processing Error; Communication Error.

Post-conditions: The corresponding MAC bridge information is returned or modified by EMS as requested.

6.2.2.9 VLAN configuration management

Summary: NMS can query or modify the configuration information about VLAN, which contains the information about VLAN ports, VLAN tagging operations, and the priority of VLAN switching.

Assumptions: The managed system supports VLAN function. The communication is available.

Actors: NMS.

Preconditions: NMS needs to query or modify the VLAN management related information on a specified NE. The specified NE exists in EMS, and the NE supports the VLAN functionality.

Description: NMS sends a request to query or modify VLAN information. The information involves VLAN ports, VLAN tagging operations, and the priority of VLAN switching. Where, the information of VLAN port contains details about a logical port of a MAC bridge port associated with a VLAN tagging, such as the filter table for this VLAN port which identifies TCI values provisioned at the bridge port, and the forward operation which will be invoked when receiving a data frame, etc. The information of VLAN tagging operations configuration data contains the details about VLAN tagging, such as upstream VLAN tagging operation mode, upstream VLAN TCI value, downstream VLAN tagging operation mode, etc. The information of VLAN switching priority contains the mapping information between user priorities of VLAN and switching priorities of an Ethernet Switch. On receiving this request, EMS starts to process it. If the operation succeeds, EMS will return or modify the corresponding VLAN information. If the operation fails, it will return error information.

VLAN information exists in the EPON equipment supporting VLAN functionality, which is based on the MAC bridge functionality.

Exceptions: Unknown Managed Entity; Invalid Parameter; EMS Processing Error; Communication Error.

Post-conditions: The corresponding VLAN information is returned or modified by EMS as requested.

6.2.3 Performance management function set

The specification level requirements for common parts of Performance management (PM) are described in 6.2.3/Q.827.1, which will be reused in this Recommendation.

Measurement data is the main objective of all the other function sets in PM. A short summary of the requirements for EPON performance measurement data may include the following: the measurement of Ethernet port, PON port, E1 port and VLAN port. The measurement data of Ethernet port contains the number of octets received and transmitted on the port, the number of inbound and outbound packets discarded on the port, and the number of the incoming and outgoing packets that contain errors, etc. The measurement data of PON port includes the upstream and downstream BERs of the port. The measurement data of E1 port focuses on the parameters about error seconds, and unavailable seconds. As for the VLAN measurement data, the number of frames received and transmitted on a port, the number of frames discarded on a port, and the number of the overflowed frames are involved.

6.2.4 Fault management function set

6.2.4.1 Overview

The specification level requirements for the common parts of Fault management (FM) are described in 6.2.4/Q.827.1, which will be reused in this Recommendation.

For EPON specific network management, Fault Management FS also includes the information of loopback test. Loopback test management FS includes the following functions: Start Loopback Test Job, Stop Loopback Test Job, Query Loopback Test Job, and Report Loopback Test Results.

6.2.4.2 Loopback test function set

6.2.4.2.1 Start loopback test job

Summary: NMS can initiate a loopback test procedure by sending a request to EMS. The tests include but are not limited to the ONU loopback test.

Assumptions: The communication between NMS and EMS and the communication between EMS and the related NE is available. The test performer or test device of the NE is available. The NE has capabilities to conduct the test.

Actors: NMS.

Preconditions: NMS needs to execute a loopback test in order to get more information to resolve the complaint of a customer or to support a maintenance activity. The specified NE for testing exists in EMS.

Description: In this use case, NMS constructs a request to start a loopback test job. The request includes the data source type, the test type, the managed entity to be tested, the start time of the test, the end time of the test, and the time interval of reporting and logging test results. EMS identifies the EPON resource to be tested and the ancillary EPON resources that must participate in the test, and then returns the identifier for the test job. At the start time of the test job, EMS executes the test sequence in collaboration with the NEs. At the end of the test or each interval for reporting and logging, EMS will report the test results as well as record them in the log. The test results contain the upstream and downstream bit error ratio, packet loss ratio, the number of received octets, the number of transmitted octets, and the number of FCS errors.

Exceptions: Unknown Managed Entity; EMS Processing Error; Communication Error.

Post-conditions: EMS starts the test job on the specified NE as requested. At each reporting interval, EMS will record the test result in the log as well as report them to NMS.

6.2.4.2.2 Stop loopback test job

Summary: NMS can request EMS to stop a running loopback test job through the management interface.

Assumptions: The communication between NMS and EMS and the communication between EMS and the related NE is available.

Actors: NMS.

Preconditions: NMS does not need EMS to perform the loopback test job any more. The specified test job exists in EMS.

Description: In this use case, NMS sends a request to stop a running loopback test job in EMS. The request parameter is the ID of the test job. If the operation succeeds, the specified test job will stop working and EMS will return success information. Otherwise it will return error information to NMS.

Exceptions: Unknown Test Job; EMS Processing Error; Communication Error.

Post-conditions: The specified test job is stopped by the request.

6.2.4.2.3 Query loopback test jobs

Summary: NMS can request EMS to query the parameter values of loopback test jobs through the management interface.

Assumptions: The communication between NMS and EMS is available.

Actors: NMS.

Preconditions: NMS needs to query the parameter information of one or more loopback test jobs in EMS. The specified test job(s) exists in EMS.

Description: In this use case, NMS sends a request to EMS to query the parameters of a loopback test job(s), which include: the test job ID, the data source of the test, the test type, the managed entity this test is performed on, the start and stop time of the test job, and the time interval for reporting and logging test results. The input parameter is the list of the test job ID(s). When the list is empty, the request is to query information of all the test jobs in EMS. If the operation succeeds, EMS will return the information of the test job(s). If the operation fails, it will return error information to NMS.

Exceptions: Unknown Test Job; EMS Processing Error; Communication Error.

Post-conditions: The corresponding information of the test job(s) is returned by EMS as requested.

6.2.4.2.4 Loopback test result report

Summary: The test results of a loopback test is generated and reported to NMS periodically according to the time interval specified when the test job is started. At each reporting interval, a corresponding "Loopback Test Result" notification will be sent to NMS, as well as logged as a log record, which can also be queried later using the "Query Log Records" function described in 6.2.1.3.2.1/Q.827.1.

6.2.5 Security management

For the specification level requirement of security management, please refer to 6.2.2.1/Q.834.3 [16].

7 Analysis

This clause provides the detailed analysis of the management interface. In the following clauses, the related managed entities and their relationships are fully analysed, and the diagrams in these clauses illustrate the static or dynamic relationships of the managed entities.

7.1 Conventions

In this clause, when specifying managed entities and their management operations, the following abbreviations are applied to indicate the qualifier of attributes, notifications or operation parameters.

– M: Mandatory.

– O: Optional.

– C: Conditional.

– R: Readable.

– W: Writable.

– S: Set by Create.

For the managed entities that are specific in EPON management, their names are suffixed by 'E' and with the first letter capitalized. For the managed entities providing just the controlling functions and may be reused in some other network technology-specific managements, their names do not contain this suffix, with the first letter capitalized. For the managed entities that are imported from other Recommendations, their names remain the same as imported.

7.2 Common management function set

7.2.1 Managed entities

7.2.1.1 Class diagram of common management entities

The class diagrams of common management entities can be found in 7.2.1.1/Q.827.1. The only addition for Figures 7-1/Q.827.1 and 7-2/Q.827.1 is to include two new managed entities LoopbackTestResultRecord and EPONAccessNetwork. Combining Figure 7-1/Q.827.1 and Figure 7-1 below will result in a complete inheritance diagram of Common management for this Recommendation. Combining Figure 7-2/Q.827.1 and Figure 7-2 below will result in a complete entities relationship diagram for Common management for this Recommendation

NOTE – EPONAccessNetwork is a sub-class of network, which will be used as a replacement in the Entities relation diagram in this Recommendation.

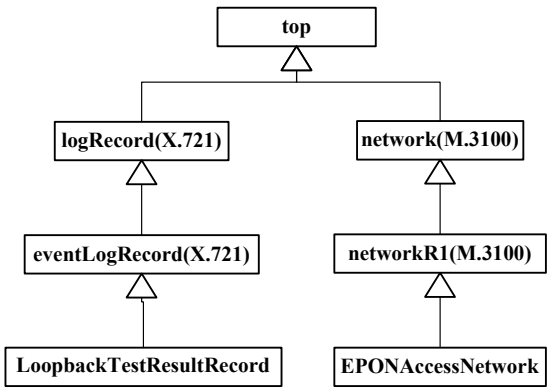


Figure 7-1/Q.838.1 – Additional inheritance diagram of common management

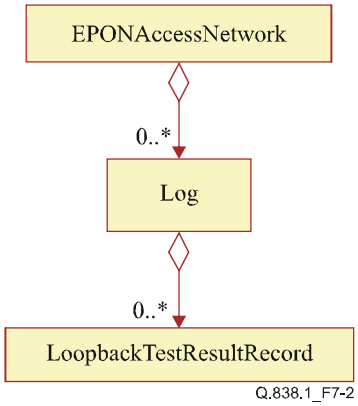


Figure 7-2/Q.838.1 – Additional containment diagram of common management

7.2.1.2 LoopbackTestResultRecord

Behaviour: This managed object class is used to define the information stored in the log as a result of receiving loopback test result notifications. The managed object class is derived from eventLogRecord.
Attributes: This managed object inherits all the attributes defined in eventLogRecord and also contains the attributes as defined in "LoopbackTestResult" notification. See 7.2.2.1 for details.
Relationships: Multiple instances of this managed entity may be contained in an instance of the Log managed object.

7.2.1.3 EPONAccessNetwork

Behaviour: This managed entity represents a set of managed entities which are visible at the NMS-EMS management interface and managed by one EMS. An instance of this managed entity is created when an EMS along with its managed resources are added to the EPON managing system. An instance of this managed entity is created when an EPON system is initialized, and it cannot be created or deleted as requested by a managing system. This managed entity derives from networkR1 and inherits the attributes and notifications of its super class.
Attributes: This managed object inherits all the attributes defined in networkR1. There are no extra attributes to be added.
Relationships: EPONAccessNetwork managed entity is composed of many transport entities and other controlling entities (e.g., Log defined in ITU-T Rec. Q.827.1). Only one instance of this managed object class exists for an EMS (This is the root managed object of an EMS).
Reportable Notifications: This managed object inherits all the notifications defined in networkR1. There are no extra notifications to be added.

7.2.2 Notification report function

The notification header and all the possible notifications defined in 7.2.3.1 and 7.2.3.2 of ITU-T Rec. Q.827.1 will be reused in this Recommendation. In the following clause, the extended notifications specific for this Recommendation are provided.

7.2.2.1 Extended notification definitions

In this clause, only one extra notification is extended to 7.2.3.2/Q.827.1.

1) LoopbackTestResult

Parameters	Description	Type	Qualifier
testJobId	It identifies the loopback test job whose results are reported.	Integer	M
testResultDefinition	It identifies the result of a loopback test job. It is a set of structure, composed of the attributeName and the corresponding attributeValue, which include: the upstream bit error ratio, downstream bit error ratio, packet loss ratio, the number of received octets, the number of transmitted octets, and the number of FCS errors.	LIST of Name/Value pairs	M
timeInterval	This parameter identifies the time interval for EMS to report the test results.	Integer (Units: minutes)	M

7.3 Configuration management function set

7.3.1 Managed entities

7.3.1.1 Class diagram of configuration management entities

Figure 7-3 is the inheritance diagram of the configuration management related entities in network element view, and Figure 7-4 is the inheritance diagram of the configuration management related entities in network view.

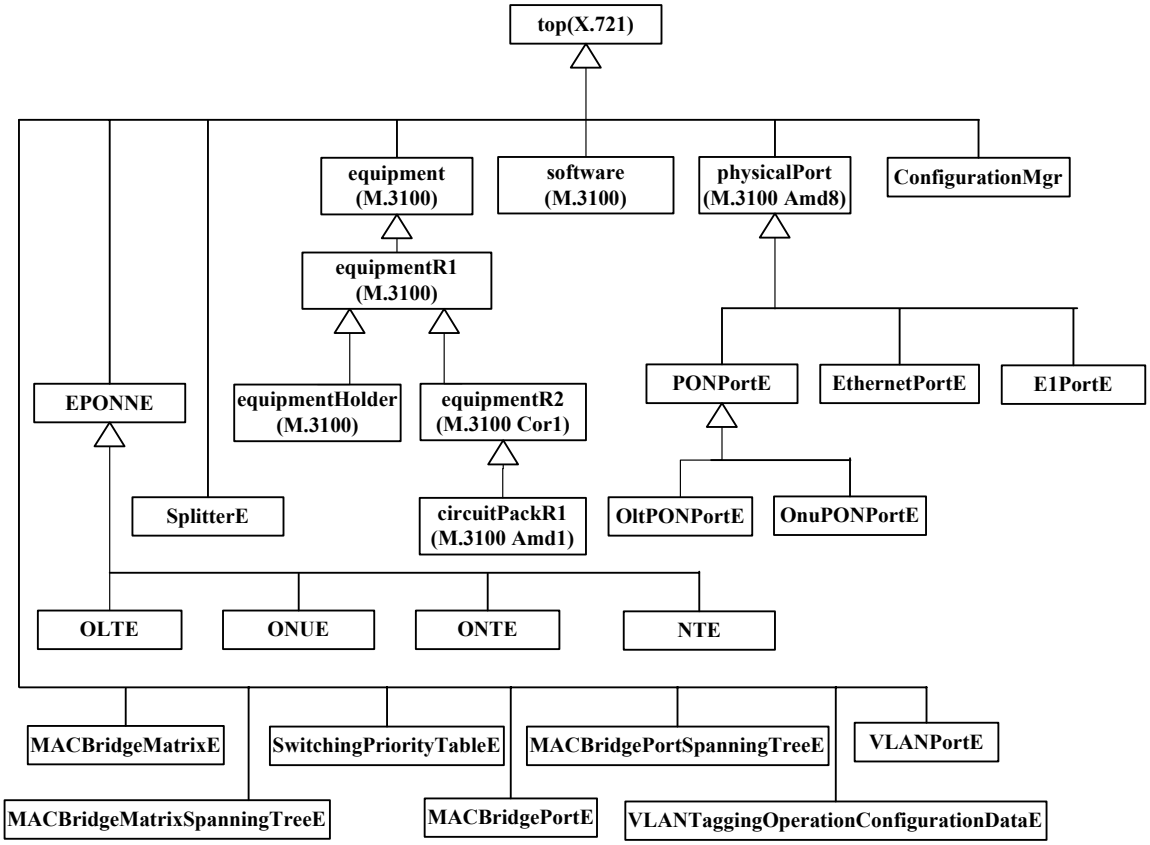


Figure 7-3/Q.838.1 – Inheritance diagram of managed entities in network element view

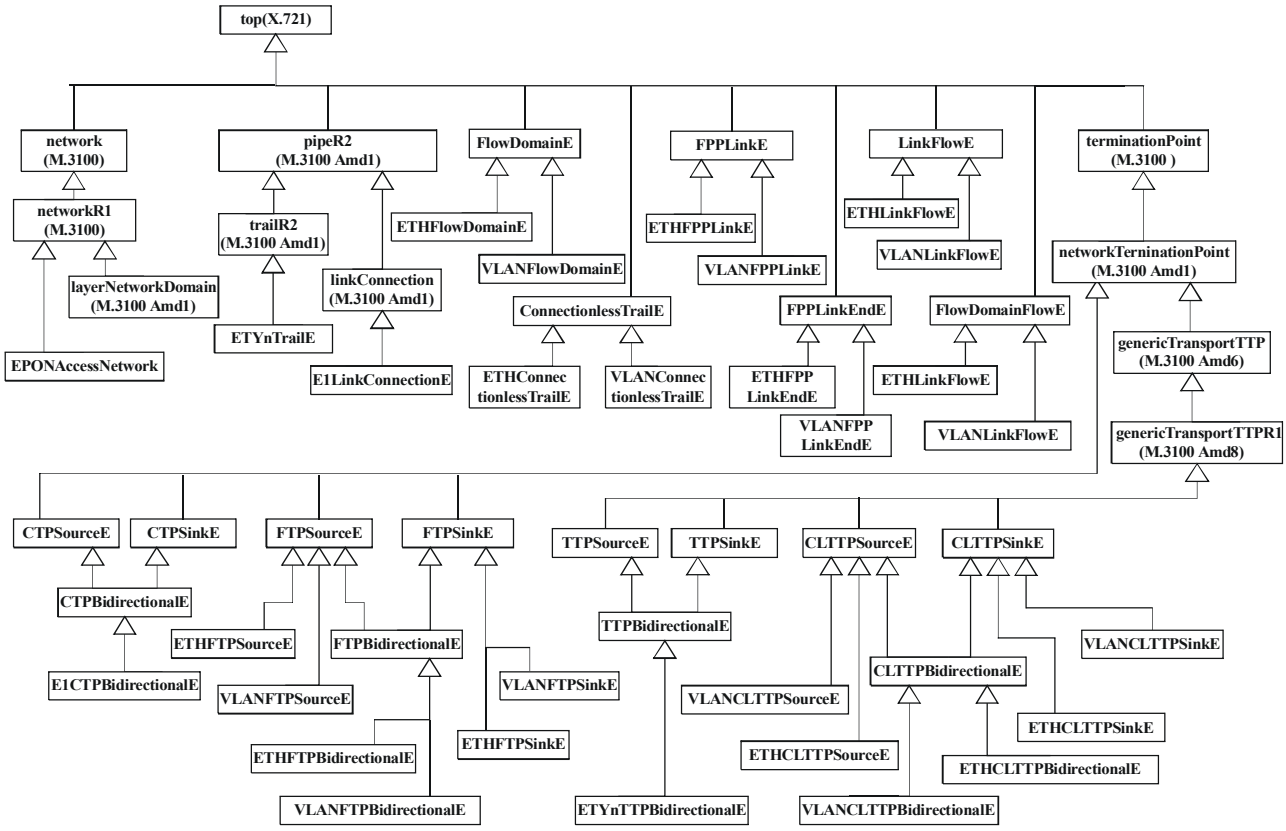


Figure 7-4/Q.838.1 – Inheritance diagram of managed entities in network view

NOTE 1 – See clause 5/Note 2 regarding the VLAN layer.

Figure 7-5 is the containment diagram of configuration management entities in both network element view and network view.

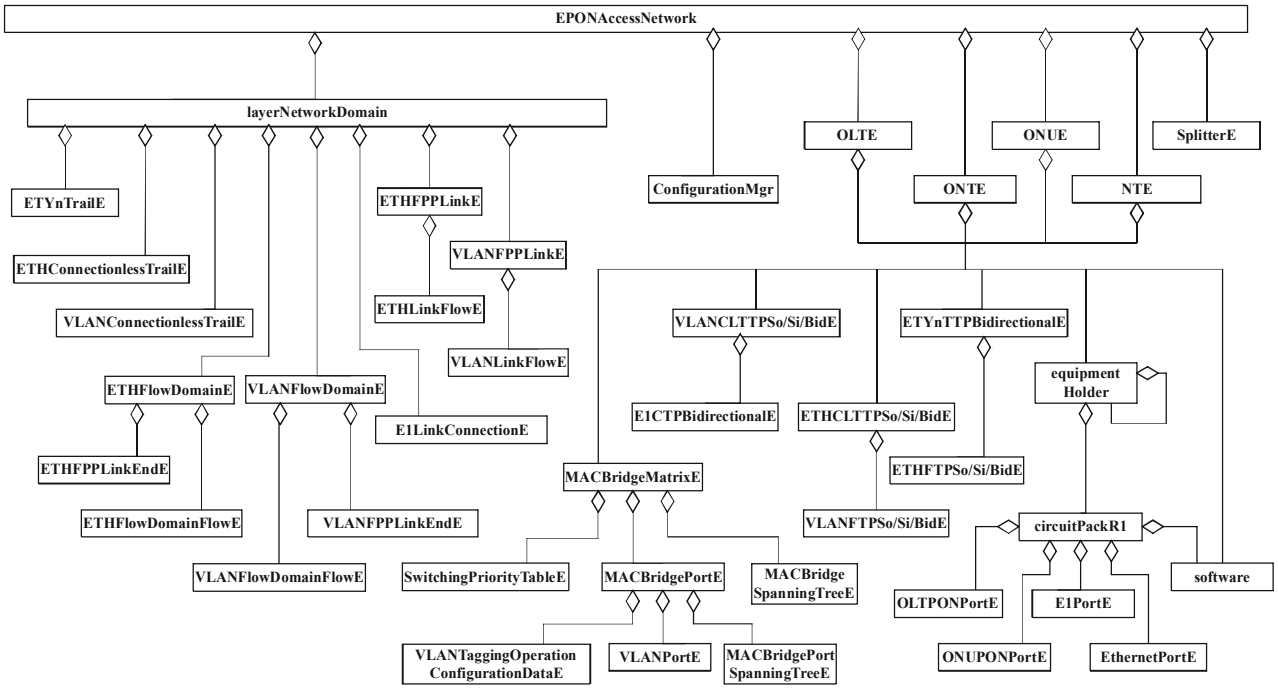


Figure 7-5/Q.838.1 – Containment diagram of configuration managed entities

NOTE 2 – See clause 5/Note 2 regarding the VLAN layer.

Figure 7-6 is the entity relationship diagram of EPON Network Elements.

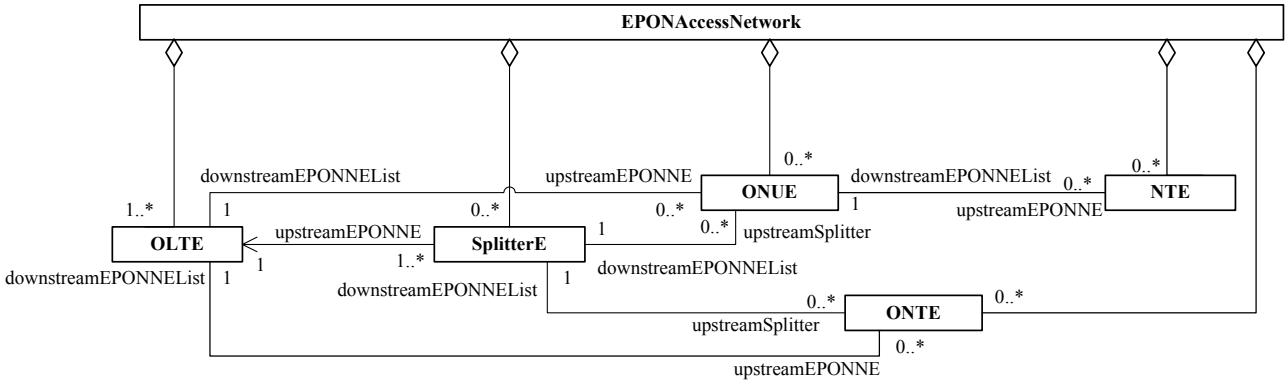


Figure 7-6/Q.838.1 – Entities-relationship diagram of configuration management – EPON NE

Figure 7-7 is the entity relationship diagram of entities related to layer network.

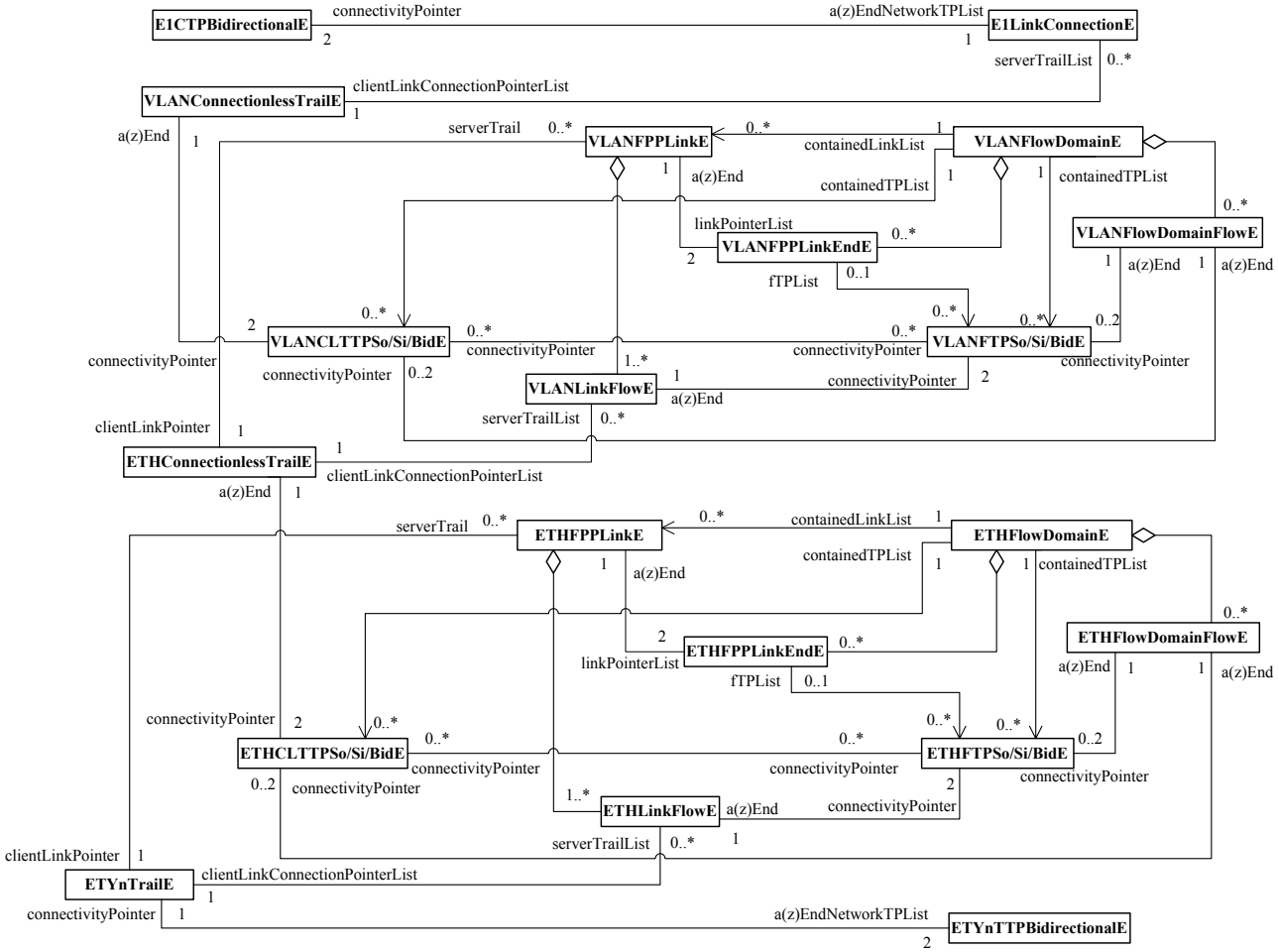


Figure 7-7/Q.838.1 – Entities relationship diagram of configuration management – Layer network

NOTE 3 – See clause 5/Note 2 regarding the VLAN layer.

Figure 7-8 is the entities-relationship diagram of TP and port entities.

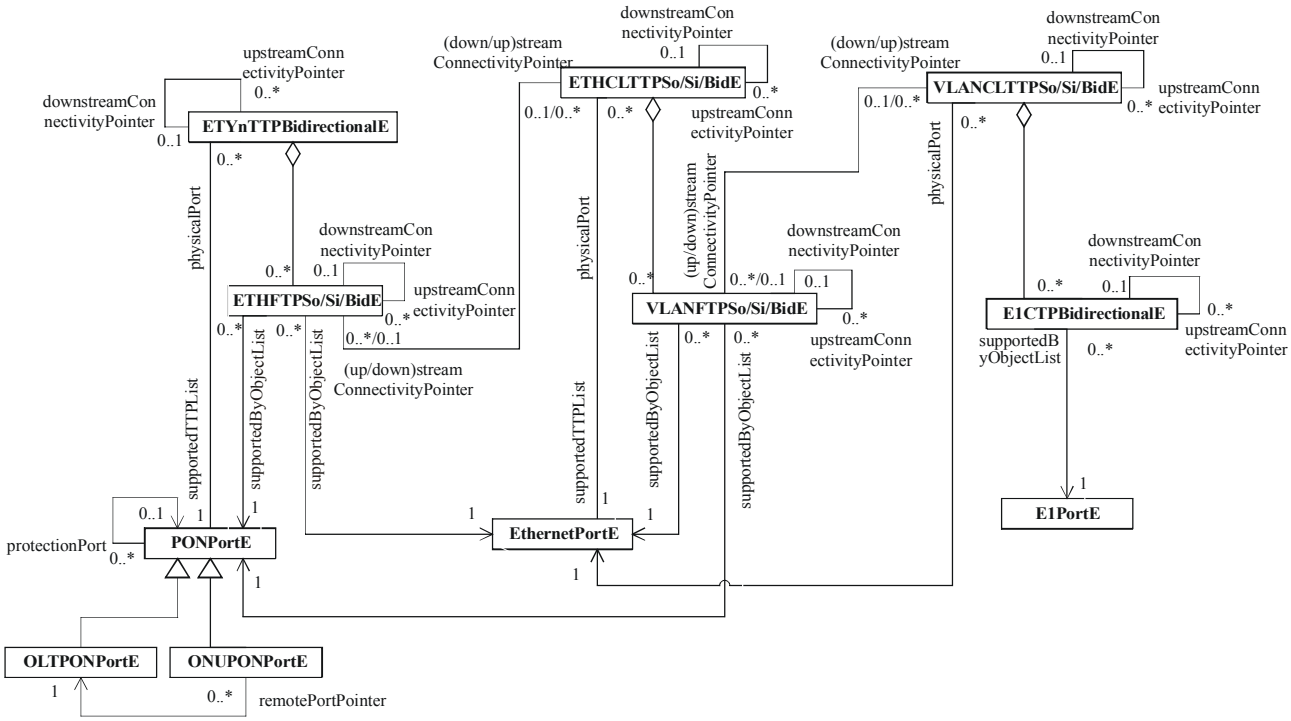


Figure 7-8/Q.838.1 – Entities relationship diagram of configuration management – TPs and ports

NOTE 4 – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.2 EPONNE

Behaviour:			
This managed entity represents one of the network elements in EPON system, and is just used for inheritance. This managed entity supports the functionality of attributes operational state, administrative state, and the alarm status defined in ITU-T Rec. X.731 [11]. Changes in status will be reported automatically or as requested by a managing system, and equipment alarms will also be reported. This managed entity is a collection of the common attributes of EPON network elements.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
administrativeState	This attribute is used to activate (unlock) or deactivate (lock) this managed entity. See ITU-T Rec. X.731 for details.	ENUM: {locked, unlocked, shuttingDown}	M, R/W
operationalState	This attribute is to indicate the operability of the managed entity, which has two possible values: disabled and enabled. See ITU-T Rec. X.731 for details.	ENUM: {enabled, disabled}	M, R

Name	Description	Type	Qualifier
alarmStatus	The Alarm Status attribute indicates the occurrence of an abnormal condition relating to an object. This attribute may also function as a summary indicator of alarm conditions associated with a specific resource. It is used to indicate the existence of an alarm condition, a pending alarm condition such as threshold situations, or (when used as a summary indicator) the highest severity of active alarm conditions.	ENUM {cleared, activeReportable-Indeterminate, activeReportable-Warning, activeReportable-Minor, activeReportable-Major, activeReportable-Critical, activePending}	M, R
externalTime	This attribute provides the time-of-day system time, which functions as a reference for all time stamp activities in the EPONNE instance. See ITU-T Rec. M.3100 [4] for details.	GeneralizedTime	O, R/W
locationName	This attribute identifies the location of this EPONNE instance. See ITU-T Rec. M.3100 for details.	String	O, R/W
vendorName	This attribute identifies the supplier of this EPONNE instance.	String	O, R/W
version	This attribute identifies the version of the EPONNE instance.	String	O, R/W
aSAPPointer	This attribute is a pointer that identifies an ASAP object that may be used by this managed entity.	Name	O, R/W

Relationships:

In each node of the EPON architecture, there exists an EPONNE instance. Each EPONNE contains zero or more equipmentHolder managed entities that represent racks, which may also contain other equipmentHolders (shelves or slots). EPONNE managed entity is the super class of NTE, OLTE, ONUE and ONTE. EPONNE instances are contained under a EPONAccessNetwork instance.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
equipmentAlarm	M
environmentalAlarm	M
communicationsAlarm	M
processingErrorAlarm	M

7.3.1.3 OLTE (Optical Line Terminal-EPON[1])

Behaviour:

This managed entity represents the optical line terminals (OLT) in the EPON system. This managed entity is derived from EPONNE and inherits all the attributes, relationships and reportable notifications of this super class. The entity also contains a pointer attribute identifying the instances of ONUE or ONTE related with this OLTE instance.

Attributes

Name	Description	Type	Qualifier
oLTEId	This is the unique identifier of this OLTE managed entity.	Name	M, R
oLTDCNAddress	This attribute identifies the DCN address of this OLT for management purpose. Usually it is an IP Address.	String (may be IPAddress)	M, R
downStreamEPONNEList	This attribute identifies all the ONUs or ONTs connected to this OLT.	LIST of Name	M, R/W
registerEnable	This attribute indicates the enabled/disabled status for ONU or ONT to register to this OLT. The value true indicates the register is enabled.	Boolean	M, R/W
regMaxTime	This attribute indicates the max time that an ONU or ONT can wait when a collision occurs during P2MP discovery (registration) [22] to this OLT.	Integer (Units: seconds)	M, R
regInterval	This attribute identifies the interval between the P2MP discovery (registration) grant frames sent to ONUs or ONTs. The default value of this attribute is 1 second.	Integer (Units: seconds)	O, R/W
bASelect	This attribute indicates the current bandwidth assignment arithmetic, and it can be either Static Bandwidth Assignment (SBA), or Dynamic Bandwidth Assignment (DBA).	ENUM {SBA, DBA}	O, R/W
bAUpInterval	This attribute indicates the period of the bandwidth assignment. This attribute is applicable only when the bASelect is DBA. The range is 0 to 4 milliseconds.	Integer (Units: ms)	O, R/W
maxONU	The maximum number of ONUs or ONTs that can be connected to this OLTE instance.	Integer	O, R

Relationships:

Each OLTE instance may be associated with zero or more ONUE or ONTE instances, and one or more SplitterE instances. Other relationships are the same as EPONNE.

Reportable Notifications: The same as EPONNE.

[1] The managed entities with an 'E" as suffix are defined for EPON specific network management. The naming rules are the same within the scope of this Recommendation, and will not be mentioned any more.

7.3.1.4 ONUE (Optical Network Unit)

Behaviour:

This managed entity represents the optical network units (ONU) in the EPON system. The managed entity is derived from EPONNE and inherits all the attributes, relationships and reportable notifications of this super class. The entity also contains pointer attributes identifying the upstream OLT and upstream Splitter it is connected to, and a list of downstream NTs connected to it.

Attributes

Name	Description	Type	Qualifier
oNUEId	This is the unique identifier of this ONUE managed entity.	Integer	M, R
upstreamEPONNE	This attribute is a pointer identifying which OLT node this ONU is connected to.	Name	M, R/W
downstreamEPONNEList	This attribute identifies all the NTs that are connected to this ONU.	LIST of Name	M, R/W
upstreamSplitter	This attribute is a pointer identifying which upstream Splitter this ONU is connected to.	Name	M, R/W
oNUTd	This attribute stores the result of the range procedure [22] of this ONU.	Integer (Units: μs)	M, R

Relationships:

Zero or more instances of this managed entity may be associated with one OLTE instance, as well as one SplitterE instance. Each ONUE may be associated with zero or more NTE instances. Other relationships are the same as EPONNE.

Reportable Notifications: The same as EPONNE.

7.3.1.5 ONTE (Optical Network Termination)

Behaviour:

This managed entity represents the optical network terminations (ONT) connected to an OLT in the EPON system. This managed entity is derived from EPONNE and inherits all the attributes, relationships and reportable notifications of this super class. The entity also contains pointer attributes identifying the upstream OLT and upstream Splitter it is connected to.

Attributes

Name	Description	Type	Qualifier
oNTEId	This is the unique identifier of this ONTE managed entity.	Integer	M, R
upstreamEPONNE	This attribute is a pointer identifying which OLT node this ONT is connected to.	Name	M, R/W
upstreamSplitter	This attribute is a pointer identifying which upstream Splitter this ONT is connected to.	Name	M, R/W
oNTTd	This attribute stores the result of the range procedure of this ONT.	Integer (Units: μs)	M, R

Relationships:

Zero or more instances of this managed entity may be associated with one OLTE instance, as well as one SplitterE instance. Other relationships are the same as EPONNE.

Reportable Notifications: The same as EPONNE.

7.3.1.6 NTE (Network Termination)

Behaviour:

This managed entity represents the network terminations (NT) connected to an ONU in the EPON system. This managed entity is derived from EPONNE and inherits all the attributes, relationships and reportable notifications of this super class. The entity also contains an attribute identifying the upstream ONU it is connected to.

Attributes

Name	Description	Type	Qualifier
nTEId	This is the unique identifier of this NTE managed entity.	Name	M, R
upstreamEPONNE	This attribute is a pointer identifying which ONU node this NT is connected to.	Name	M, R/W

Relationships:

Zero or more instances of this managed entity may be associated with one ONUE instance. Other relationships are the same as EPONNE.

Reportable Notifications: The same as EPONNE.

7.3.1.7 SplitterE

Behaviour:

This managed entity represents the passive splitter in ODN. The entity contains attributes identifying the upstream OLT and the downstream ONUs or ONTs it is connected to.

Attributes

Name	Description	Type	Qualifier
splitterEId	This attribute is the unique identifier of this managed entity.	Integer	M, R
locationName	This attribute identifies the location of this Splitter.	String	O, R/W
venderName	This attribute identifies the name of the vendor of this Splitter.	String	O, R/W
version	This attribute indicates the version of this Splitter instance.	String	O, R
serialNumber	This attribute indicates the serial number of this Splitter instance, which may further be used in inventory management.	String	M, R
allot	This attribute indicates the splitting ratio of this Splitter.	String (e.g., "x:y")	M, R
upstreamEPONNE	This attribute is a pointer identifying the OLT node this Splitter belongs to.	Name	M, R/W
downstreamEPONNEList	This attribute identifies the instances of ONUE or ONTE connected to the Splitter.	LIST of Name	M, R/W

Relationships:

One or more instances of this managed entity may be associated with one OLTE instance, and each Splitter instance may be associated with zero or more downstream ONUE or ONTE instances.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.8 equipment (M.3100)

Behaviour:

The equipment object class is a class of managed objects that represent physical components of a managed element, including replaceable components. An instance of this object class is present in a single geographic location. An equipment may be nested within another equipment, thereby creating a containment relationship. The equipment type shall be identified by sub-classing this object class. Either the name of the sub-class or an attribute may be used for identifying the equipment type. The object class is defined in ITU-T Rec. M.3100.

7.3.1.9 equipmentR1 (M.3100)

Behaviour:

This object class is derived from equipment and defined in ITU-T Rec. M.3100.

7.3.1.10 equipmentR2 (M.3100 Corrigendum 1)

Behaviour:

This object class is derived from equipmentR1 and defined in ITU-T Rec. M.3100 Corrigendum 1 [5].

7.3.1.11 equipmentHolder (M.3100)

Behaviour:

The Equipment Holder object class is a class of managed objects that represents physical resources of a network element that are capable of holding other physical resources. Examples of resources represented by instances of this object class are equipment bay, shelf and slot. This object class is derived from equipmentR1 and defined in ITU-T Rec. M.3100.

Relationships:

This managed entity supports the nested containment relationship, representing the physical resources that also have such nested containment structure. Zero or more rack-typed equipmentHolder instances may be contained in an EPON NE instance, and zero or more shelf-typed or slot-typed instances may be contained in an instance of this managed entity. When the holderStatus of a slot-typed equipmentHolder instance is not empty, it means a circuit pack is contained in this slot.

7.3.1.12 circuitPackR1 (M.3100 Amendment 1)

Behaviour:

The Circuit Pack object class is a class of managed objects that represents a plug-in replaceable unit that can be inserted into or removed from the equipment holder of the Network Element. This object class is derived from equipmentR2 and defined in ITU-T Rec. M.3100 Amendment 1 [4].

Relationships:

Zero or one instance of this managed entity can be contained in a slot-typed equipmentHolder instance. Each circuitPackR1 instance may contain zero or more physicalPort instances.

7.3.1.13 software (M.3100)

Behaviour:

The software object class is a class of managed objects that represents logical information stored in equipment, including programs and data tables.

Relationships:

Zero or more instances of this managed entity can be contained in one instance of EPONNE or circuitPackR1.

7.3.1.14 physicalPort (M.3100 Amendment 8)

Behaviour:

This managed object class represents the characteristics of physical termination of network equipments. It is a collection of common attributes of physical ports, and it is defined for inheritance. See ITU-T Rec. M.3100 Amendment 8 [7] for details.

Relationships:

Zero or more instances of a derived class of physicalPort can be contained in a circuitPackR1 instance. One instance of a derived class of physicalPort can be associated with zero or more instances of a derived class of networkTerminationPoint. The attribute "supportedTTPList" stores references to the Generic Transport Trail Termination Points with Physical Port SignalRateAndMapping List (genericTransportTTPR1) supported by this physical port. The associated genericTransportTTPs are considered the lowest-layer TTPs supported by the physical port.

7.3.1.15 PONPortE

Behaviour:

This managed object class is a collection of common attributes of the PON port (including both the OLT PON port and the ONU PON port). It is derived from physicalPort and inherits all the attributes, relationships, and reportable notifications from its super class.

Attributes

Name	Description	Type	Qualifier
transferPower	This attribute indicates the transferring optical power of this PON port.	Integer (Units: dBm)	M, R
receiveSensitivity	This attribute indicates the receiving optical sensitivity of this PON port.	Integer (Units: dBm)	M, R
protectionEnable	This attribute indicates whether this PON port is protected or not. The true value indicates that the protection of this port is enabled.	Boolean	O, R/W
protectionPort	This attribute indicates the protection port of this PON port. This attribute is valid only when the "protectionEnable" attribute is of true value.	Name	O, R
churningKeyEnable	This attribute indicates whether this PON port has churning key control function or not. The true value indicates that this port has churning key control function enabled.	Boolean	M, R/W

Relationships:

The same as physicalPort. Each instance of PONPortE or its derived classes can be associated with another instance of PONPortE or its derived classes when protection is enabled, and the attribute "protectionPort" is used for this purpose.

Reportable Notifications: The same as physicalPort.

7.3.1.16 OltPONPortE

Behaviour:

This managed entity represents OLT PON ports. The managed entity is derived from PONPortE and inherits all the attributes, relationships and reportable notifications of the super class.

Attributes

Name	Description	Type	Qualifier
maxONUNumber	This attribute indicates the max number of ONUs supported by this OLT PON port.	Integer	M, R
currentONUNumber	This attribute indicates the current number of ONUs connected to this OLT PON port.	Integer	M, R

Relationships:

The same as PONPortE. Instances of this managed entity can only be contained in a circuitPackR1 instance of an OLT. Each OltPONPortE instance can be associated with zero or more instances of OnuPONPortE. Each OltPONPortE instance can be associated with zero or more ETYnBidirectionalE or ETHFTPSource/Sink/BidirectionalE instances, and the inherited attribute "supportedTTPList" is used to specify the ETYnBidirectionalE instances it supports directly.

Reportable Notifications: The same as PONPortE.

7.3.1.17 OnuPONPortE

Behaviour:

This managed entity represents the PON ports of ONU or ONT. The managed entity is derived from PONPortE and inherits all the attributes, relationships and reportable notifications of the super class.

Attributes

Name	Description	Type	Qualifier
remotePortPointer	This attribute indicates the identifier of the remote OLT PON port to which this PON port is connected.	Name	M, R

Relationships:

The same as PONPortE. Instances of this managed entity can only be contained in a circuitPackR1 instance of an ONU or ONT. Zero or more OnuPONPortE instances can be associated with one ONUPONPortE instance, and the attribute "remotePortPointer" is used for this purpose. Each OnuPONPortE instance can be associated with zero or more ETYnBidirectionalE or ETHFTPSource/Sink/BidirectionalE instances, and the inherited attribute "supportedTTPList" is used to specify the ETYnBidirectionalE instances it supports directly.

Reportable Notifications: The same as physicalPort.

7.3.1.18 E1PortE

Behaviour:

This managed entity represents the E1 ports. The managed entity is derived from physicalPort and inherits all the attributes, relationships and reportable notifications of the super class.

Attributes

Name	Description	Type	Qualifier
loopEnable	This attribute indicates whether the loopback of this E1 port is enabled. The value true indicates it is enabled.	Boolean	M, R/W

Name	Description	Type	Qualifier
codingType	This attribute indicates the encoding type of this E1 port. The value is a integer which has the following interpretation: 1: HDB3, 2: NRZ.	Integer {HDB3(1), NRZ(2)}	M, R
impedance	This attribute indicates the matching impedance of this E1 port. The value is an integer which has the following interpretation: 1: non-balance mode, 75 Ω; 2: balance mode, 120 Ω.	Integer {75Ω(1), 120Ω(2)}	M, R
Relationships: The same as physicalPort. Instances of this managed entity can be contained in a circuitPackR1 instance of an OLT, ONU or ONT which provides E1 interface. Each E1PortE instance can be associated with zero or more E1CTPBidirectionalE instances.			
Reportable Notifications: The same as physicalPort.			

7.3.1.19 EthernetPortE

Behaviour: This managed entity represents the Ethernet ports. The managed entity is derived from physicalPort and inherits all the attributes, relationships and reportable notifications of the super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
ifMtu	The size of the largest packet which can be sent/received on the port, specified in octets. In cases that network datagrams are transmitted, this indicates the size of the largest network datagram that can be sent on this port. For details, see RFC 2233 [26].	Integer (Units: octets)	M, R
ifPhysAddress	The physical (MAC) address of this port. The port's media-specific MIB must define the bit and byte ordering and format of the value contained by this attribute. For interfaces which do not have such an address (e.g., a serial line), this attribute should contain an octet string of zero length. For details, see RFC 2233.	MAC Address: (String)	M, R
ifCurrentSpeed	This attribute indicates the current assigned speed of this Ethernet port.	Integer (Units: Kbit/s)	M, R/W
Relationships: The same as physicalPort. Instances of this managed entity can be contained in a circuitPackR1 instance of an OLT, ONU or ONT which provides Ethernet interface. Each EthernetPortE instance can be associated with zero or more instances of ETHCLTTPSource/Sink/BidirectionalE, ETHFTPBidirectionalE, VLANCLTTPSource/Sink/BidirectionalE, or VLANFTP/BidirectionalE instances, and the inherited attribute "supportedTTPList" is used to specify the ETHCLTTPSource/Sink/BidirectionalE instances it supports directly.			
Reportable Notifications: The same as physicalPort.			

7.3.1.20 MACBridgeMatrixE

Behaviour:			
This managed entity is used to organize data that affects all ports on a MAC Bridge. Instances of this managed entity can be created or deleted by request of a managing system.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
mACBridgeMatrixEId	This is the unique identifier of this MACBridgeMatrixE managed entity.	Integer	M, R
bridgePortCount	This attribute provides the number of existing ports controlled by this bridge.	Integer	M, R
spanningTreeInd	This boolean attribute indicates whether or not a spanning tree algorithm is enabled. The value true means enabled.	Boolean	M, R/W
bridgeMACAddress	This attribute indicates the MAC address for this MACBridgeMatrixE instance.	MAC Address	M, R
Relationships:			
Zero or one instance of this managed entity may be contained in an EPONNE instance that supports the MAC bridge matrix function.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O

7.3.1.21 MACBridgeMatrixSpanningTreeE

Behaviour:			
This managed entity is used to organize and record data that is relevant to spanning tree configurations. Some of the data is volatile. Instances of this managed entity shall be automatically created or deleted upon the creation/deletion of a MACBridgeMatrixE.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
mACBridgeMatrix SpanningTreeEId	This is the unique identifier of this MACBridgeMatrixSpanningTreeE managed entity.	Integer	M, R
bridgePriority	This attribute denotes the priority of the bridge and it is positive integer-valued. For details, see RFC 1493 [25].	Integer	M, R/W
bridgeID	This attribute provides the bridge identifier for the root of the spanning tree. This attribute consists of Bridge Priority and Bridge MAC Address of MACBridgeMatrixE instance. For details, see RFC 1493 [25].	STRUCT {bridge Priority: Integer; bridge Address: MAC Address}	M, R
rootPathCost	This attribute provides the cost of the best path to the root as seen from the bridge. Upon autonomous instantiation, the value is 0. For details, see RFC 1493 [25].	Integer	M, R

Name	Description	Type	Qualifier
rootPortNum	This attribute provides the port number that has the lowest cost from the bridge to the root bridge. The value 0 means that the bridge itself is the root. Upon autonomous instantiation, the value 0 is used. For details, see RFC 1493 [25].	Integer	M, R
maxAge	This attribute indicates the maximum age (in 256ths of a second) for an entry in the spanning tree listing. It indicates the maximum age in 256ths of a second for received protocol information before it is discarded. The range is 6 s to 40 s in accordance with IEEE 802.1D [23].	Integer (Units: 1/256 seconds)	M, R
helloTime	This attribute provides the time interval (in 256ths of a second) between the generation of Configuration BPDUs by the Root. It is conveyed in Configuration BPDUs to facilitate the monitoring of protocol performance by management functions. The range is 1 s to 10 s in accordance with IEEE 802.1D.	Integer (Units: 1/256 seconds)	M, R
forwardDelay	This attribute gives the timeout value (in 256ths of a second) to be used by all Bridges in the Bridged LAN, and it is set by the Root. It is conveyed to ensure that each Bridge in a Bridged LAN uses a consistent value for the Forward Delay Timer when transferring the state of a Port to the Forwarding State. This parameter is also used as the timeout value for ageing Filtering Database dynamic entries following changes in active topology. The range is 4 s to 30 s in accordance with IEEE 802.1D.	Integer (Units: 1/256 seconds)	M, R
Relationships: One instance of this managed entity is contained in one MACBridgeMatrixE instance.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O

7.3.1.22 SwitchingPriorityTableE

Behaviour: This managed entity is used for mapping between user priorities of VLAN and switching priorities of Ethernet Switch.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
switchingPriorityTableEId	This is the unique identifier of this SwitchingPriorityTableE managed entity.	Integer	M, R

Name	Description	Type	Qualifier
priorityTable	This table shows the mapping between user priorities of VLAN and switching priorities of an Ethernet Switch. Switching is actually executed according to switching priorities.	LIST of STRUCT {vlan Priority: Integer, switching Priority: Integer}	M, R/W
Relationships: One instance of this managed entity is contained in one MACBridgeMatrixE instance.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O

7.3.1.23 MACBridgePortE

Behaviour: This managed entity is used to organize and record data that is associated with a bridge port. Some of the data is volatile.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
mACBridgePortEId	This is the unique identifier of this MACBridgePortE managed entity.	Integer	M, R
portNum	This attribute provides the port number. For details, see RFC 1493 [25].	Integer	M, R
mACBridgeTable	This attribute lists the destination MAC Addresses served by this port, whether they are learned or statically assigned, whether packets having them as destination addresses are filtered or forwarded, and their ages. Upon autonomous instantiation, this attribute is a null list.	LIST of MAC Address	M, R
portSpanningTreeInd	This boolean attribute indicates whether or not the spanning tree algorithm is used by this MAC Bridge Port. The value true means enabled. Note that its value can be true only when the spanningTreeInd of MACBridgeMatrixE is true.	Boolean	M, R/W
relatedPort	This attribute indicates the E1 port, Ethernet port or PON port related to this MACBridgePortE.	Name	M, R
Relationships: More than one instance of this managed entity can be contained in an instance of MACBridgeMatrixE. Zero or more instances of MACBridgePortE can be associated with one instance of PONPortE, or EthernetPortE, or E1PortE.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O

7.3.1.24 MACBridgePortSpanningTreeE

Behaviour:

This managed entity is used to organize and record data that is associated with a bridge port for spanning tree configurations. Some of the data is volatile. Instances of this managed entity shall be automatically created or deleted upon the creation/deletion of a MACBridgePortE.

Attributes

Name	Description	Type	Qualifier
mACBridgePortSpanningTreeEId	This is the unique identifier of this MACBridgePortSpanningTreeE managed entity.	Integer	M, R
portPriority	This attribute denotes the priority of the port. For details, see RFC 1493 [25].	Integer	M, R/W
portPathCost	This attribute provides the cost contribution of the port to the path cost towards the spanning tree root bridge. For details, see RFC 1493 [25].	Integer	M, R
designatedBridgeRootCostPort	This attribute provides the root Bridge, designated bridge, designated port and designated cost, based on the outputs of the "Read port parameters" operation defined in 14.8.2.1 of IEEE 802.1D, i.e.: – Bridge identifier of the root bridge transmitted by the designated bridge for the segment. – Bridge identifier of the designated bridge for the port's segment. – Port number of the designated port on the designated bridge considered to be part of this port's segment. – Path cost contribution of the designated port to this port's segment. The type of designated root is BridgeIdentifier, which is a structure composed of the bridgePriority and the bridgeAddress, See below: BridgeIdentifier ::= STRUCT { bridgePriority : Integer; bridgeAddress : MACAddress; } The type of designated cost is Integer; The type of designated bridge is BridgeIdentifier;	STRUCT {designated Root: Bridge Identifier; designated Cost: Integer, designated Bridge: Bridge Identifier; designated Port: Port Identifier} Definition of "Bridge Identifier" and "Port Identifier" can be found in the left column.	M, R

designatedBridgeRootCost Port	The type of designated port is PortIdentifier, which is a structure composed of the portPriority and the portNumber, See below: PortIdentifier ::= STRUCT {portPriority : Integer; portNumber : Integer} For details, see RFC 1493 [25].		
portState	This attribute provides status information on the port. Valid values include "disabled", "listening", "learning", "forwarding", "blocking", "linkdown", and "stp_off" in accordance with IEEE 802.1D. (NOTE – The value "linkdown" is introduced to denote the port status where the Ethernet link state is down. This value is necessary to distinguish the case where Ethernet is physically down and the case where Ethernet is administratively down, which can be denoted by "disabled". The value "stp_off" is introduced to denote the port status where Spanning Tree Protocol is disabled, by setting "PortSpanningTreeInd" of "MAC Bridge Port" to false, and Ethernet link state is up. This value is used to distinguish whether or not a bridge port forwarding frames is under control of STP.) For details, see RFC 1493 [25].	ENUM: {disabled, listening, learning, forwarding, blocking, linkdown, stp_off}	M, R
Relationships: One instance of this managed entity is contained in one instance of MACBridgePortE.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O
stateChange			O

7.3.1.25 VLANPortE

Behaviour: This managed entity is a virtual port used to organize data associated with each VLAN tagging. Instances of this managed entity can be created or deleted by a managing system.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANPortEId	This is the unique identifier of this VLANPortE managed entity.	Integer	M, R
vLANFilterTable	This attribute identifies TCI values (consisting of user priority, CFI and VID) which are provisioned at a bridging port. The descriptions for TCI, CFI and VID can be found in IEEE 802.1Q [24].	STRUCT {user Priority: Integer; cfi : Integer, vId : Integer}	M, R/W

Name	Description	Type	Qualifier
forwardOperation	When a frame is received, the frame is processed according to the following Forward Operations. The operations are invoked based on the value of VID, user priority, or the entire TCI or whether or not the TCI field exists. This attribute indicates that the received frame is treated as indicated below.	Integer	M, R/W

#	Type of received frame	
	Tagged	**Untagged**
0	Depends on Bridge Table of MAC Bridge Port	Depends on Bridge Table of MAC Bridge Port
1	Discard	Depends on Bridge Table of MAC Bridge Port
2	Depends on Bridge Table of MAC Bridge Port	Discard
3	Depends on Bridge Table of MAC Bridge Port when the received VID is included in this table.	Depends on Bridge Table of MAC Bridge Port
4	Discarded when the received VID is not included in this table.	Discard
5	Discarded when the received VID is included in this table.	Depends on Bridge Table of MAC Bridge Port
6	Depends on Bridge Table of MAC Bridge Port when the received VID is not included in this table.	Discard
7	Depends on Bridge Table of MAC Bridge Port when the received user priority is included in this table.	Depends on Bridge Table of MAC Bridge Port
8	Discarded when the received user priority is not included in this table.	Discard
9	Discarded when the received user priority is included in this table.	Depends on Bridge Table of MAC Bridge Port
10	Depends on Bridge Table of MAC Bridge Port when the received user priority is not included in this table	Discard
11	Depends on Bridge Table of MAC Bridge Port when the received TCI is included in this table.	Depending on Bridge Table of MAC Bridge Port
12	Discarded when the entire received TCI is not included in this table.	Discard
13	Discarded when the entire received TCI is included in this table.	Depends on Bridge Table of MAC Bridge Port
14	Depends on Bridge Table of MAC Bridge Port when the entire received TCI is not included in this table.	Discard

Relationships:

One or more instances of this managed entity may be contained in each instance of MACBridgePortE.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.26 VLANTaggingOperationConfigurationDataE

Behaviour:

This managed entity is used to organize data associated with VLAN tagging. An Instance of this managed entity is used at MAC Bridge Port that is located at the edge of the network and is created/deleted by the request of the managing system.

Attributes

Name	Description	Type	Qualifier
vLANTaggingOperation ConfigurationDataEId	This is the unique identifier of this VLANTaggingOperationConfigurationDataE managed entity.	Integer	M, R
upstreamVLANtagging OperationMode	This attribute selects whether or not the upstream VLAN tagging is sent. Valid values are true, indicating "the upstream frame is sent as tagged whether or not the received frame is tagged". Note that TCI, consisting of user priority, CFI and VID, is attached or overwritten by using the "upstreamVLANTaggingTCIValue", and false, indicating "the upstream frame is sent 'as it is', regardless of whether or not the received frame is tagged".	Boolean	M, R/W
upstreamVLANTagging TCIValue	This attribute indicates the TCI value for upstream VLAN tagging. It is used when the upstreamVLANTaggingOperationMode is true.	STRUCT {user Priority: Integer; cfi: Integer; vId: Integer}	M, R/W
downstreamVLANtagging OperationMode	This attribute selects whether or not the downstream VLAN tagging is sent. Valid values are true indicating "the downstream frame is sent 'as it is', regardless of whether or not the received frame is tagged", and false indicating "the downstream frame is sent as untagged whether or not the received frame is tagged".	Boolean	M, R/W

Relationships:

Zero or one instance of this managed entity may be contained in each instance of MACBridgePortE that is located at the edge of the network.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.27 layerNetworkDomain (M.3100 Amendment 1)

Behaviour:

This managed object represents a transport administrative domain in which all resources pertain to the same layer. The signal Id may be a simple rate and format or may be a bundle of entities with the same characteristic information which form an aggregate signal. This managed object is defined in ITU-T Rec. M.3100 Amendment 1.

Relationships:

Zero or more instances of layerNetworkDomain can be contained in an instance of EPONAccessNetwork. A layerNetworkDomain groups zero or more (connectionless) trails. A layerNetworkDomain is partitioned into zero or more subnetworks or FlowDomainEs.

7.3.1.28 pipeR2 (M.3100 Amendment 1)

Behaviour:

This is a class of managed objects which ensures the transfer of information between two or more termination points. It is defined for inheritance.

7.3.1.29 trailR2 (M.3100 Amendment 1)

Behaviour:

This is a class of managed objects in layer networks which is responsible for the integrity of transfer of characteristic information from one or more other layer networks. This managed entity is derived from pipeR2 and inherits all the attributes, relationships and reportable notifications of its super class.

7.3.1.30 ETYnTrailE

Behaviour:

This managed entity is used to describe the transport entity transferring information between two ETYnTTPBidirectionalE instances. An instance of this managed entity is created automatically when an ONU or ONT has been installed and ranged. Instances of this managed entity can also be deleted by request of the management system. The managed entity supports availability status and administrative state functions as defined in ITU-T Rec. X.731. Changes in state are reported automatically or on demand to the managing system. This managed entity is derived from trailR2 and inherits all the attributes, relationships and reportable notifications of its super class.

Relationships:

Zero or more ETYnTrailEs may be contained in one ETYn layerNetworkDomain instance, and each ETYnTrailE instance is associated with two ETYnTTPBidirectionalE instances it joins. Each ETYnTrailE instance may be associated with zero or more ETHLinkFlowE instances that it serves.

7.3.1.31 linkConnection (M.3100 Amendment 1)

Behaviour:

The Link Connection object class is a class of managed objects responsible for the transparent transfer of information between (Network) Connection Termination Points. This managed entity is derived from pipeR2 and inherits all the attributes, relationships and reportable notifications of its super class.

7.3.1.32 E1LinkConnectionE

Behaviour:

This managed entity is used to describe the transport entity transferring information between two E1CTPBidirectionalE instances at EPON Service layer. Instances of this managed entity can also be created and deleted as requested by a managing system. The managed entity supports availability status and administrative state functions as defined in ITU-T Rec. X.731. Changes in state are reported automatically or on demand to a managing system. This managed entity is derived from linkConnection and inherits all the attributes, relationships and reportable notifications of its super class.

Relationships:

This managed entity is established between two E1CTPBidirectionalE instances. Zero or more E1LinkConnectionE instances may be contained in one E1layerNetworkDomainE instance, and each E1LinkConnectionE instance is associated with the two E1CTPBidirectionalE instances it joins. Each E1LinkConnectionE may also be associated with one VLANConnectionlessTrailE instance serving this E1LinkConnection instance.

7.3.1.33 terminationPoint (M.3100)

Behaviour:

This managed object represents the termination of a transport entity, such as a trail or a connection. See ITU-T Rec. M.3100 for details.

7.3.1.34 networkTerminationPoint (M.3100 Amendment 1)

Behaviour:

This managed object class is derived from terminationPoint and defined in ITU-T Rec. M.3100 Amendment 1. In this Recommendation, the meaning of networkTerminationPoint is extended in two ways. First, taking into account the connectionless characteristics of Ethernet, in addition to representing the terminations of connection-oriented transport entities such as trail and link connection, this managed object class also represents the terminations of connectionless transport entities such as connectionless trail and link flow. Therefore, the attribute "connectivityPointer" of this managed object class stands for the pointer that may point to the link connection (or link flow) or trail (or connectionless trail) terminated by the termination point instance. Second, in this Recommendation, the sub-classes derived from networkTerminationPoint are modelled in the combined NE view and network view specified in ITU-T Rec. Q.834.1 [15].

7.3.1.35 genericTransportTTP (M.3100 Amendment 6)

Behaviour:

This managed object class represents endpoints of transport connections. It may be used by technology-specific models as an abstraction of an underlying transport layer. This managed object class is derived from networkTerminationPoint. See ITU-T Rec. M.3100 Amendment 6 [6] for details.

7.3.1.36 genericTransportTTPR1 (M.3100 Amendment 8)

Behaviour:

This managed object class represents a genericTransportTTP which has an associated physical port object and hosts the SignalRateAndMapping list of this physical port. This managed object class is derived from genericTransportTTP. See ITU-T Rec. M.3100 Amendment 8 [7] for details.

Relationships:

Each instance of derived class of genericTransportTTPR1 is associated with one instance of derived class of physicalPort. The attribute "physicalPort" is used as a reference to the Physical Port that supports this generic transport TTP.

7.3.1.37 CTPSourceE (Connection Termination Point Source)

Behaviour:

This managed object originates a link connection. This managed entity is derived from networkTerminationPoint and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
upstreamConnectivityPointer	The upstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that sends information (traffic) to this networkTerminationPoint instance at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: TTPSourceE, TTPBidirectionalE, CTPSinkE, CTPBidirectionalE.	CHOICE {none: NULL; single: Name; }	M, R/W

7.3.1.38 CTPSinkE

Behaviour:			
This managed object terminates a link connection. This managed entity is derived from networkTerminationPoint and inherits the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
downstreamConnectivity Pointer	The downstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that receives information (traffic) from this networkTerminationPoint instance at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: TTPSinkE, TTPBidirectionalE, CTPSourceE, CTPBidirectionalE. The downstream connectivity pointer may identify one or more objects depending on whether the signal is connected to one or more networkTerminationPoint instances.	CHOICE {none: NULL; single: Name; broadcast: LIST of Name; }	M, R/W

7.3.1.39 CTPBidirectionalE

Behaviour:
This object class is a class of managed objects that originates a link connection and terminates a link connection. This managed entity is derived from CTPSourceE and CTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

7.3.1.40 E1CTPBidirectionalE

Behaviour:			
This managed entity terminates an E1 link connection and originates an E1 link connection. It is derived from CTPBidirectionalE and inherits all the attributes, relationships and reportable notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
e1CTPEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in a VLANCLTTPSourceE/ VLANCLTTPSinkE/VLANCLTTPBidirectionalE instance in an OLT, ONU or ONT EPON NE instance which supports E1 ports. Each E1CTPBidirectionalE is associated with an E1PortE instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of E1CTPBidirectionalE may be associated with zero or more instances of E1CTPBidirectionalE according to the values of upstream/downstream connectivity pointers.

7.3.1.41 TTPSourceE (Trail Termination Point Source)

Behaviour:

This managed object represents a termination point where a trail is originated. This managed entity is derived from genericTransportTTPR1 and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
downstreamConnectivity Pointer	The downstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that receives information (traffic) from this networkTerminationPoint instance at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: CTPSourceE or CTPBidirectionalE or TTPSinkE or TTPBidirectionalE. The downstream connectivity pointer may identify one or more objects depending on whether the signal is connected to one or more networkTerminationPoint instances.	CHOICE {none: NULL; single: Name; broadcast: List of Name; }	M, R/W

7.3.1.42 TTPSinkE

Behaviour:

This object class is a class of managed objects representing a termination point where a trail is terminated. This managed entity is derived from genericTransportTTPR1 and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
upstreamConnectivity Pointer	The upstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that sends information (traffic) to this networkTerminationPoint instance at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: CTPSinkE or CTPBidirectionalE, or TTPSourceE or TTPBidirectionalE.	CHOICE {none: NULL; single: Name; }	M, R/W

7.3.1.43 TTPBidirectionalE

Behaviour:

This object class is a class of managed objects that originates a trail (or connectionless trail) and terminates a trail. This managed entity is derived from TTPSourceE and TTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

7.3.1.44 ETYnTTPBidirectionalE (ETYn layer TTP Bidirectional)

Behaviour:

This managed entity terminates and/or originates an EPON physical layer trail (ETYnTrailE). It is derived from TTPBidirectionalE and inherits all the attributes, relationships and reportable notifications of this super class.

Attributes

Name	Description	Type	Qualifier
eTYnTTPBidirectionalEId	This is a unique identifier for this managed entity.	Integer	M, R
totalUpstreamBandwidth	This attribute identifies the total amount of upstream bandwidth assigned to this termination point.	Integer (Units: kbit/s)	M, R
availableUpstream Bandwidth	This attribute identifies the upstream bandwidth currently available on this termination point.	Integer (Units: kbit/s)	M, R/W
totalDownstream Bandwidth	This attribute identifies the total amount of downstream bandwidth assigned to this termination point.	Integer (Units: kbit/s)	M, R
availableDownstream Bandwidth	This attribute identifies the downstream bandwidth currently available on this termination point.	Integer (Units: kbit/s)	M, R/W

Relationships:

Zero or more instances of this managed entity can be contained in one EPONNE instance. Each ETYnTTPBidirectionalE instance is associated with a PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, the inherited attribute "physicalPort" is used for this purpose. Each ETYnTTPBidirectionalE instance may be associated with zero or more other instances of ETYnTTPBidirectionalE, according to the values of upstream/downstream connectivity pointers.

7.3.1.45 FTPSourceE (Flow Termination Point Source)

Behaviour:

This managed object originates a link flow and/or terminates a flow domain flow (connectionless). This managed entity is derived from networkTerminationPoint and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
upstreamConnectivityPointer	The upstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that sends information (traffic) to this networkTerminationPoint instance at the same layer, or is null.	CHOICE { none: NULL; single: Name; }	M, R/W

7.3.1.46 FTPSinkE

Behaviour:

This managed object terminates a link flow and/or originates a flow domain flow. This managed entity is derived from networkTerminationPoint and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
downstreamConnectivityPointer	The downstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that receives information (traffic) from this networkTerminationPoint instance at the same layer, or is null. The downstream connectivity pointer may identify one or more objects depending on whether the signal is connected to one or more networkTerminationPoint instances.	CHOICE { none: NULL; single: Name; broadcast: LIST of Name }	M, R/W

7.3.1.47 FTPBidirectionalE

Behaviour:

This object class is a class of managed objects that originates and terminates a link flow and/or flow domain flow. This managed entity derives from FTPSourceE and FTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

7.3.1.48 ETHFTPSourceE (ETH layer FTP Source)

Behaviour:

This managed object originates an ETH link flow and/or terminates an ETH flow domain flow. This managed entity is derived from FTPSourceE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHFTPSourceEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETYnTTPBidirectionalE instance. Each ETHFTPSourceE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of ETHFTPSourceE may be associated with zero or more instances of ETHCLTTPSourceE/BidirectionalE or ETHFTPSinkE/BidirectionalE and the inherited attribute "upstreamConnectivityPointer" is used for this purpose.

7.3.1.49 ETHFTPSinkE

Behaviour:

This managed object terminates an ETH link flow and/or originates an ETH flow domain flow. This managed entity is derived from FTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
eTHFTPSinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETYnTTPBidirectionalE instance. Each ETHFTPSinkE instance is associated with an E1PortE or EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of ETHFTPSinkE may be associated with zero or more instances of ETHCLTTPSinkE/BidirectionalE or ETHFTPSourceE/BidirectionalE, and the inherited attribute "downstreamConnectivityPointer" is used for this purpose.

7.3.1.50 ETHFTPBidirectionalE

Behaviour:

This object class is a class of managed objects that originates and terminates an ETH link flow and/or an ETH flow domain flow. This managed entity is derived from FTPBidirectionalE and inherits all the attributes and the notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
eTHFTPBidirectionalEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETYnTTPBidirectionalE instance. Each ETHFTPBidirectionalE instance is associated with an E1PortE or EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of ETHFTPBidirectionalE may be associated with zero or more instances of ETHCLTTPSourceE/SinkE/BidirectionalE or ETHFTPSourceE/SinkE/BidirectionalE, and the inherited attributes "upstream/downstreamConnectivityPointer" are used for this purpose.

7.3.1.51 VLANFTPSourceE (VLAN layer FTP Source)

Behaviour:

This managed object originates a VLAN link flow and/or terminates a VLAN flow domain flow. This managed entity is derived from FTPSourceE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANFTPSourceEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETHCLTTPE instance. Each VLANFTPSourceE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of VLANFTPSourceE may be associated with zero or more instances of VLANCLTTPSourceE/BidirectionalE or VLANFTPSinkE/BidirectionalE, and the inherited attribute "upstreamConnectivityPointer" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.52 VLANFTPSinkE

Behaviour:

This managed object terminates a VLAN link flow and/or originates a VLAN flow domain flow. This managed entity is derived from FTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
vLANFTPSinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETHCLTTPE instance. Each VLANFTPSinkE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of VLANFTPSinkE may be associated with zero or more instances of VLANCLTTPSinkE/BidirectionalE or VLANFTPSourceE/BidirectionalE, and the inherited attribute "downstreamConnectivityPointer" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.53 VLANFTPBidirectionalE

Behaviour:

This managed object originates and terminates a VLAN link flow and/or a VLAN flow domain flow. This managed entity is derived from FTPBidirectional and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
vLANFTPBidirectionalEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of this managed entity can be contained in an ETHCLTTPE instance. Each VLANFTPBidirectionalE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "supportedByObjectList" is used for this purpose. Each instance of VLANFTPBidirectionalE may be associated with zero or more instances of VLANCLTTPSourceE/SinkE/BidirectionalE or VLANFTPSourceE/SinkE/BidirectionalE, and the inherited attributes "upstream/downstreamConnectivityPointer" are used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.54 CLTTPSourceE (Connectionless Trail Termination Point Source)

Behaviour:

This managed object represents a class of managed objects that originate connectionless trails and/or flow domain flows. This managed entity is derived from genericTransportTTPR1 and inherits all the attributes, relationships, and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
downstreamConnectivity Pointer	The downstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that receives information (traffic) from this networkTerminationPoint instance at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: CLTTPSinkE, CLTTPBidirectionalE, CLCTPSourceE, CLCTPBidirectionalE. The downstream connectivity pointer may identify one or more objects depending on whether the signal is connected to one or more networkTerminationPoint instances.	CHOICE { none: NULL; single: Name; broadcast: LIST of Name; }	M, R/W

7.3.1.55 CLTTPSinkE

Behaviour: This object class represents a class of managed objects that terminate connectionless trails and/or flow domain flows. This managed entity is derived from genericTransportTTPR1 and inherits all the attributes, relationships, and reportable notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
upstreamConnectivity Pointer	The upstream connectivity pointer attribute points to the networkTerminationPoint managed object, within the same managed element, that sends information (traffic) to this termination point at the same layer, or is null. The referenced object shall be an instance of one of the following classes or its sub-classes: CLTTPSourceE, CLTTPBidirectionalE, CLCTPSinkE, CLCTPBidirectionalE.	CHOICE { none: NULL; single: Name; }	M, R/W

7.3.1.56 CLTTPBidirectionalE

Behaviour: This object class represents a class of managed objects that originate and terminate connectionless trails and/or flow domain flows. This managed entity is derived from CLTTPSourceE and CLTTPSinkE and inherits all the attributes, relationships and reported notifications of its super class.

7.3.1.57 ETHCLTTPSourceE (ETH layer Connectionless TTP Source)

Behaviour: This managed object represents a class of managed objects that originate ETH connectionless trails and/or ETH flow domain flows. This managed entity is derived from CLTTPSourceE and inherits all the attributes, relationships and reportable notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
eTHCLTTPSourceEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of ETHCLTTPSourceE can be contained in an EPONNE instance. Each ETHCLTTPSourceE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "physicalPort" is used for this purpose. Each instance of ETHCLTTPSourceE may be associated with zero or more instances of ETHFTPSourceE/BidirectionalE or ETHCLTTPSinkE/BidirectionalE, and the inherited attribute "downstreamConnectivityPointer" is used for this purpose.

7.3.1.58 ETHCLTTPSinkE

Behaviour:

This object class represents a class of managed objects that terminate ETH connectionless trails and/or ETH flow domain flows. This managed entity is derived from CLTTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHCLTTPSinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of ETHCLTTPSinkE can be contained in an EPONNE instance. Each ETHCLTTPSinkE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "physicalPort" is used for this purpose. Each instance of ETHCLTTPSinkE may be associated with zero or one instance of ETHFTPSinkE/BidirectionalE or ETHCLTTPSourceE/BidirectionalE, and the inherited attribute "upstreamConnectivityPointer" is used for this purpose.

7.3.1.59 ETHCLTTPBidirectionalE

Behaviour:

This object class represents a class of managed objects that originate and terminate ETH connectionless trails and/or ETH flow domain flows. This managed entity is derived from CLTTPBidirectional and inherits all the attributes, relationships and reportable notifications of its super classes.

Attributes

Name	Description	Type	Qualifier
eTHCLTTPBidirectionalEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of ETHCLTTPBidirectionalE can be contained in an EPONNE instance. Each ETHCLTTPBidirectionalE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "physicalPort" is used for this purpose. Each instance of ETHCLTTPBidirectionalE may be associated with zero or more instances of ETHFTPSinkE/SourceE/BidirectionalE, and the inherited attributes "upstream/downstreamConnectivityPointer" are used for this purpose.

7.3.1.60 VLANCLTTPSourceE (VLAN layer Connectionless TTP Source)

Behaviour:

This managed object represents a class of managed objects that originate VLAN connectionless trails and/or VLAN flow domain flows. This managed entity is derived from CLTTPSourceE and inherits all the attributes, relationships and notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANCLTTPSourceEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of VLANCLTTPSourceE can be contained in an EPONNE instance. Each VLANCLTTPSourceE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "physicalPort" is used for this purpose. Each instance of VLANCLTTPSourceE may be associated with zero or more instances of VLANFTPSourceE/BidirectionalE or VLANCLTTPSinkE/BidirectionalE, and the inherited attribute "downstreamConnectivityPointer" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.61 VLANCLTTPSinkE

Behaviour:

This object class represents a class of managed objects that terminate VLAN connectionless trails and/or VLAN flow domain flows. This managed entity is derived from CLTTPSinkE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANCLTTPSinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of VLANCLTTPSinkE can be contained in an EPONNE instance. Each VLANCLTTPSinkE instance is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, and the inherited attribute "physicalPort" is used for this purpose. Each instance of VLANCLTTPSinkE may be associated with zero or one instance of VLANFTPSinkE/BidirectionalE or VLANCLTTPSourceE/BidirectionalE, and the inherited attribute "upstreamConnectivityPointer" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.62 VLANCLTTPBidirectionalE

Behaviour:

This object class represents a class of managed objects that originate and/or terminate VLAN connectionless trails and/or VLAN flow domain flows. This managed entity is derived from CLTTPBidirectionalE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANCLTTPBidirectionalEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of VLANCLTTPBidirectionalE can be contained in an EPONNE instance. Each VLANCLTTPBidirectionalE is associated with an EthernetPortE or PONPortE (OLTPONPortE or ONUPONPortE) instance in an EPON NE, the inherited attribute "physicalPort" is used for this purpose. Each instance of VLANCLTTPBidirectionalE may be associated with zero or more instances of VLANFTPSinkE/SourceE/BidirectionalE or VLANCLTTPSinkE/SourceE/BidirectionalE, and the inherited attributes "upstream/downstreamConnectivityPointer" are used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.63 FlowDomainE

Behaviour:			
A FlowDomainE instance exists within a single layer network. It is defined by the set of flow points that are available for the purpose of transferring information. This entity is described in ITU-T Rec. G.809 as flow domain.			
Attributes			
Name	**Description**	**Type**	**Qualifier**

signalId	This attribute defines the characteristic information of the layer to which the entity under consideration belongs.	CHOICE {simple: Characteristic Information;
		bundle: BundleType;
		complex: LIST of BundleType}
		Characteristic Information ::= String
		BundleType ::= STRUCT {
		characteristic InfoType: Characteristic Information;
		bundlingFactor: Integer;
		}
			M, R/S

administrativeState	This attribute is used to activate (unlock) or deactivate (lock) this managed entity. See ITU-T Rec. X.731 for details.	ENUM {locked, unlocked}	O, R/W
availabilityStatus	This attribute indicates the availability status of instances of this object class.	LIST of Integer {inTest(0), failed(1), powerOff(2), offLine(3), offDuty(4), dependency(5), degraded(6), notInstalled(7), logFull(8)}	O, R
containedTPList	This attribute is a list of pointers to networkTerminationPoint instances that are contained in the flow domain instance.	LIST of Name	O, R/W
linkPointerList	This attribute points to the FPPLinkE instances terminated by this flow domain instance.	LIST of Name	O, R
supportedByObjectList	The value of this attribute identifies a set of managed entities that are capable of directly affecting the performance and/or status of this flow domain instance.	LIST of Name	O, R/W

Name	Description	Type	Qualifier
usageState	This attribute identifies the usage state of the flow domain instance.	ENUM {idle, active, busy}	O, R
userLabel	This attribute assigns a user-friendly name to the FlowDomainE instance.	String	O, R/W
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O
stateChange			O

7.3.1.64 ETHFlowDomainE

Behaviour:

An ETH flow domain exists in an ETH layer network. It is defined by the set of ETH flow points that are available for the purpose of transferring information. This object class is derived from FlowDomainE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHFlowDomainEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more ETHFlowDomainE instances can be contained in an ETH layer network domain instance. Each ETHFlowDomainE can also contain zero or more ETHFPPLinkEndE instances. Zero or more ETH layer networkTerminationPoint (network view) instances can also be associated (this association is actually indicating containment in network view) with one ETHFlowDomainE instance, and the inherited attribute "containedTPList" is used for this purpose. Zero or more instances of ETHFPPLinkE can be associated with one ETHFlowDomainE instance, and the inherited attribute "linkPointerList" is used for this purpose.

7.3.1.65 VLANFlowDomainE

Behaviour:

A VLAN flow domain exists in a VLAN layer network. It is defined by the set of VLAN flow points that are available for the purpose of transferring information. This object class is derived from FlowDomainE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
vLANFlowDomainEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more VLANFlowDomainE instances can be contained within a VLAN layer network domain instance. Each VLANFlowDomainE can also contain zero or more VLANFPPLinkEndE instances. Zero or more VLAN layer networkTerminationPoint (network view) instances can also be associated (this association is actually indicating containment in network view) with one VLANFlowDomainE instance, and the inherited attribute "containedTPList" is used for this purpose. Zero or more instances of VLANFPPLinkE can be associated with one VLANFlowDomainE instance, and the inherited attribute "linkPointerList" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.66 FPPLinkE (Flow Point Pool Link)

Behaviour: A flow point pool link (FPP link) represents the topological relationship and available capacity between a pair of flow domains at the same layer. This entity is described in ITU-T Rec. G.809 as flow point pool link.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
aEnd	This pointer attribute identifies the link end at one extremity.	Name	M, R/W
totalLinkCapacity	This attribute identifies the total bandwidth that is available to the link.	LIST of STRUCT { ingress: Integer; egress: Integer} (Units: kbit/s)	M, R

signalId	This attribute defines the characteristic information of the layer to which the entity under consideration belongs.	CHOICE {simple: Characteristic Information;
		bundle: BundleType;
		complex: LIST of BundleType}
		Characteristic Information ::= String
		BundleType ::= STRUCT {
		characteristic InfoType: Characteristic Information;
		bundlingFactor: Integer;
		}
			M, R/S

zEnd	This pointer attribute identifies the link end at the other extremity.	Name	M, R/W
serverTrail	This attribute points to a trail in the server layer that supports the link in a client.	Name	M, R
provisionedLinkCapacity	This attribute indicates the amount of bandwidth assigned to the Link.	LIST of STRUCT { ingress: Integer; egress: Integer} (Units: kbit/s)	M, R
userLabel	This attribute assigns a user-friendly name to this object instance.	String	O, R/W

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.67 ETHFPPLinkE (ETH layer FPP Link)

Behaviour:

This managed entity represents the topological relationship and available capacity between a pair of ETH FPPLinkEndE instances. This object class is derived from FPPLinkE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHFPPLinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

This managed entity is established between two ETHFPPLinkEndE instances. Zero or more ETHFPPLinkE instances may be contained in one ETH layer network domain instance, and each ETHFPPLinkE instance is associated with the two ETHFPPLinkEndE it joins. Each ETHFPPLinkE instance may contain zero or more ETHLinkFlowE instances and may also be associated with one ETYnTrailE instance serving this ETHFPPLinkE.

7.3.1.68 VLANFPPLinkE (VLAN layer FPP Link)

Behaviour:

This managed entity represents the topological relationship and available capacity between a pair of VLAN FPPLinkEnd instances. This object class is derived from FPPLinkE and inherites all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
vLANFPPLinkEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

This managed entity is established between two VLANFPPLinkEndE instances. Zero or more VLANFPPLinkE instances may be contained in one VLAN layer network domain instance, and each VLANFPPLinkE instance is associated with the two VLANFPPLinkEndE it joins. Each VLANFPPLinkE instance may contain zero or more VLANLinkFlowE instances and may also be associated with one ETHConnectionlessTrailE instance serving this VLANFPPLinkE.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.69 FPPLinkEndE (Flow Point Pool Link End)

Behaviour:

This managed entity represents the end of a flow point pool link.

Attributes			
Name	**Description**	**Type**	**Qualifier**
totalLinkEndCapacity	This attribute indicates the total amount of bandwidth of this Link End.	LIST of STRUCT {ingress: Integer; egress: Integer} (Units: kbit/s)	M, R
linkPointer	This attribute points to the FPPLink connecting this link end.	Name	M, R
linkEndDirectionality	This attribute specifies whether this link end managed object is sink, source, or bidirectional.	ENUM {sink, source, bidirectional}	M, R
provisionedLinkEnd Capacity	This attribute indicates the amount of bandwidth assigned to this link end.	Integer	M, R
fTPList	This attribute lists the Flow Termination Points (Source/Sink/Bidirectional) represented by this managed entity.	LIST of Name	O, R/W
userLabel	This attribute assigns a user-friendly name to the associated object.	String	O, R/W
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O

7.3.1.70 ETHFPPLinkEndE (ETH layer FPP Link End)

Behaviour:

This managed entity represents the end of an ETH flow point pool link. This object class is derived from FPPLinkEndE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
eTHFPPLinkEndId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

Zero or more instances of ETHFPPLinkEndE may be contained in an ETHFlowDomainE instance. Each ETHFPPLinkEndE instance is associated with one ETHFPPLinkE instance, and the inherited attribute "linkPointer" is used for this purpose. Each ETHFPPLinkEndE instance may also be associated with zero or more ETHFTPSourceE/SinkE/BidirectionalE instances, and the inherited attribute "fTPList" is used for this purpose.

7.3.1.71 VLANFPPLinkEndE (VLAN layer FPP Link End)

Behaviour:

This managed entity represents the end of a VLAN flow point pool link. This object class is derived from FPPLinkEndE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANFPPLinkEndEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:
Zero or more instances of VLANFPPLinkEndE may be contained in a VLANFlowDomains instance. Each VLANFPPLinkEndE instance is associated with one VLANFPPLinkE instance, and the inherited attribute "linkPointer" is used for this purpose. Each VLANFPPLinkEndE instance may also be associated with zero or more VLANFTPSourceE/SinkE/BidirectionalE instances, and the inherited attribute "fTPList" is used for this purpose.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.72 LinkFlowE

Behaviour:			
This managed entity presents the link flow described in ITU-T Rec. G.809, which is capable of transferring information (traffic units) transparently across an FPP Link and is delimited by Flow Termination Points.			
Attributes			
Name	**Description**	**Type**	**Qualifier**

signalId	This attribute describes the signal that is transferred across this instance.	CHOICE {simple: Characteristic Information;
		bundle: BundleType;
		complex: LIST of BundleType}
		Characteristic Information ::= String
		BundleType ::= STRUCT {
		characteristic InfoType: Characteristic Information;
		bundlingFactor: Integer;
		}
			M, R/S

aEnd	The value of this attribute identifies one end of this link flow. This attribute cannot be null.	Name	M, R/W
zEnd	The value of this attribute identifies the other end of this link flow.	Name	M, R/W
serverTrailList	This attribute identifies trails that support this link flow instance.	LIST of Name	C (Note), R/W
administrativeState	This attribute is used to activate (unlock) or deactivate (lock) this managed entity. See ITU-T Rec. X.731 for details.	ENUM: {locked, unlocked}	O, R/W
aSAPPointer	This attribute is a pointer that identifies an ASAP object that may be used by this managed entity.	Name	O, R/W

Name	Description	Type	Qualifier
availabilityStatus	This attribute indicates the availability status of instances of this object class.	LIST of Integer {inTest(0), failed(1), powerOff(2), offLine(3), offDuty(4), dependency(5), degraded(6), notInstalled(7), logFull(8)}	O, R
operationalState	This attribute is to indicate the operability of the managed entity, which has two possible values: disabled and enabled. See ITU-T Rec. X.731 for details.	ENUM: {enabled, disabled}	O, R
userLabel	This attribute assigns a user-friendly name to this object.	String	O, R/W
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O
stateChange			O
communicationsAlarm			O
NOTE – This attribute is applicable when the link flow is supported by one or more server trails.			

7.3.1.73 ETHLinkFlowE

Behaviour:

This object class represents the capability of transferring information (traffic units) transparently across an ETH FPP Link. It is derived from LinkFlowE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHLinkFlowEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

This managed entity is established between two ETHFTPE (Source/Sink/Bidirectional) instances. One or more ETHLinkFlowE instances may be contained in one ETHFPPLinkE instance, and each ETHLinkFlowE instance is associated with the two ETHFTPE instances it joins. Each ETHLinkFlowE may also be associated with one ETYnTrailE instance serving this ETHLinkFlowE instance.

7.3.1.74 VLANLinkFlowE

Behaviour:

This object class represents the capability of transferring information (traffic units) transparently across a VLAN FPP Link. It is derived from LinkFlowE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANLinkFlowEId	This is the unique identifier of the managed entity.	Integer	M, R
Relationships: This managed entity is established between two VLANFTPE (Source/Sink/Bidirectional) instances. One or more VLANLinkFlowE instances may be contained in one VLANFPPLinkE instance, and each VLANLinkFlowE instance is associated with the two VLANFTPE instances it joins. Each VLANLinkFlowE may also be associated with one ETHConnectionlessTrailE instance serving this VLANLinkFlowE instance.			

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.75 FlowDomainFlowE

Behaviour: This managed entity presents the flow domain flow described in ITU-T Rec. G.809, which is a grouping of traffic units that are transferred transparently across a flow domain. The Flow Domain Flow object class is a class of managed objects that associates the termination point object identified in the A end attribute and the termination point object(s) listed in the Z end attribute of this managed object.			
Attributes			
Name	**Description**	**Type**	**Qualifier**

signalId	This attribute describes the signal that is transferred across this instance.	CHOICE {simple: Characteristic Information;
		bundle: BundleType;
		complex: LIST of BundleType}
		Characteristic Information ::= String
		BundleType ::= STRUCT {
		characteristic InfoType: Characteristic Information;
		bundlingFactor: Integer;
		}
			M, R/S

aEnd	The value of this attribute identifies one end of this flow domain flow. This attribute cannot be null.	Name	M, R/W
zEnd	The value of this attribute identifies the other end of this flow domain flow.	Name	M, R/W
administrativeState	This attribute is used to activate (unlock) or deactivate (lock) this managed entity. See ITU-T Rec. X.731 for details.	ENUM: {locked, unlocked}	O, R/W

Name	Description	Type	Qualifier
availabilityStatus	This attribute indicates the availability status of instances of this object class.	LIST of Integer {inTest(0), failed(1), powerOff(2), offLine(3), offDuty(4), dependency(5), degraded(6), notInstalled(7), logFull(8)}	O, R
userLabel	This attribute assigns a user-friendly name to the associated object.	String	O, R/W
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O
stateChange			O
communicationsAlarm			O

7.3.1.76 ETHFlowDomainFlowE

Behaviour:

This object class represents a grouping of traffic units that are transferred transparently across an ETH flow domain. It is derived from FlowDomainFlowE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHFlowDomainFlowEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:

This managed entity is established between two ETHFTPE or ETHCLTTPE (Source/Sink/Bidirectional) instances. Zero or more ETHFlowDomainFlowE instances may be contained in one ETHFlowDomainE instance. Each ETHFlowDomainFlowE instance is associated with the two ETHFTPE or ETHCLTTPE instances it joins.

7.3.1.77 VLANFlowDomainFlowE

Behaviour:

This object class represents a grouping of traffic units that are transferred transparently across a VLAN flow domain. It is derived from FlowDomainFlowE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
vLANFlowDomainFlowEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:
This managed entity is established between two VLANFTPE or VLANCLTTPE (Source/Sink/Bidirectional) instances. Zero or more VLANFlowDomainFlowE instances may be contained in one VLANFlowDomainE instance. Each VLANFlowDomainFlowE instance is associated with the two VLANFTPE or VLANCLTTPE instances it joins.

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.78 ConnectionlessTrailE

Behaviour:
This managed entity represents the transfer of monitored adapted characteristic information of the client layer network between connectionless trail termination points. It is delimited by two connectionless TTPs, one at each end of the connectionless trail. It represents the association between a source and destination on a per traffic unit or datagram basis. A connectionless trail is formed by associating flow terminations with a traffic unit or datagram. This entity is described in ITU-T Rec. G.809 as connectionless trail.

Attributes			
Name	**Description**	**Type**	**Qualifier**

signalId	This attribute describes the signal that is transferred across this instance.	CHOICE {simple: Characteristic Information;
		bundle: BundleType;
		complex: LIST of BundleType}
		Characteristic Information ::= String
		BundleType ::= STRUCT {
		characteristic InfoType: Characteristic Information;
		bundlingFactor: Integer;
		}
			M, R/S

aEnd	The value of this attribute identifies one end of this connectionless trail.	Name	M, R/W
zEnd	The value of this attribute identifies the other end of this connectionless trail.	Name	M, R/W
administrativeState	This attribute is used to activate (unlock) or deactivate (lock) this managed entity. See ITU-T Rec. X.731 for details.	ENUM: {locked, unlocked}	O,R/W
aSAPPointer	This attribute is a pointer that identifies an ASAP object that may be used by this managed entity.	Name	O, R/W

Name	Description	Type	Qualifier
availabilityStatus	This attribute indicates the availability status of instances of this object class.	LIST of Integer {inTest(0), failed(1), powerOff(2), offLine(3), offDuty(4), dependency(5), degraded(6), notInstalled(7), logFull(8)}	O, R
operationalState	This attribute is to indicate the operability of the managed entity, which has two possible values: disabled and enabled. See ITU-T Rec. X.731 for details.	ENUM: {enabled, disabled}	O, R
userLabel	The User Label attribute assigns a user-friendly name to the associated object.	String	O, R/W
connectionList	This attribute defines the list of Link flows and flow domain flows which may compose this connectionless trail in the same layer.	LIST of Name	O, R/S
clientLinkPointerList	This attribute is a set of pointers to the links that reflect the capacity of a trail in the client layer network domain(s).	LIST of Name	O, R
clientLinkConnection PointerList	This attribute is a set of pointers to the link connections or link flows in the client layer network domain(s) that are supported by the trail.	LIST of Name	O, R
Reportable Notifications:			
objectCreation			O
objectDeletion			O
attributeValueChange			O
stateChange			O
communicationsAlarm			O

7.3.1.79 ETHConnectionlessTrailE

Behaviour:

This managed entity represents the transfer of monitored adapted characteristic information of the client layer network between ETHCLTTPs. It is derived from ConnectionlessTrailE and inherits all the attributes, relationships and reportable notifications of its super class.

Attributes

Name	Description	Type	Qualifier
eTHConnectionlessTrailEId	This is the unique identifier of the managed entity.	Integer	M, R

Relationships:
Zero or more ETHConnectionlessTrailEs may be contained in one ETH layerNetworkDomain instance, and each ETHConnectionlessTrailE is associated with the two ETHCLTTPE (Source/Sink/Bidirectional) instances it joins. Each ETHConnectionlessTrailE may be associated with zero or more VLANFPPLinkE or VLANLinkFlowE instances that it serves.

7.3.1.80 VLANConnectionlessTrailE

Behaviour:			
This managed entity represents the transfer of monitored adapted characteristic information of the client layer network between VLANCLTTPs. It is derived from ConnectionlessTrailE and inherits all the attributes, relationships and reportable notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
vLANConnectionlessTrailId	This is the unique identifier of the managed entity.	Integer	M, R
Relationships:			
Zero or more VLANConnectionlessTrailEs may be contained in one VLAN layerNetworkDomain instance, and each VLANConnectionlessTrailE is associated with the two VLANCLTTPE (Source/Sink/Bidirectional) instances it joins. Each VLANConnectionlessTrailE may be associated with zero or more E1LinkConnectionE instances that it serves.			

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.3.1.81 ConfigurationMgr

Behaviour:			
This managed entity is used for EMS to provide the configuration management control functions for NMS.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
configurationMgrId	This is the unique identifier of the managed entity.	Integer	M, R
Operations			
Name	**Description**		
modifyAttributeValue	This operation is used to modify the attribute values of the EPON physical equipment, MAC bridge information object, VLAN information object, or topological objects.		
queryAttributeValue	This operation is used to query the attribute values of the EPON physical equipment, MAC bridge information object, VLAN information object, or topological objects.		
assignBandwidth	This operation is used to statically assign the bandwidth for each ONU or ONT within an EPON system.		
establishE1Connection	This operation is used to assign a connection relationship between an E1 port on OLT and an E1 port on ONU or ONT equipment according to customers' requirements.		
Relationships:			
Zero or one instance of this managed entity may be contained in an EPONAccessNetwork instance.			

7.3.2 Basic configuration function set

Basic configuration functions involve creation, deletion, query and modification of the configuration information. That is to say, NMS can create or delete some network resource related

entities and query or modify attribute values of the specified entities through the management interface.

7.3.2.1 Class diagram

Figure 7-9 is the class diagram of the Basic configuration function set.

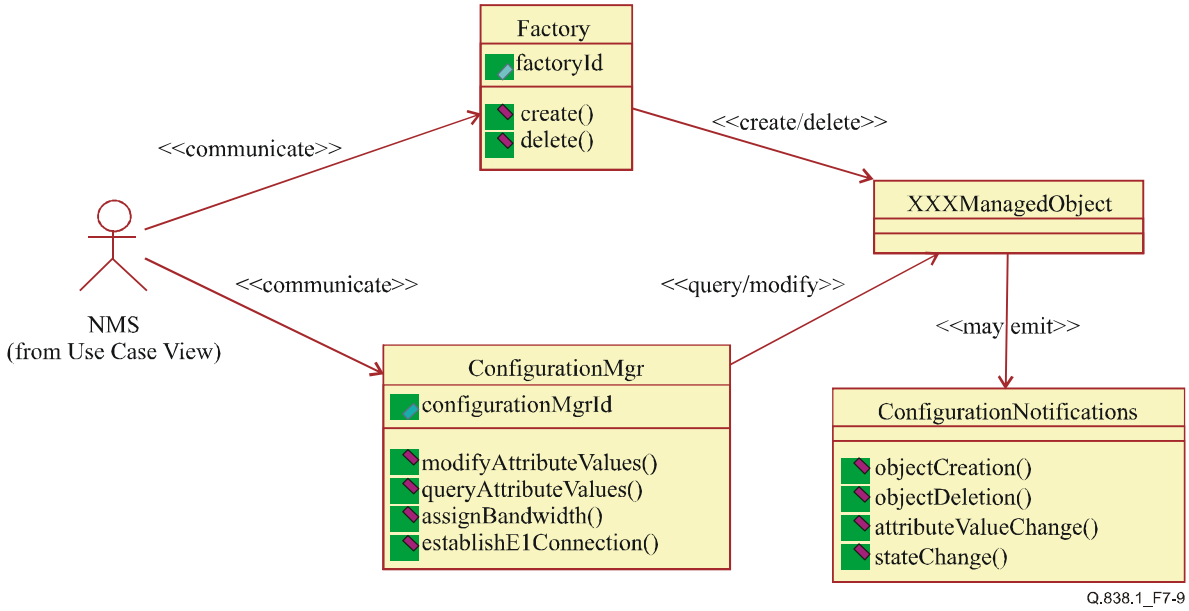


Figure 7-9/Q.838.1 – Class diagram of basic configuration functions

7.3.2.2 Sequence diagram

Figure 7-10 depicts the sequence of the basic configuration functions.

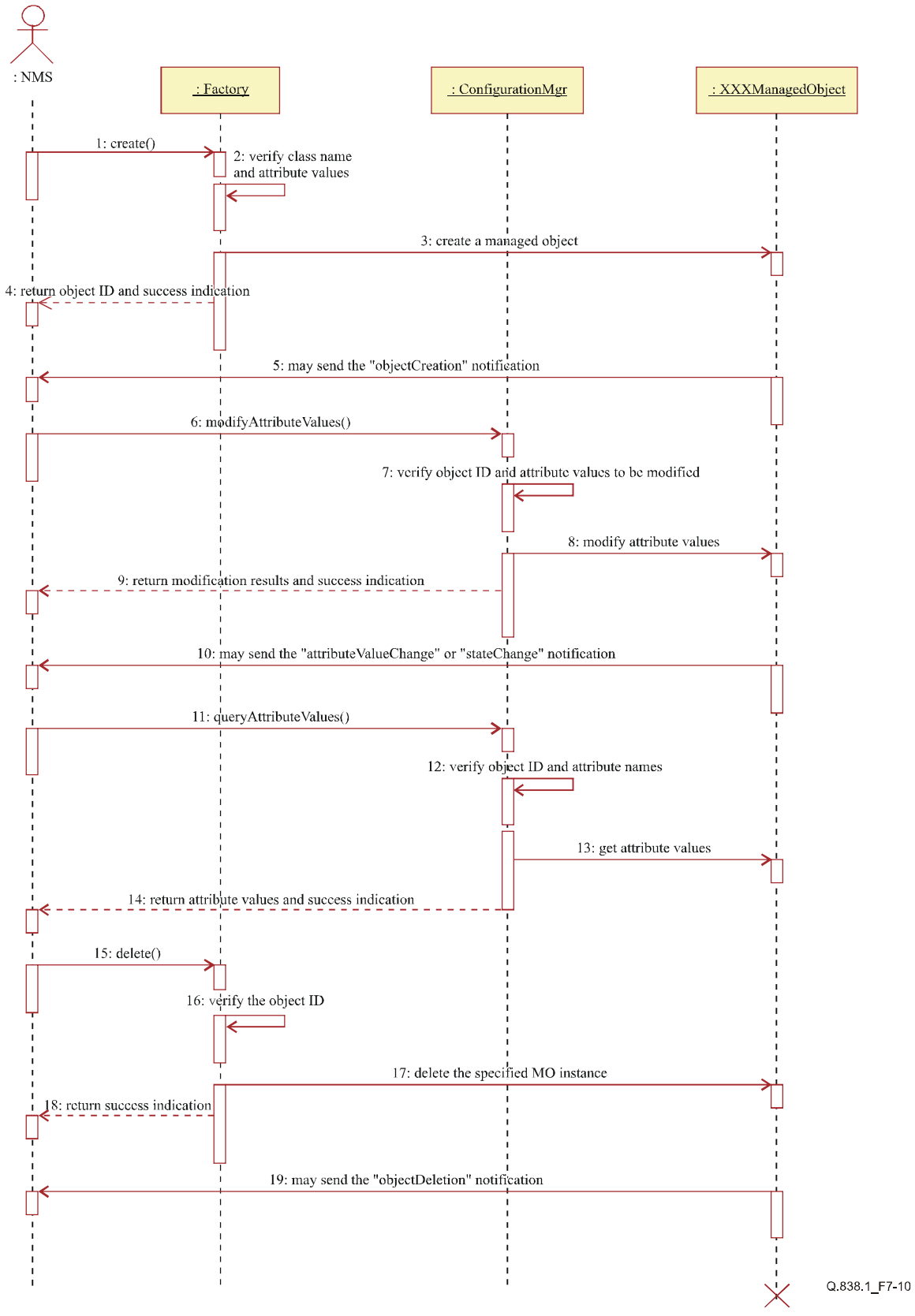


Figure 7-10/Q.838.1 – Sequence diagram of basic configuration functions

7.3.2.3 Management operations

1) "create" Operation

Owner Entity	Factory		
Description	This function is used to create a configuration resource object. The object may stand for physical or logical resource. The input parameters include the class name of the object, and the attribute values of the object. If the creation succeeds, EMS will return the identifier of the created object instance as well as the success information, and sends an object creation notification. If the creation fails, EMS will send back to NMS the error message.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moClassName	This parameter specifies the managed object class name of the object instance to be created.	Name
	attributeValues	This parameter specifies the list of attribute name and attribute values to be used for the creation of the object instance.	LIST of Name/Value pairs (The types of Attribute Value vary for different attributes.)
Output Parameters	moInstance	This parameter identifies the managed object that has just been created.	Name
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownClassName	The class name specified in the request is unknown to EMS.	
	CreationUnsupported	It is not supported to create an instance of the specified managed object class through the management interface.	
	InvalidParameter	At least one attribute name or attribute value in the "attributeValues" parameter is invalid.	
	EMSProcessingError	Error occurs during EMS processing.	
	CommunicationError	Communication error occurs.	

2) "delete" Operation

Owner Entity	Factory
Description	This function is used to delete one or more configuration resource related objects. The objects may stand for physical or logical resources. The input parameter is the list of the object ID. The behaviour for deletion can be found in 6.2.2.2.2. If the deletion succeeds or partially succeeds, EMS will return the identifiers of the deleted object instance as well as the failed deletion information, and may send the corresponding object deletion notifications. If the deletion fails, EMS will send back to NMS error information.

Operation fields	Name	Description	Type
Input parameters	moInstanceList	This parameter specifies a list of the managed objects to be deleted.	LIST of Name
Output Parameters	succDeletionInfoList	This parameter specifies the managed objects that have just been deleted successfully.	LIST of Name

	failedDeletionInfoList	This parameter specifies the deletion failure information of this operation. It is a list of structure, for each undeleted managed object, the ID and the reason are specified.
		The possible reasons for deletion failure are:
		– Not allowed;
		– Association not removed;
		– Containing other managed entities;
		– Other reason.
			LIST of STRUCT {
			moInstance : Name;
			reason : DeletionFailureReason(ENUM);
			}
			The possible values for type "DeletionFailure Reason" can be found in the left column.

Return Value	–	Success indication	ENUM {success, partialSuccess, failed}
Exceptions raised	UnknownManagedEntity	The managed objects specified in the request are unknown to EMS.	
	DeletionUnsupported	It is not supported to delete the specified managed object instance(s) through the management interface.	
	EMSProcessingError	Error occurs during EMS processing.	
	CommunicationError	Communication error occurs.	

3) "queryAttributeValues" Operation

Owner Entity	ConfigurationMgr		
Description	This operation is used to query the attribute values of one or more CM related managed objects. The input parameters of the request contain the list of object ID. If the operation succeeds, the attribute values of the requested managed objects as well as success indication will be returned. If the operation fails, EMS will send back to NMS error information.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moInstanceList	This parameter specifies managed objects whose attribute values are queried.	LIST of Name
	attributeNameList	This parameter contains the list of attribute names to be queried. An empty list indicates all the possible attributes for the specified managed entities.	LIST of AttributeName

Operation fields	Name	Description	Type
Output Parameters	queryResult	This parameter is the list of the object instance as well as the attribute names and values related to each of the MO instance.	LIST of STRUCT{ moInstance : Name, attributeInfoList : LIST of Name/Value pairs}
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownManagedEntity	The specified managed object(s) is unknown to EMS.	
	InvalidParameter	At least one attribute in the "attributeNameList" parameter is invalid.	
	EMSProcessingError	Error occurs during the operation processing.	
	CommunicationError	Communication error occurs.	

4) "modifyAttributeValues" Operation

Owner Entity	ConfigurationMgr		
Description	This operation is used to modify the attribute values of one or more configuration resource objects of the same type. The input parameters of the request contain the list of object ID, and the input modification list that specifies the attribute names to be modified, the corresponding values and the operation type. If the operation succeeds, the output modification list which includes the modified instance ID, the modified attribute names and values as well as a success indication will be returned. If the operation fails, EMS will send back to NMS error information.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moClass	This parameter specifies the class name of the managed object(s) to be modified.	String
	moInstanceList	This parameter specifies managed objects whose attribute values are to be modified.	LIST of Name

	modificationList	This parameter specifies the list of attribute name to be modified, the corresponding value and the operation type. The possible operation type may be: replace, addItem, removeItem and setToDefault.	LIST of
			STRUCT {
			attributeInfo:
			Name/Value
			pairs
			operator:
			ModifyOperator
			}
			ModifyOperator:
			:= ENUM {
			replace, addItem,
			deleteItem,
			setToDefault}

Output Parameters	–	–	–
Return Value	–	Success indication	Boolean

Operation fields	Name	Description
Exceptions raised	UnknownManagedEntity	The specified managed object(s) is unknown to EMS.
	AttributeNotModifiable	The specified attribute(s) is not modifiable for the managed object class.
	InvalidParameter	The item of the "modificationList" parameter is invalid.
	EMSProcessingError	Error occurs during the operation processing.
	CommunicationError	Communication error occurs.

7.3.2.4 Related notifications

The reportable notifications related to the basic configuration management functions are listed below. For the detailed definitions of these notifications, refer to 7.2.3.1/Q.827.1.

1) objectCreation
2) objectDeletion
3) attributeValueChange
4) stateChange

7.3.3 Physical equipment configuration management function

7.3.3.1 Sequence diagram

Please refer to Figure 7-10 for details.

7.3.3.2 Management operations

The management operations involved in physical equipment configuration management are "modifyAttributeValues" and "queryAttributeValues", which are specified in 7.3.2, "Basic Configuration Function Set". NMS can invoke these two functions to query or modify the attribute values of the physical equipments within EPON system.

7.3.4 Bandwidth assignment

7.3.4.1 Sequence diagram

Figure 7-11 is the bandwidth assignment sequence diagram.

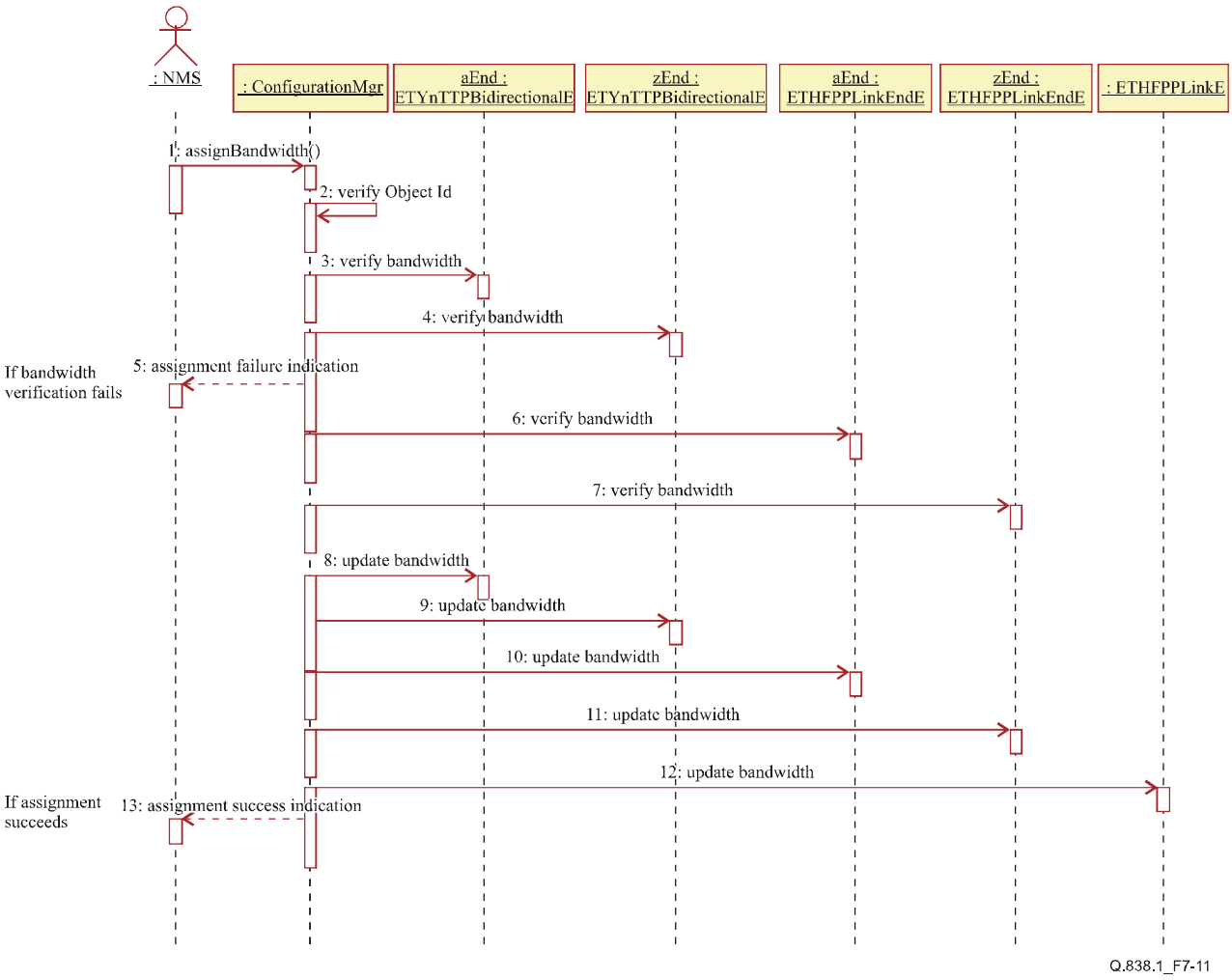


Figure 7-11/Q.838.1 – Sequence diagram of bandwidth assignment function

7.3.4.2 Management operations

1) "assignBandwidth" Operation

Owner Entity	**ConfigurationMgr**
Description	This operation is used to statically assign downstream or upstream bandwidth for each ONU or ONT. The input parameters of the request contain the ID of the OLT, the ID of ONU or ONT, the bandwidth value to be assigned, and the direction of the assignment. If the bandwidth resource can satisfy the requirement, EMS will set the related attribute values to associated entities. Otherwise, EMS will notify NMS that the operation has failed.

Operation fields	Name	Description	Type
Input parameters	oLTId	This parameter specifies the OLT.	Name
	oNUId	This parameter specifies the ONU or ONT.	Name
	bandwidth	This parameter specifies bandwidth value to be assigned.	Integer (Units: Mbit/s)
	direction	This parameter specifies the direction of the bandwidth assignment, which can be either upstream or downstream.	ENUM {upstream, downstream}
Output Parameters	–	–	–
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownManagedEntity	The ID of OLT, ONU or ONT specified in the request are unknown to EMS.	
	BandwidthNotEnough	There is not enough bandwidth resource for the specified direction of bandwidth assignment.	
	CommunicationError	Communication error occurs.	
	EMSProcessingError	Processing error occurs.	

7.3.5 E1 connection management

7.3.5.1 Sequence diagram

The following Figure 7-12 illustrates the sequence of establishing an E1 connection.

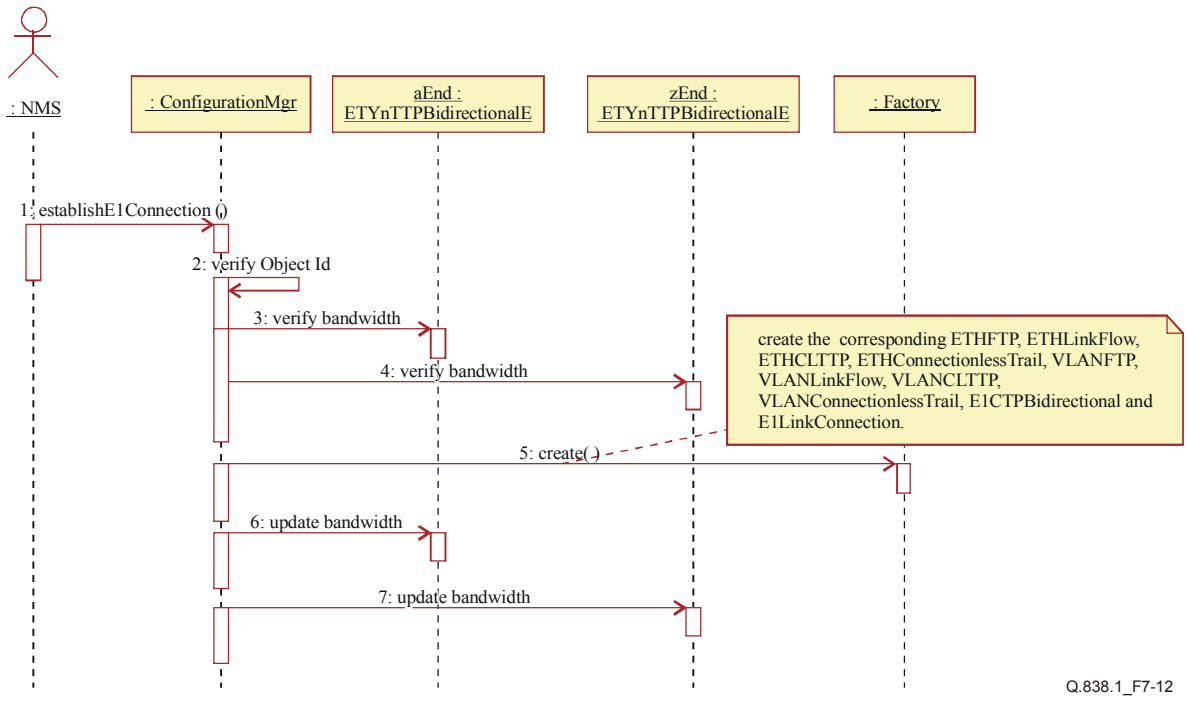


Figure 7-12/Q.838.1 – Sequence diagram for establishing E1 connection

The deleting, querying and modifying information of an E1 Connection can be easily achieved by "delete", "queryAttributeValues", "modifyAttributeValues" described in 7.3.2, "Basic Configuration Function Set". See also Figure 7-10 for the related sequence diagram.

7.3.5.2 Management operations

1) "establishE1Connection" operation

Owner Entity	**ConfigurationMgr**		
Description	This operation is used to establish an E1 connection between an E1 port of OLT and an E1 port of ONU or ONT. The input parameters of the request contain the ID of OLT E1 port, and the E1 port ID of ONU or ONT. If the resources are not available or any exception occurs, EMS will report to NMS that the connection establishment operation fails along with the possible causes. Or else, EMS will then establish the relationship between the two E1 ports.		
Operation fields	**Name**	**Description**	**Type**
Input Parameters	oLTE1PortId	This parameter identifies the OLT E1 port.	Name
	oNUE1PortId	This parameter identifies the ONU or ONT E1 port.	Name
Output Parameters	e1ConnectionId	This parameter identifies the E1LinkConnection which has been created by the operation.	Name
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownManagedEntity	The specified E1 port(s) is unknown to EMS.	
	BandwidthNotEnough	There is not enough bandwidth resource to establish the E1 connection as requested.	
	CommunicationError	Communication error occurs.	
	EMSProcessingError	Processing error occurs.	

7.3.6 Software configuration management

7.3.6.1 Sequence diagram

Refer to Figure 7-10 for details.

7.3.6.2 Management operations

The management operations involved in software configuration management are "modifyAttributeValues" and "queryAttributeValues", which are specified in 7.3.2, "Basic Configuration Function Set". NMS can invoke these two functions to query or modify the attribute values of the software of NEs within EPON system.

7.3.7 MAC bridge configuration management

7.3.7.1 Sequence diagram

Refer to Figure 7-10.

7.3.7.2 Management operations

The management operations involved in MAC bridge configuration management are "create", "delete", "queryAttributeValues" and "modifyAttributeValues", which are specified in 7.3.2, "Basic Configuration Function Set". NMS can invoke these functions to create, delete, query or modify the attribute values of the managed entities related to MAC bridge both in network element view and network view.

7.3.8 VLAN configuration management

7.3.8.1 Sequence diagram

See Figure 7-10.

7.3.8.2 Management operations

The management operations involved in MAC bridge configuration management are "create", "delete", "modifyAttributeValues" and "queryAttributeValues", which are specified in 7.3.2, "Basic Configuration Function Set". NMS can invoke these functions to create, delete, query or modify the attribute values of the managed entities associated with VLAN both in network element view and network view.

7.4 Performance management function set

The common part for the analysis of Performance management FS can be found in 7.3/Q.827.1. In this Recommendation, only the performance measurement parameters for EPON specific management are provided.

7.4.1 Performance measurement parameters

7.4.1.1 Ethernet port performance measurement parameters

Behaviour: This set of measurement parameters is collected at the Ethernet ports of OLT, ONU or ONT.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
ifInOctets	The number of octets in valid MAC frames received on this interface. See also RFC 2358 [27].	Integer	M, R
ifInUcastPkts	The number of packets delivered by this sub-layer to a higher (sub-)layer, which were not addressed to a multicast or broadcast address at this sub-layer. See also RFC 2233 [26].	Integer	M, R
ifInDiscards	The number of incoming packets which were chosen to be discarded even though no errors had been detected to prevent their being deliverable to a higher-layer protocol. One possible reason for discarding such a packet could be to free up buffer space. See also RFC 2233.	Integer	M, R
ifInErrors	The number of incoming packets that contained errors preventing them from being deliverable to a higher-layer protocol. It is the sum for this port of dot3StatsAlignmentErrors, dot3StatsFCSErrors, dot3StatsFrameTooLongs, dot3StatsInternalMacReceiveErrors and dot3StatsSymbolErrors. See also RFC 2233 and RFC 2358.	Integer	M, R
ifInUnknownProtos	The number of packets received via the interface which were discarded because of an unknown or unsupported protocol. See also RFC 2233.	Integer	M, R

Name	Description	Type	Qualifier
ifOutOctets	The number of octets transmitted in valid MAC frames on this interface. See also RFC 2358.	Integer	M, R
ifOutUcastPkts	The total number of packets that higher-level protocols requested be transmitted and which were not addressed to a multicast or broadcast address at this sub-layer, including those that were discarded or not sent. See also RFC 2233.	Integer	M, R
ifOutDiscards	The number of outgoing packets which were chosen to be discarded even though no errors had been detected to prevent their being transmitted. See also RFC 2233.	Integer	M, R
ifOutErrors	The number of outgoing packets that could not be transmitted because of errors. It is the sum for this port of dot3StatsSQETestErrors, dot3StatsLateCollisions, dot3StatsExcessiveCollisions, dot3StatsInternalMacTransmitErrors and dot3StatsCarrierSenseErrors. See also RFC 2233 and RFC 2358.	Integer	M, R

7.4.1.2 PON port performance measurement parameters

Behaviour: This set of measurement parameters is collected at PON ports of OLT, ONU or ONT.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
pONIfBERUp	The upstream BER value of the PON port.	Real	M, R
pONIfBERDown	The downstream BER value of the PON port.	Real	M, R

7.4.1.3 E1 port performance measurement parameters

Behaviour: This set of measurement parameters is collected at E1 ports of OLT, ONU or ONT.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
lineErroredSeconds (LES)	The number of the seconds in which one or more Line Code Violation error events were detected. See also RFC 2495 [28].	Integer	M, R
controlledSlipSeconds (CSS)	The number of the one-second interval containing one or more controlled slips. This is not incremented during an Unavailable Second. See also RFC 2495.	Integer	M, R
erroredSeconds (ES)	For E1-CRC links, this is the number of the seconds with one or more Path Code Violation, or one or more Out of Frame defects, or one or more Controlled Slip events, or a detected AIS defect. For E1-noCRC links, the presence of Bipolar Violations also triggers an Errored Second. This is not incremented during an Unavailable Second. See also RFC 2495.	Integer	M, R

Name	Description	Type	Qualifier
severelyErroredSeconds (SES)	For E1-CRC signals, this indicates the number of the seconds with 832 or more Path Code Violation Error Events, or one or more Out of Frame defects. For E1-noCRC signals, a Severely Errored Second is a 2048 Line Code Violation Error Events or more. This is not incremented during an Unavailable Second. See also RFC 2495.	Integer	M, R
severelyErroredFraming Seconds (SEFS)	The number of the seconds with one or more Out of Frame defects, or a detected AIS defect. See also RFC 2495.	Integer	M, R
unavailableSeconds (UAS)	The number of the seconds that the interface is unavailable. Detailed descriptions for making the decision that the interface is unavailable can be found in RFC 2495.	Integer	M, R

7.4.1.4 VLAN port performance measurement parameters

Behaviour: This set of performance measurement parameters is collected at VLAN ports.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
vlanPortInFrames	The number of valid frames received by this port from its segment which were classified as belonging to this VLAN. Note that a frame received on this port is counted if and only if it is for a protocol being processed by the local forwarding process for this VLAN. This includes received bridge management frames classified as belonging to this VLAN. See also RFC 2674 [29] and IEEE 802.1Q.	Integer	M, R
vlanPortOutFrames	The number of valid frames transmitted by this port to its segment from the local forwarding process for this VLAN. This includes bridge management frames originated by this device which are classified as belonging to this VLAN. See also RFC 2674 and IEEE 802.1Q.	Integer	M, R
vlanPortInDiscards	The number of valid frames received by this port from its segment which were classified as belonging to this VLAN which were discarded due to VLAN related reasons. See also RFC 2674 and IEEE 802.1Q.	Integer	M, R
vlanPortInOverflow Frames	The number of times the associated "dot1qTpVlanPortInFrames" counter has overflowed. See also RFC 2674.	Integer	M, R
vlanPortOutOverflow Frames	The number of times the associated "dot1qTpVlanPortOutFrames" counter has overflowed. See also RFC 2674.	Integer	M, R
vlanPortInOverflow Discards	The number of times the associated "dot1qTpVlanPortInDiscards" counter has overflowed. See also RFC 2674.	Integer	M, R

NOTE – See clause 5/Note 2 regarding the VLAN layer.

7.5 Fault management function set

The common part for the analysis of Fault management FS can be found in 7.4/Q.827.1.

7.5.1 Managed entities

7.5.1.1 Class diagram of fault management entities

The class diagrams of Fault management entities can be found in 7.4.1.1/Q.827.1. The only addition for Figure 7-15/Q.827.1 and Figure 7-16/Q.827.1 is to include one extra managed entity FaultMgr. Combining Figure 7-15/Q.827.1 and Figure 7-13 will result in a complete inheritance diagram of Fault management. Combining Figure 7-16/Q.827.1 and Figure 7-14 will result in a complete entities relationship diagram for Fault management. Figure 7-15 is the class diagram of the management entity FaultMgr.

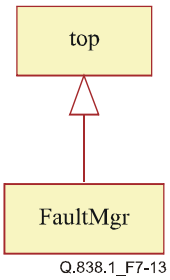


Figure 7-13/Q.838.1 – Inheritance diagram of the fault management

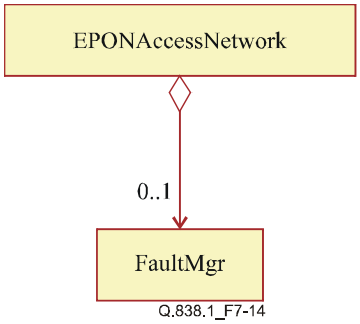


Figure 7-14/Q.838.1 – Entities relationship diagram of fault management

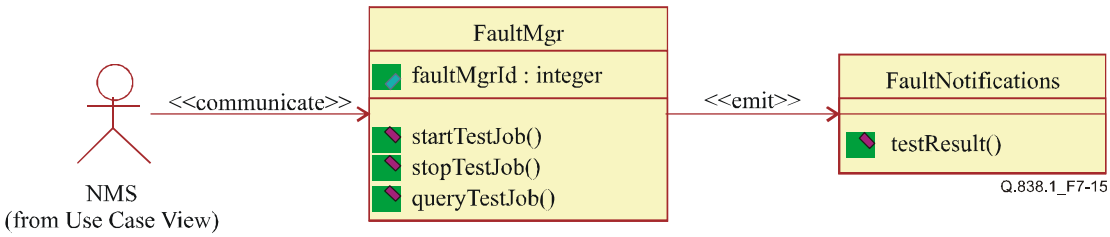


Figure 7-15/Q.838.1 – Class diagram of FaultMgr

7.5.1.2 FaultMgr

Behaviour: This managed entity provides the controlling function for the fault management between NMS and EMS.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
faultMgrId	This is the unique identifier of the managed entity.	Integer	M, R
Operations			
Name	**Description**		
startTestJob	This function is used to indicate OLT to start a loopback test job on a PON port of the remote ONU or ONT.		
stopTestJob	This function is used to stop a loopback test job.		
queryTestJob	This function is used to query a loopback test job.		
Relationships: Zero or one instance of this managed entity exists for each EPONAccessNetwork instance.			

7.5.2 Loopback test

7.5.2.1 Sequence diagram

Figure 7-16 illustrates the sequence of loopback test.

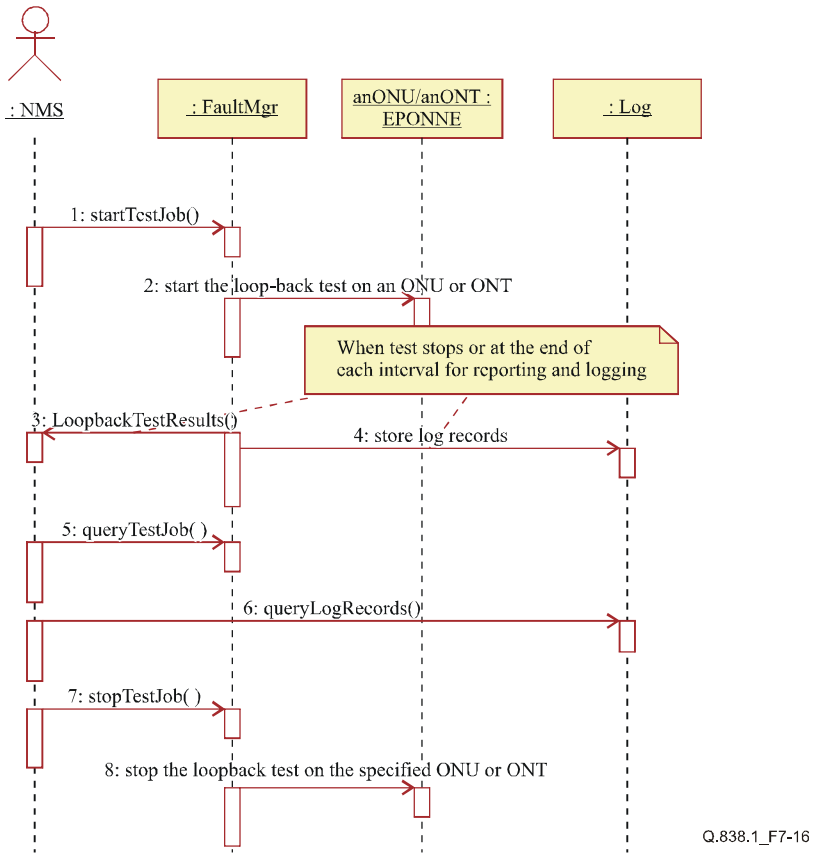


Figure 7-16/Q.838.1 – Sequence diagram of loopback test function

7.5.2.2 Management operations

1) "startTestJob" operation

Owner Entity	FaultMgr		
Description	This function is used to start a loopback test job on an ONU or ONT.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	dataSourceType	This parameter specifies whether the data source used for the loopback test is internal or external.	ENUM {internal, external}
	testType	This parameter specifies the type of the test. (Currently the test type is ONU(ONT) loopback test, which may be extended in the future)	Integer (1: ONU/ONT loop back test)
	moInstance	This parameter specifies the ONU or ONT managed object to be tested.	Name
	startTime	This parameter identifies the start time of the test job. The default value (when empty) is the current time.	Generalized Time
	endTime	This parameter identifies the end time of the test job. The default value (when empty) means the test will continue until interruption.	Generalized Time
	timeInterval	This parameter identifies the time interval for EMS to report and log the test results.	Integer (Units: minutes)
Output Parameters	testJobId	This parameter is the identifier of the test job started by this operation.	Integer
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownManagedEntity	The managed entity specified in the test request is unknown to EMS.	
	EMSProcessingError	Error occurs during the operation processing.	
	CommunicationError	Communication error occurs.	

2) "stopTestJob" Operation

Owner Entity	FaultMgr		
Description	This function is used to stop a running loopback test job. If the operation succeeds, EMS will stop the loopback test on the specified NE.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	testJobId	This parameter is the identifier of the test job.	Integer
Output Parameters	–	–	–
Return Value	–	Success indication	Boolean

Exceptions raised	UnknownTestJob	The test job Id specified in the request is unknown to EMS.
	EMSProcessingError	Error occurs during the operation processing.
	CommunicationError	Communication error occurs.

3) "queryTestJob" Operation

Owner Entity	FaultMgr		
Description	This function is used to query the information of one or more loopback test jobs.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	testJobIdList	This parameter is a list of the identifiers of the test jobs to be queried. When the list is empty, it means all the running test jobs in EMS.	LIST of Name
Output Parameters	testJobInfoList	This parameter provides the information of the request loopback test job. It is a list of TestJobInfo. For each test job, the information contains the following: TestJobInfo ::= STRUCT {testJobId: Integer dataSource: ENUM {internal, external} testType: Integer moInstance: Name startTime: GeneralizedTime endTime: GeneralizedTime timeInterval: Integer (Units: minutes) } The description for each of the above items can be found in the "statTestJob" operation.	LIST of TestJobInfo (TestJobInfo can be found in the left column)
Return Value	–	Success indication	Boolean
Exceptions raised	UnknownTestJob	The job ID(s) specified in the request is unknown to EMS.	
	EMSProcessingError	Error occurs during the operation processing.	
	Communication Error	Communication error occurs.	

7.5.3 Alarm causes

The following are the probable causes specific for EPON management. The probable cause values will be assigned numbers at the design phase. And all the common probable causes defined in ITU-T Recs M.3100, X.721 and X.733 are also used in EPON network management whenever applicable.

ProbableCause	Description	Type
NEPowerAlarm (M.3100 powerProblem)	Power problem occurs on either OLT or ONU/ONT side.	equipmentAlarm
PortSignalLoss Alarm (M.3100 lossOfSignal)	Signal loss occurs on a PON port or E1 port of either OLT or ONU/ONT side.	communicationsAlarm
PortNoOptical SignalAlarm	No optical signal on an optical port (PON port or Ethernet port using optical) of either OLT or ONU/ONT side.	equipmentAlarm
Port Syncronization LossAlarm	Synchronization loss occurs on a PON port or E1 port of either OLT or ONU/ONT side.	equipmentAlarm
PONPortBER Alarm	BER performance alarm occurs on a PON port of either OLT or ONU/ONT side.	qualityOfServiceAlarm
E1PortAISAlarm (M.3100 aIS)	AIS alarm occurs on an E1 port of OLT, ONU or ONT.	equipmentAlarm
E1PortRemote AlarmDetect	When the remote port has not received signal from this E1 port, it will send a check to this E1 port, indicating there are problems in sending signals in this port. In this case, the Remote Alarm Detect will be raised. This could happen on an E1 port of OLT, ONU, or ONT.	equipmentAlarm
Registration FailureAlarm	ONU or ONT P2MP discovery (registration) fails.	communicationsAlarm

7.6 Security management function

For the description of analysis of security management, refer to 6.3.1/Q.834.3.

Appendix I

Table of managed entities

Managed entity name in this Recommendation	Statement
NotificationDispatcher	Defined in ITU-T Rec. Q.827.1.
NotificationDispatcherFactory	Defined in ITU-T Rec. Q.827.1.
Log	Defined in ITU-T Rec. Q.827.1.
LogFactory	Defined in ITU-T Rec. Q.827.1.
logRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
eventLogRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
alarmRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
attributeValueChangeRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
stateChangeRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
objectCreationRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
objectDeletionRecord (ITU-T Rec. X.721)	Defined in ITU-T Rec. X.721.
BulkDataTransferReadyRecord	Defined in ITU-T Rec. Q.827.1.

Managed entity name in this Recommendation	Statement
BulkDataTransferPreparationErrorRecord	Defined in ITU-T Rec. Q.827.1.
LoopbackTestResultRecord	Newly defined.
FileTransferController	Defined in ITU-T Rec. Q.827.1.
network (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
networkR1 (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
EPONAccessNetwork	Newly defined.
EPONNE	Newly defined.
OLTE	Newly defined.
ONUE	Newly defined.
ONTE	Newly defined.
NTE	Newly defined.
SplitterE	Newly defined.
equipment (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
equipmentR1 (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
equipmentR2 (ITU-T Rec. M.3100 Cor.1)	Defined in ITU-T Rec. M.3100 Corrigendum 1.
equipmentHolder (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
circuitPackR1 (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.
software (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
physicalPort (ITU-T Rec. M.3100 Amd.8)	Defined in ITU-T Rec. M.3100 Amendment 8.
PONPortE	Newly defined.
OltPONPortE	Newly defined.
OnuPONPortE	Newly defined.
E1PortE	Newly defined.
EthernetPortE	Newly defined.
MACBridgeMatrixE	Newly defined.
MACBridgeMatrixSpanningTreeE	Newly defined.
SwitchingPriorityTableE	Newly defined.
MACBridgePortE	Newly defined.
MACBridgePortSpanningTreeE	Newly defined.
VLANPortE	Newly defined (see clause 5/Note 2).
VLANTaggingOperationConfigurationDataE	Newly defined.
layerNetworkDomain (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.
pipeR2 (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.
trailR2 (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.
ETYnTrailE	Newly defined.
linkConnection (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.
E1LinkConnectionE	Newly defined.
terminationPoint (ITU-T Rec. M.3100)	Defined in ITU-T Rec. M.3100.
networkTerminationPoint (ITU-T Rec. M.3100 Amd.1)	Defined in ITU-T Rec. M.3100 Amendment 1.

Managed entity name in this Recommendation	Statement
genericTransportTTP (ITU-T Rec. M.3100 Amd.6)	Defined in ITU-T Rec. M.3100 Amendment 6.
GenericTransportTTPR1 (ITU-T Rec. M.3100 Amd.8)	Defined in ITU-T Rec. M.3100 Amendment 8.
CTPSourceE	Newly defined.
CTPSinkE	Newly defined.
CTPBidirectionalE	Newly defined.
E1CTPBidirectionalE	Newly defined.
TTPSourceE	Newly defined.
TTPSinkE	Newly defined.
TTPBidirectionalE	Newly defined.
ETYnTTPBidirectionalE	Newly defined.
FTPSourceE	Newly defined.
FTPSinkE	Newly defined.
FTPBidirectionalE	Newly defined.
ETHFTPSourceE	Newly defined.
VLANFTPSourceE	Newly defined (see clause 5/Note 2).
ETHFTPSinkE	Newly defined.
VLANFTPSinkE	Newly defined (see clause 5/Note 2).
ETHFTPBidirectionalE	Newly defined.
VLANFTPBidirectionalE	Newly defined (see clause 5/Note 2).
CLTTPSourceE	Newly defined.
CLTTPSinkE	Newly defined.
CLTTPBidirectionalE	Newly defined.
ETHCLTTPSourceE	Newly defined.
VLANCLTTPSourceE	Newly defined (see clause 5/Note 2).
ETHCLTTPSinkE	Newly defined.
VLANCLTTPSinkE	Newly defined (see clause 5/Note 2).
ETHCLTTPBidirectionalE	Newly defined.
VLANCLTTPBidirectionalE	Newly defined (see clause 5/Note 2).
FlowDomainE	Newly defined.
VLANFlowDomainE	Newly defined (see clause 5/Note 2).
ETHFlowDomainE	Newly defined.
FlowPointPoolLinkE	Newly defined.
ETHFPPLinkE	Newly defined.
VLANFPPLinkE	Newly defined (see clause 5/Note 2).
FlowPointPoolLinkEndE	Newly defined.
ETHFPPLinkEndE	Newly defined.
VLANFPPLinkEndE	Newly defined (see clause 5/Note 2).
LinkFlowE	Newly defined.
ETHLinkFlowE	Newly defined.
VLANLinkFlowE	Newly defined (see clause 5/Note 2).

Managed entity name in this Recommendation	Statement
ConnectionlessTrailE	Newly defined.
ETHConnectionlessTrailE	Newly defined.
VLANConnectionlessTrailE	Newly defined (see clause 5/Note 2).
FlowDomainFlowE	Newly defined.
ETHFlowDomainFlowE	Newly defined.
VLANFlowDomainFlowE	Newly defined (see clause 5/Note 2).
ConfigurationMgr	Newly defined.
FaultMgr	Newly defined.
MeasurementJob	Defined in ITU-T Rec. Q.827.1.
MeasurementJobFactory	Defined in ITU-T Rec. Q.827.1.
ThresholdMonitor	Defined in ITU-T Rec. Q.827.1.
ThresholdMonitorFactory	Defined in ITU-T Rec. Q.827.1.
ASAP	Defined in ITU-T Rec. Q.827.1.
ASAPFactory	Defined in ITU-T Rec. Q.827.1.

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