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SERIES Q: SWITCHING AND SIGNALLING

Q3 interface

Requirements and analysis for NMS-EMS management interface of Ethernet over Transport and Metro Ethernet Network (EoT/MEN)

ITU-T Recommendation Q.840.1

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ITU-T Recommendation Q.840.1

Requirements and analysis for NMS-EMS management interface of Ethernet over Transport and Metro Ethernet Network (EoT/MEN)

Summary

ITU-T Recommendation Q.840.1 covers the management of Ethernet over Transport (EoT) and Metro Ethernet Network (MEN). In this Recommendation, the Element Management System (EMS) is an Operations System (OS) used to manage the individual NEs in a network. One or more systems may be required depending on the different supplier products and geographic distribution of the elements in the network. The goal of these systems is to manage elemental layer (NE view) information specific to the network element. The Network Management System (NMS) represents an integrated management OS across the different network technology and EMSs. An NMS communicates with an EMS through the Q Interface to realize its management functions. The functional requirements for the management interface between EoT/MEN EMS and NMS for the integrated management at the network layer and at the element layer are provided in this Recommendation.

Source

ITU-T Recommendation Q.840.1 was approved on 16 March 2007 by ITU-T Study Group 4 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

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ITU-T Recommendation Q.840.1

Requirements and analysis for NMS-EMS management interface of Ethernet over Transport and Metro Ethernet Network (EoT/MEN)

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 Metro Ethernet as defined in MEF-10 and Ethernet over Transport (EoT), specifically the Ethernet ETH layer as defined in [ITU-T G.8010]. This Recommendation follows the interface specification methodology described in [ITU-T M.3020].

In this Recommendation, the EMS is an Operations System (OS) used to manage the individual network elements supporting Metro Ethernet and EoT services as well as the networks between them. One or more EMSs may be deployed 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 EMSs. The NMS communicates with EMS through the Q Interface to realize its management functions.

The management functions covered in this Recommendation include configuration management, performance measurement parameters management, and alarm reporting and testing 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 Metro Ethernet and EoT 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 Metro Ethernet and EoT services management are addressed.

This Recommendation is built on and extends the information model provided in [MEF 7].

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.

[MEF 4] Metro Ethernet Forum, Technical Specification MEF 4 (2004), *MEF Architecture Framework – Part 1: Generic Framework*.

[MEF 6] Metro Ethernet Forum, Technical Specification MEF 6 (2004), *Ethernet Services Definitions – Phase I*.

[MEF 7] Metro Ethernet Forum, Technical Specification MEF 7 (2004), *EMS-NMS Information Model*.

[MEF 10.1] Metro Ethernet Forum, Technical Specification MEF 10.1 (2006), *Ethernet Service Attributes Phase 2*.

[MEF 11] Metro Ethernet Forum, Technical Specification MEF 11 (2004), *User Network Interface (UNI) Requirements and Framework.*

[MEF 12] Metro Ethernet Forum, Technical Specification MEF 12 (2005), *Metro Ethernet Network Architecture Framework – Part 2: Ethernet Services Layer*.

[MEF 13] Metro Ethernet Forum, Technical Specification MEF 13 (2005), *User Network Interface (UNI) Type 1 Implementation Agreement*.

[MEF 15] Metro Ethernet Forum Technical Specification MEF 15 (2005), *Requirements for Management of Metro Ethernet Phase 1 Network Elements*.

[MEF 16] Metro Ethernet Forum, Technical Specification MEF 16 (2006), *Ethernet Local Management Interface (E-LMI)*.

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

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

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

[ITU-T G.8011] ITU-T Recommendation G.8011/Y.1307 (2004), *Ethernet over Transport – Ethernet services framework*.

[ITU-T G.8011.1] ITU-T Recommendation G.8011.1/Y.1307.1 (2004), *Ethernet private line service*.

[ITU-T G.8011.2] ITU-T Recommendation G.8011.2/Y.1307.2 (2005), *Ethernet virtual private line service*.

[ITU-T G.8012] ITU-T Recommendation G.8012/Y.1308 (2004), *Ethernet UNI and Ethernet NNI*.

[ITU-T M.3020] ITU-T Recommendation M.3020 (2007), *Management interface specification methodology*.

[ITU-T M.3100] ITU-T Recommendation M.3100 (2005), *Generic network information model*.

[ITU-T Q.827.1] ITU-T Recommendation Q.827.1 (2004), *Requirements and analysis for the common management functions of NMS-EMS interfaces* plus Amendment 1 (2007), *Addition of a common managed entity EMS*.

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

[IEEE 802-3] IEEE 802.3 (2002), *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*.

[IEEE 802.1Q] IEEE 802.1Q (2005), *IEEE Standard for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks*.

[IEEE 802.1X] IEEE 802.1X (2004), *IEEE Standard for Local and Metropolitan Area Networks: Port-Based Network Access Control*.

[IETF RFC 2863] IETF RFC 2863 (2000), *The Interfaces Group MIB*.

[IETF RFC 3635] IETF RFC 3635 (2003), *Definitions of Managed Objects for the Ethernet-like Interface Types*.

[IETF RFC 3636] IETF RFC 3636 (2003), *Definitions of Managed Objects for IEEE 802.3 Medium Attachment Units (MAUs)*.

3 Terms and definitions

This Recommendation uses the following terms.

3.1 Definitions imported from [ITU-T G.805]

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

– Connection;
– Connection point;
– Link;
– Termination connection point;
– Trail;
– Trail termination.

3.2 Definitions imported from [ITU-T G.809]

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

– Adaptation;
– Characteristic information;
– Client/server relationship;
– Connectionless trail;
– Flow;
– Flow domain;
– Flow domain flow;
– Flow point;
– Flow point pool;
– Flow point pool link;
– Flow termination;
– Layer network;
– Link flow;
– Port;
– Transport.

3.3 Definitions imported from [ITU-T G.8010]

The following terms from [ITU-T G.8010] are used in this Recommendation:

– ETH Link;
– Traffic Conditioning Function;
– Flow Domain Fragment.

3.4 Definitions imported from [ITU-T G.8011]

The following terms from [ITU-T G.8011] are used in this Recommendation:

– Committed Information Rate (CIR);
– Ethernet Private Line (EPL);
– Ethernet Virtual Private Line (EVPL);

– Ethernet Private LAN (EPLAN);
– Ethernet Virtual Private LAN (EVPLAN).

3.5 Definitions imported from [MEF 10.1]

The following terms from [MEF 10.1] are used in this Recommendation:

– Bandwidth Profile: Also defined in [ITU-T G.8011];
– Broadcast Service Frame;
– CE-VLAN ID Preservation;
– CE-VLAN ID/EVC Map;
– Class of Service (CoS): Also defined in [ITU-T G.8011];
– Color-aware;
– Color-blind;
– Committed Burst Size (CBS): Also defined in [ITU-T G.8011];
– Committed Information Rate (CIR): Also defined in [ITU-T G.8011];
– Customer Edge (CE);
– Ethernet Virtual Connection (EVC);
– Excess Burst Size (EBS): Also defined in [ITU-T G.8011];
– Excess Information Rate (EIR): Also defined in [ITU-T G.8011];
– Frame;
– Ingress Frame;
– Metro Ethernet Network (MEN);
– Multicast Service Frame;
– Point-to-Point EVC;
– Service Frame;
– Service Multiplexing;
– Service Provider;
– Unicast Service Frame;
– User Network Interface: Also defined in [ITU-T G.8012].

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations:

ASAP Alarm Severity Assignment Profile
AVC Attribute Value Change
BER Bit Error Rate
CBS Committed Burst Size
CE Customer Edge
CES Circuit Emulation Service
CI Characteristic Information
CIR Committed Information Rate
CM Configuration Management

CoS	Class of Service
CRC	Cyclic Redundancy Check
CTP	Connection Termination Point
EBS	Excess Burst Size
EIR	Excess Information Rate
ELMI	Ethernet Local Management Interface
EMS	Element Management System
EoT	Ethernet over Transport
ETH	Ethernet MAC layer network
ETYn	Ethernet physical layer network of order n
FCS	Frame Check Sequence
FD	Flow Domain
FDFr	Flow Domain Fragment
FDX	Full Duplex
FE	Fast Ethernet
FM	Fault Management
FP	Flow Point
FPP	Flow Point Pool
FS	Function Set
FTP	Flow Termination Point
GE	Gigabit Ethernet
GFP	Generic Framing Procedure
HDLC	High-level Data Link Control
HDX	Half Duplex
ID	Identifier
LAN	Local Area Network
LAPS	Link Access Procedure – SDH
MAC	Media Access Control
MEN	Metro Ethernet Network
MIB	Management Information Base
MTTR	Mean Time To Restore
NE	Network Element
NMS	Network Management System
NNI	Network Node Interface
NT	Network Termination
OS	Operations System
P2MP	Point to MultiPoint

PHY Physical Layer Entity

PM Performance Management

QoS Quality of Service

SDH Synchronous Digital Hierarchy

SLA Service Level Agreement

SLS Service Level Specification

SNC Subnetwork Connection

SNI Service Node Interface

STP Spanning Tree Protocol

TCI Tag Control Information

TMN Telecommunications Management Network

TP Termination Point

TTP Trail Termination Point

UML Unified Modelling Language

UNI User Network Interface

VC Virtual Container

VCG Virtual Container Group

VID VLAN ID

VLAN Virtual Local Area Network

VPN Virtual Private Network

WAN Wide Area Network

5 General overview

In [ITU-T G.8010], two layer networks are defined in the EoT network architecture:

– Ethernet MAC (ETH) layer network;

– Ethernet PHY (ETY) layer network.

The ETH layer network is a path layer network. The ETY layer network is a section layer network. They are in a G.805/G.809 client/server relationship where client layer link connections are supported by server layer trails. The ETH layer network characteristic information can be transported through ETH links supported by trails in the ETY layer network and other path layer networks (e.g., SDH VC-n, OTN ODUk, MPLS, ATM).

This Recommendation focuses on what is considered to be the essential functionality of Metro Ethernet Network (MEN) and EoT network management at the ETH layer over dedicated/private or shared/virtual bandwidth provided by the transport layer (SDH/SONET, PDH, ATM, MPLS, OTH, ETY, etc). It provides a model for VLAN-based Ethernet services. The services to be modelled are the ones identified in the G.8011-series of ITU-T Recommendations as Ethernet Private Line (EPL), Ethernet Virtual Private Line (EVPL), Ethernet Virtual Private LAN (EVPLAN) and Ethernet Private LAN (EPLAN) service types, as well as the ones identified in [MEF 6] as Ethernet Line (E-Line) and Ethernet LAN (E-LAN) service types. The EPL and EVPL service types have two subtypes: non-extendible and extendible services. The service type definitions are based on the Ethernet Connection (EC) defined in [ITU-T G.8011], and on the point-to-point (pt-pt) or

multipoint-to-multipoint (mp-mp) Ethernet Virtual Connection (EVC) defined in [MEF 10.1], respectively.

MEF Services Phase 2 introduces the rooted multipoint connection type. In a Rooted-Multipoint EVC, one or more of the UNIs **MUST** be designated as a Root and each of the other UNIs **MUST** be designated as a Leaf. An ingress Service Frame mapped to the EVC at a Root UNI **MAY** be delivered to one or more of the other UNIs in the EVC. An ingress Service Frame mapped to the EVC at a Leaf UNI **MUST NOT** result in an egress Service Frame at another Leaf UNI but **MAY** result in an egress Service Frame at some or all of the Root UNIs.[1]

The ITU-T EC definition is based on the ETH Connection/Connectivity definition of [ITU-T G.8010] which in turn is based on the ETH link, ETH Flow Domain (FD) and ETH Flow Domain Fragment (FDFr) definitions of [ITU-T G.8010]. The MEF EVC definition is based on the UNI-N definition of [MEF 10.1] and [MEF 13], and the ETH link, ETH FD and ETH FDFr definitions of [MEF 12].

The scope of this Recommendation includes three views of MEN and EoT network management:

– Network Element (NE) related information;

– network view;

– service view (also known as customer view).

The NE related information exchanged at the EMS-NMS interface depends on information specified at the EMS-NE interface. Management information about Ethernet equipment, as specified (or being specified) by IETF or IEEE or ITU-T for the EMS-NE interface, needs to be reused at the NMS-EMS interface to model corresponding management information. The MEF has specified requirements for the management of Metro Ethernet network elements (ME-NEs) in [MEF 15].

The network view presents Ethernet services from the perspective of the network or service provider. As a result, various topology, service and performance characteristics are visible that may not be visible from other views. The service or customer view describes Ethernet services from the perspective of the customer. Such a description does not provide any details about how a service is realized. The detailed network viewpoint is complementary to the opaque customer viewpoint looking into the network.

For example, the MEF EVC may be carried over an EC as described by ITU-T, i.e., a service defined from a customer perspective with MEF EVC and UNI attributes can be deployed over a network infrastructure service defined with ITU-T EC and UNI attributes. As another example, the MEF E-Line service type can be implemented using the EPL and EVPL infrastructure services defined in [ITU-T G.8011.1] and [ITU-T G.8011.2]. The [ITU-T G.8011.1] EPL service and the [ITU-T G.8011.2] EVPL service can be viewed as subsets of the MEF services of the E-line service type, and the [ITU-T G.8011.1] and [ITU-T G.8011.2] attributes can be mapped to MEF attributes. That is, the EPL and EVPL described by ITU-T can be used to implement the MEF E-Line services.

The requirements and logical model provided in this Recommendation will be used for creating protocol specific MIBs based on CORBA, SNMP, XML, etc. This logical model has great value in that it provides a protocol independent way of representing the information required for managing Metro Ethernet and EoT services. The goal of this Recommendation is to provide a set of functional requirements and logical model that can be used to develop protocol-specific models in a semantically consistent fashion.

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[1] Rooted multipoint EVC is defined in [MEF 10.1].

This Recommendation addresses the following functional areas of MEN and EoT network management:

– ETH layer Flow Point Pool (e.g., UNI, NNI) configuration provisioning;
– ETH layer configuration and provisioning (including flow domain (subnetwork) provisioning and link provisioning);
– ETH layer network Flow Domain Fragment management (including set-up/modification and deletion for ETH FDFrs);
– ETH layer fault management (including notification and testing);
– ETH layer performance monitoring;
– management of the MAU/ETY layers (infrastructure provisioning of dedicated and shared bandwidth, bridge protocol configuration, link aggregation, etc.).

In the Network-Level Management Architecture (see Figure 5-1), the NMS interfaces to a set of subtending Element Management Systems (EMSs) which, in turn, interfaces to the Metro Ethernet NEs within its span of control. In this architecture, the NMS Environment delegates the responsibility of managing the individual elements to the EMSs, and only manages the flow domains as presented by the EMSs. Thus the EMS exposes a network view to the NMS Environment. It is also important for the EMS to expose the equipment view, especially for fault management.

The EMS shown in Figure 5-1 is used to manage the individual network elements supporting Metro Ethernet and EoT 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 represents an integrated management OS environment across potentially different technologies and supplier systems. Figure 5-1 shows the EMS-NMS interface (Q interface) addressed in this Recommendation.

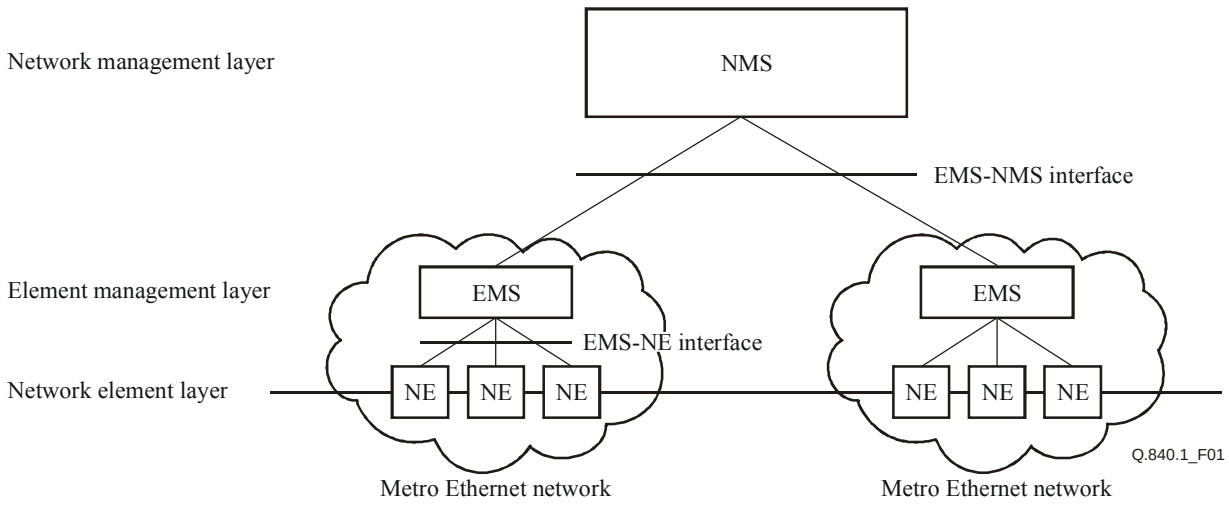

Figure 5-1 – Network-level management architecture

The Ethernet Services Layer, also referred to as the ETH Layer, is the specific layer network within a Metro Ethernet Network (MEN) responsible for the instantiation of Ethernet MAC oriented connectivity services and the delivery of Ethernet PDUs presented across well-defined internal and external interfaces. The ETH Layer is responsible for all service-aware aspects associated with Ethernet MAC flows, including operations, administration, maintenance and provisioning capabilities required to support Ethernet connectivity services. As per the MEF services model

([MEF 10.1]), the Service Frame presented by the ETH Layer external interfaces is expected to be an Ethernet unicast, multicast or broadcast frame conforming to the IEEE 802.3 frame format.

Figure 5-2 shows the relationship between the MEN interfaces defined in the MEF Generic Architecture Framework ([MEF 4] and [MEF 12]) and the ETH Layer. From the perspective of the ETH Layer, only those components of the UNI/NNI related to Ethernet service-aware functions are relevant. From a functional modelling viewpoint, the Ethernet Services Layer Network consists of topological, transport and processing entities.

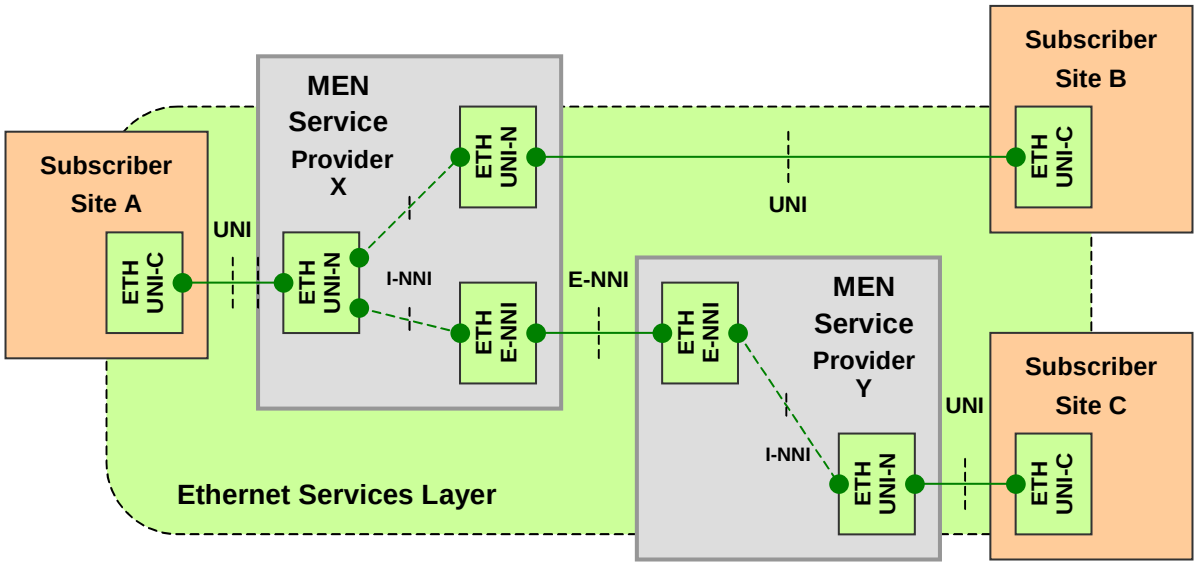

Figure 5-2 – ETH layer interfaces and reference points

5.1 Network Element view concepts

Generally, the NE view provides an abstraction of network elements allowing their monitoring and configuration. It provides a network element layer abstraction, allowing the management of individual NEs mainly from a physical resources viewpoint, so that the managed NEs can be functioning properly. The NE view information model is mainly used for the EMS-NE interface, but not limited to this interface.

The NE related information exchanged at the NMS-EMS interface provides node level information for the NMS to manage every NEs in the network. It depends on the information specified at the EMS-NE interface, but might be different for the NMS's special purpose of the NMS. For example, NE view information model at the NMS-EMS interface can be used to support fault management related functions, so that the alarm reported to NMS can be located to a specific entity at the NMS-EMS interface. But it is usually not the purpose for NMS to configure every NE view attributes as detailed at the EMS-NE interface. The NMS can expand its management functions and scope through NE view. And in cases when an EMS does not support network view in the northbound NMS-EMS interface, it can use NE view to provide necessary information to the NMS.

For MEN/EoT network, the NE view provides the basic Ethernet information in a single equipment, such as ETY Port. Based on the information from different views, the NMS can manage the MEN/EoT network in the node and equipment levels as well as the network and logic level.

5.2 Network View concepts

The Network View provides an abstraction of network resources allowing for flexibility in the management of the network. It provides a network layering abstraction, allowing multiple network technologies to be managed in an integrated fashion. The network view abstraction allows for the representation of a topological view of network resources, and the management of end-to-end connections or flows across the network. The network view abstraction resides at the Network Management Layer (NML) of TMN. The network view abstraction provides more service, flow, and connection oriented information than Element Management Layer (EML) and Element Layer (EL) nodal oriented management information models.

Network view models incorporate the concepts of layer networks, flow or subnetwork partitioning, topological view, and flow or connectivity view. These concepts allow the network view to provide an abstraction of the network being managed as an aggregate view of network resources.

A layer network domain (LND) represents an administration's view of the network resources responsible for transporting a specific type of characteristic information (e.g., IP, ETH (layer 2 Ethernet MAC), ETY (Ethernet PHY), MPLS, SDH/SONET).

The topological view represents the network structure and topology. This view describes the flow domains or subnetworks that make up the LND, and partitioning relationships of the flow domains or subnetworks within the LND. Flow domains or subnetworks are connected and related through Links. Links represent capacity supported by an underlying (or server) LND.

The connectivity or transport view of the network view model describes the flows (connections) through an LND, and the supporting flows (connections) through the flow domains (subnetworks) and links. This view describes how flows traverse flow domains and their partitioned components. The relationships of the flows to the supporting underlying server LND are provided through the use of link connections. Flows (connections) describe how capacity and resources are assigned to support trails through an LND.

The layer network concept provides a separation of resources and capabilities that support the transport of specific types of characteristic information (e.g., IP packets and Ethernet frames). Flow domain partitioning allows a flow domain to be partitioned into component flow domains and the links that connect them.

The mapping for EoT/MEN terms to G.809, G.8010 and G.805 is shown in Table 5-1. In this Recommendation, the terms of ETH FDFr, ETH FDFr/EVC, ETH FDFr EVC and ETH_FDFr_EVC are the same as indicated in those ITU-T G-series Recommendations.

Table 5-1 – Comparison of G.805, G.809/G.8010 and EoT/MEN terms

Connection Oriented (G.805)	**Connectionless (G.809/G.8010)**	**Metro Ethernet /EoT Entity**
Subnetwork	FlowDomain/ MatrixFlowDomain	ETH_Flow_Domain
LinkEnd	FPP (FlowPointPool)	ETH_FPP
Link	FPPLink	ETH_FPP_Link
SNC (SubnetworkConnection)	FDFr (FlowDomainFragment)/ MatrixFlowDomainFragment	ETH_FDFr_EVC
Network CTP (Connection Termination Point)	FlowPoint	ETH_Flow_Point
Network TTP (Trail Termination Point)	FlowPoint	ETH_Flow_Point MAUTransportPort

5.2.1 Network layering

Layer networks provide the logical separation of network resources that support transport for different types of characteristic information. An LND represents an administration's view of the layer network responsible for transporting a specific type of characteristic information. Layer networks may use transport resources in other layer networks. That is, an LND may act as a client LND with respect to another LND that provides transport resources, the server LND. In Figure 5-3, the IP LND uses transport resources of the ETH LND. The ETH LND in turn uses the resources of the MPLS LND; the MPLS LND in turn uses the resources of the SDH/SONET LND, and the SDH/SONET LND utilizes the physical transport resources represented in the WDM LND.

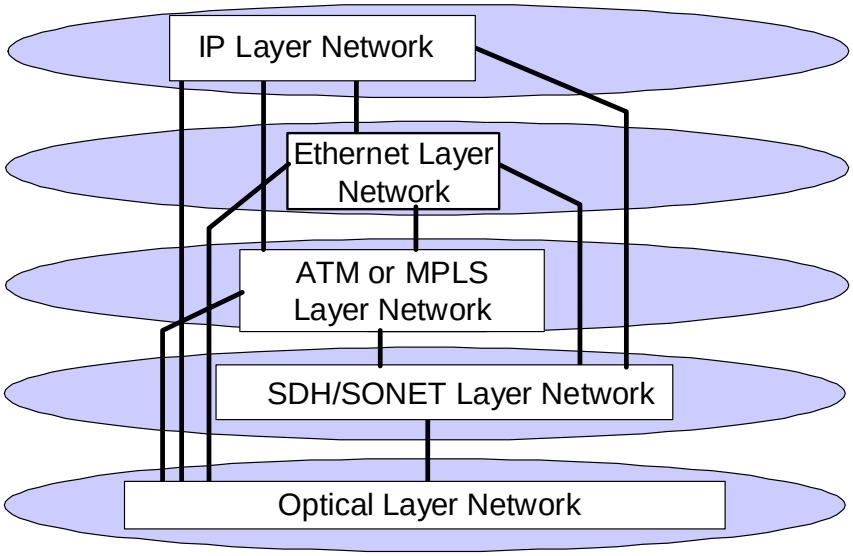

Figure 5-3 – Network layering example

Flows, connections, resources, and network topology can be managed and represented separately for each LND. However, relationships are made between LNDs that use the transport services of other LNDs. The concept of network layering is important for separating the management concerns of different network technologies and services.

5.2.2 Partitioning

Flow domains (subnetworks) are composed of flow domains (subnetworks) and links. Recursively, a flow domain (subnetwork) may be partitioned into sub-flow domains (subnetworks) and the links that connect them.

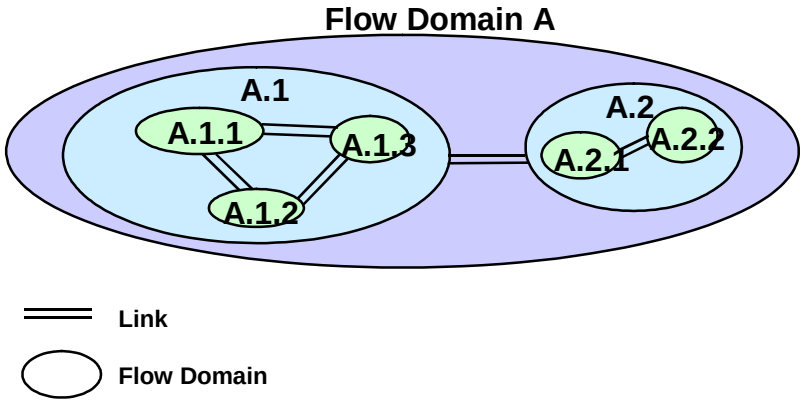

Figure 5-4 – Partitioning example

Partitioning is useful in describing various management criteria under which a carrier's network might be divided. For example, the carrier's network might be partitioned along the lines of the network operations centre (NOC) responsible for each flow domain or subnetwork. Within each flow domain (subnetwork) representing a NOC, flow domains (subnetworks) could be partitioned to describe the resources that are managed by a specific element management system (EMS). Again within each EMS related flow domain (subnetwork), a flow domain (subnetwork) could be used to represent the resources of a specific set of network elements (e.g., bridge).

There are many ways flow domains and subnetworks can be partitioned. The partitions should represent the business needs of a specific management interface.

5.2.3 Topological provisioning

Topological elements represent the logical topology or structure of the flow domain (subnetwork) within an LND. These elements include flow domains (subnetworks) and the links that connect them.

The flow domain (or subnetwork) provides capacity for carrying characteristic information within an LND. Flow domains (subnetworks) can be partitioned into a set of component flow domains (subnetworks) and links.

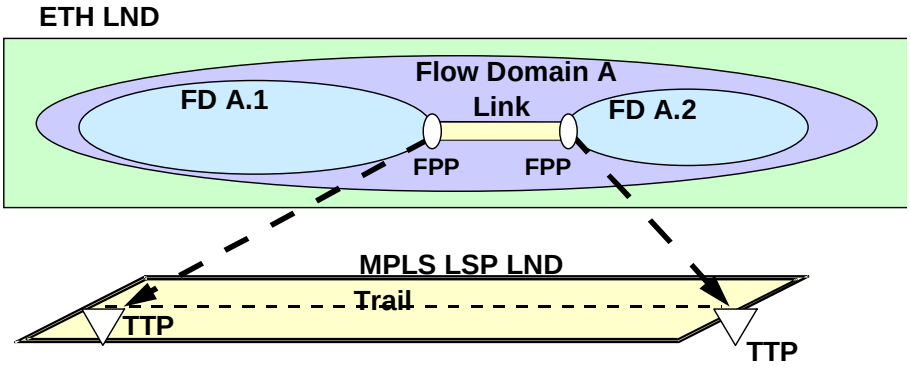

Figure 5-5 – Topological elements

Flow domains can be used to represent: a carrier's entire layer network; vendor-specific component flow domains of the carrier's layer network; and even "atomic" flow domains (matrix flow domains) that correspond to individual NEs (bridges).

A Link is a topological component that describes a fixed topological relationship between flow domains (subnetworks), along with the capacity supported by an underlying server LND trail. Links in the client LND are supported by trails in an underlying server LND.

The termination of a Link is called a Flow Point Pool (FPP) or Link End. The FPP or Link End describes configuration information associated with an interface, such as a UNI or NNI. The FPP or Link End is associated with the trail termination of the underlying server trail used to perform adaptation and transport of the characteristic information of the client LND.

5.2.4 Flow/connection management

Flow and connection elements are responsible for transporting characteristic information across the LND, across flow domains (subnetworks), and across Links.

A Flow Domain Fragment (FDFr) or Subnetwork Connection (SNC) (e.g., ETH Virtual Connection, ATM PVC, etc.) is a connection responsible for transporting characteristic information across a flow domain or subnetwork. If the flow domain (subnetwork) that the FDFr (SNC) traverses is partitioned, the FDFr (SNC) may be partitioned into its component FDFrs (SNCs).

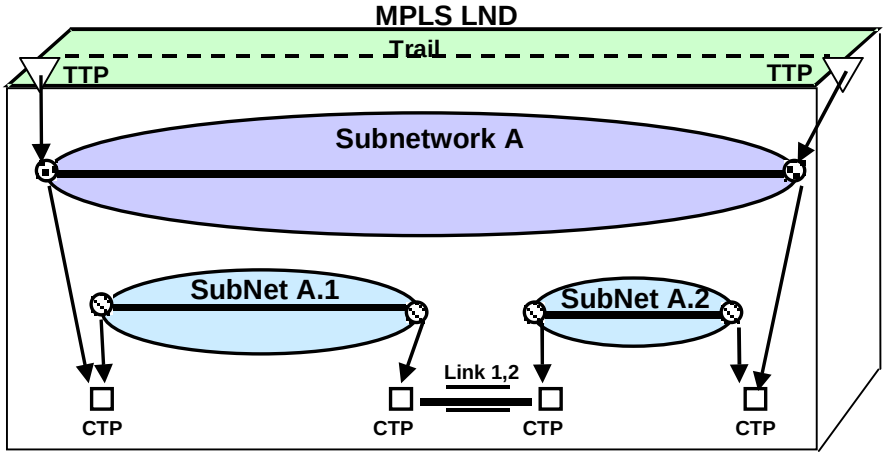

Figure 5-6 – Connection elements

A Subnetwork Connection is terminated at Connection Termination Points (CTPs). A Flow Domain Fragment is terminated at Flow Points (FPs). Because subnetworks may be partitioned, several Subnetwork Connection end-points may coincide at a single CTP. Likewise a single FP may represent the termination of several FDFrs from the same partitioned FDFr. The CTP (FP) represents the actual point of termination of both SNCs (FDFrs) and link connections.

5.3 Service View concepts [MEF 10.1]

The Ethernet Service View allows Subscribers to successfully plan and integrate Services into their overall networking infrastructure, allows suppliers of Customer Edge Equipment to implement capabilities into their products so that they can be used to successfully access Ethernet Services, and allows Service Providers to describe services in Service Level Specifications and provide such services at the User Network Interface (UNI).

The Ethernet Services are modelled from the point of view of the Subscriber's equipment referred to as the Customer Edge (CE) that is used to access the service at the UNI into the Provider Edge (PE). Service Attributes represent the definition of Service Level Specification.

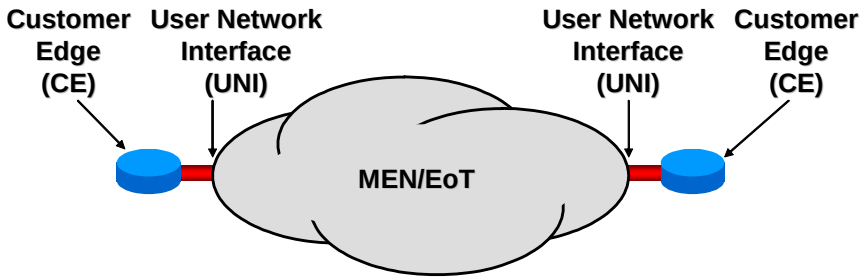

Figure 5-7 – Ethernet services model [MEF 6] [MEF 10.1]

The technical definition of a service is in terms of what is visible at the Customer Edge (CE) including the UNI, which is the demarcation point between the Service Provider and the Subscriber and where the CE and the Metro Ethernet Network (MEN)/EoT exchange Service Frames. In the Service View, there are no assumptions about the details of the Metro Ethernet Network/EoT (e.g., it may consist of a single switch or a combination of networks based on many different technologies).

6 Interface requirements

6.1 Business level requirements

This Recommendation only focuses on the management interface between NMS and EMS for Metro Ethernet and EoT, 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, state changes, performance data, and fault information to NMS.

6.1.1 Actor roles

The actor in this Recommendation is the NMS. The NMS is the network management system that manages the whole Metro Ethernet/EoT systems by interacting with the EMSs.

6.1.2 Telecommunications resources

Both the EMS and the managed equipment supporting Metro Ethernet and Ethernet over Transport 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 Metro Ethernet/EoT management interface. The actor is the NMS which is the EoT network management system that manages the whole EoT network by interacting with the EMS.

The functional requirements of this management interface are sub-divided into the Common, Configuration, Performance, and Fault management functional areas.

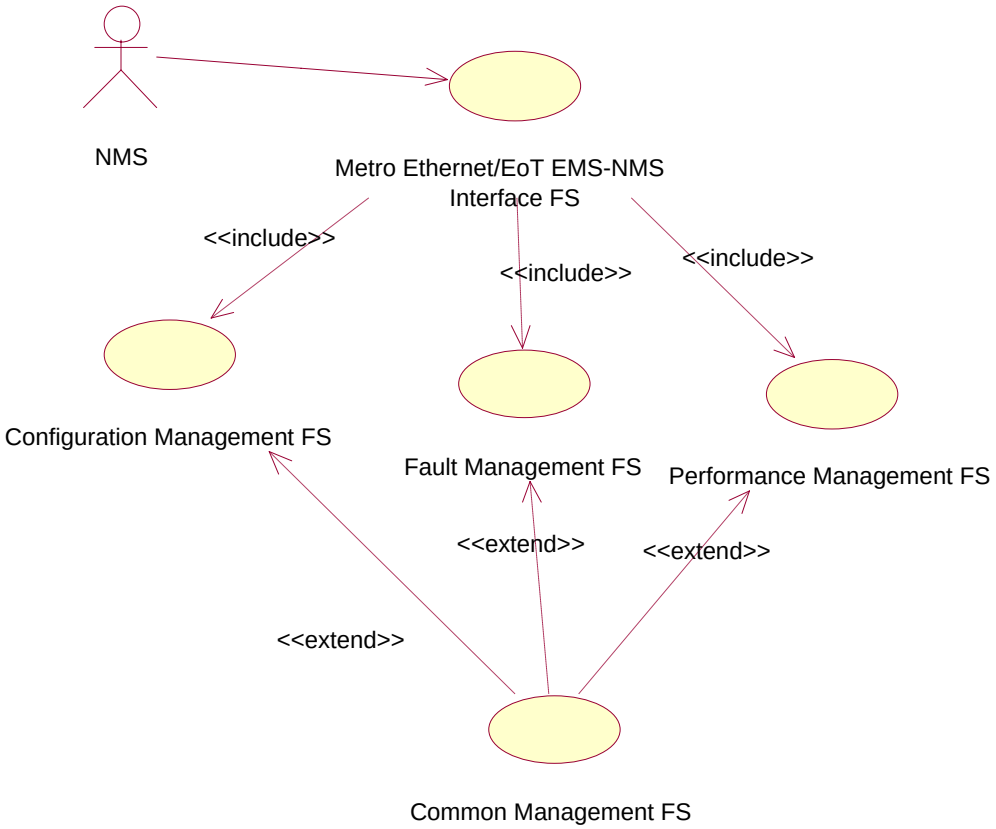

Figure 6-1 – Metro Ethernet/EoT management interface function set

The diagrams for common management can be found in [ITU-T Q.827.1].

Figure 6-2 shows the Use Case Diagram of the common management function sets according to [ITU-T Q.827.1].

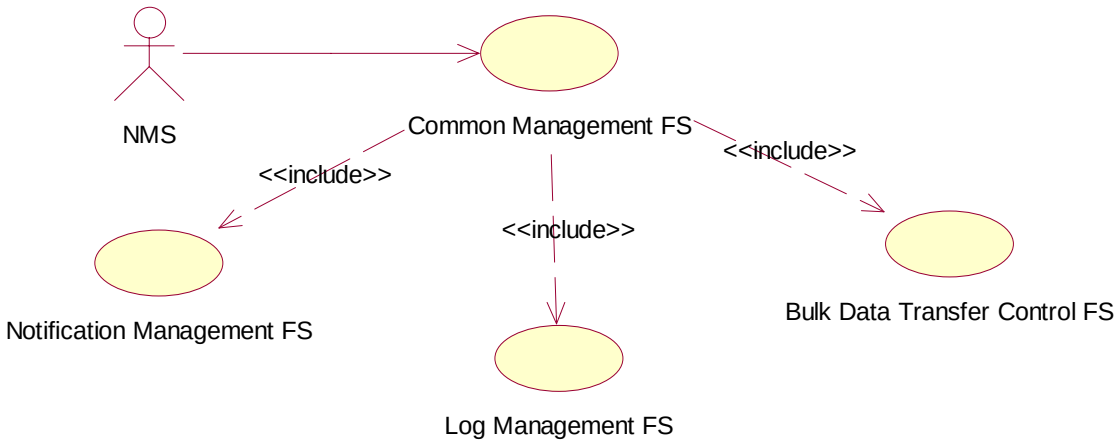

Figure 6-2 – Common management function set overview

Figure 6-3 shows the functions involved in the Configuration management function set.

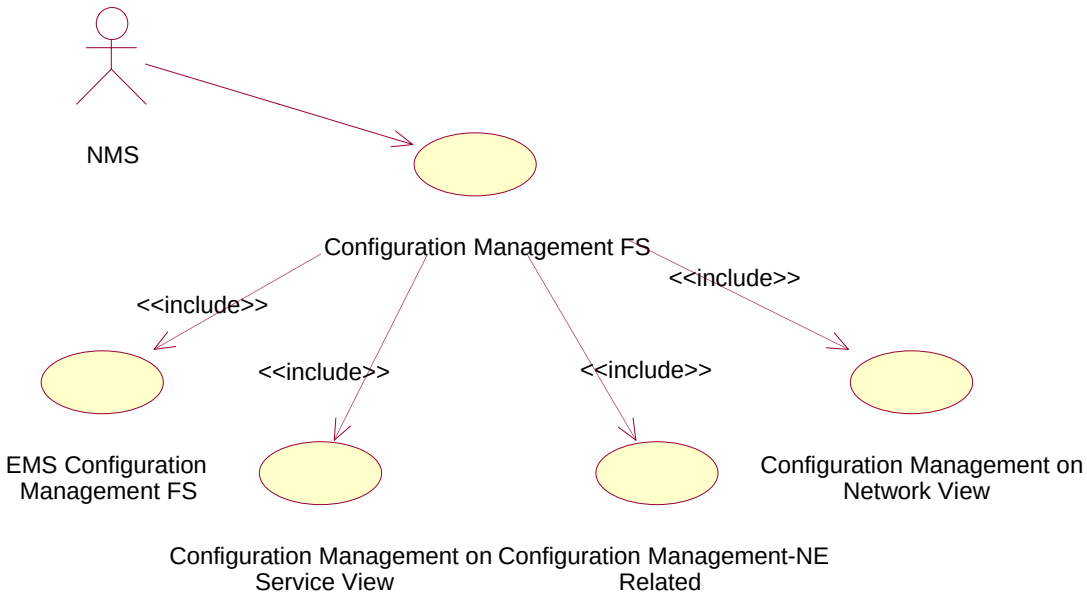

Figure 6-3 – Configuration management function set

The use case diagram for performance management function set according to [ITU-T Q.827.1] is found in Figure 6-4.

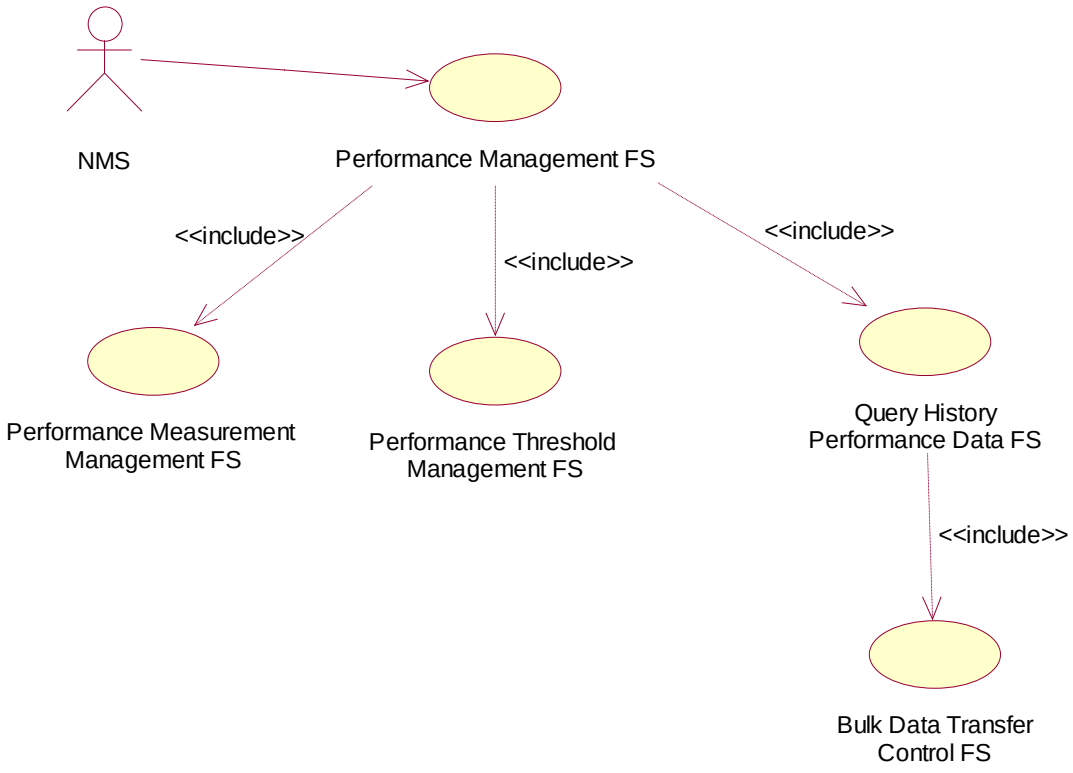

Figure 6-4 – Performance management function set

The use case diagram for Fault management function set based on [ITU-T Q.827.1] is shown in Figure 6-5.

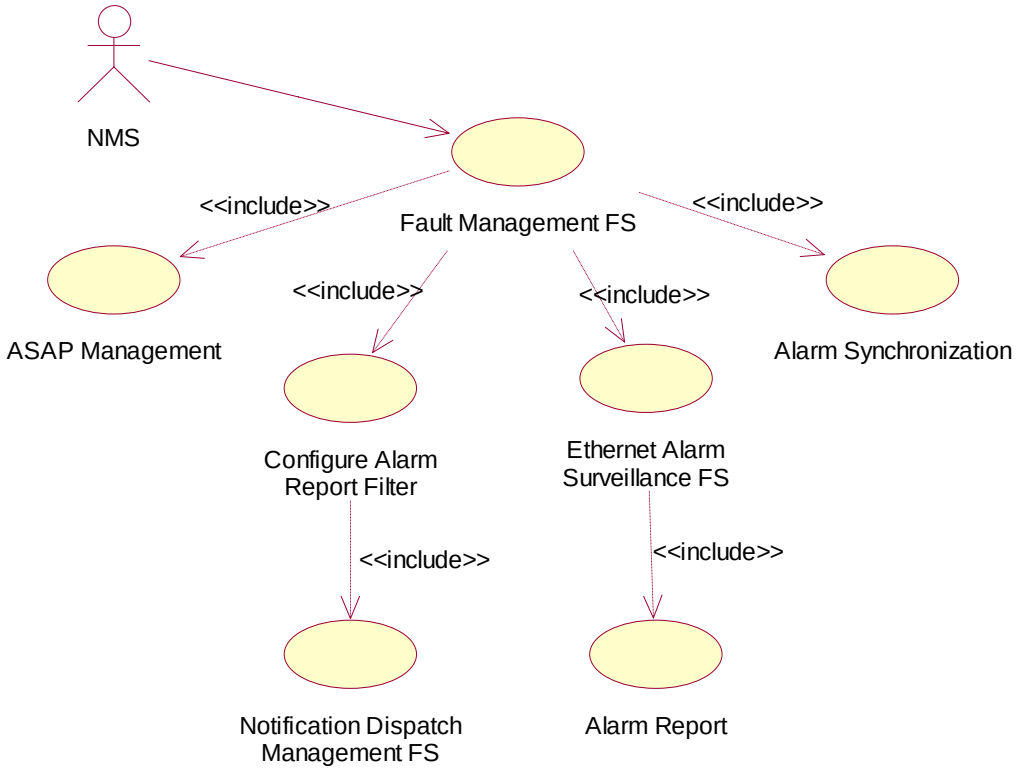

Figure 6-5 – Fault management function set

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 clause 6.2 of [ITU-T 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 Common Management Function Set includes the Notification Management Function Set, the Log Management Function Set and the Bulk Data Transfer Control Function Set. The Specification Level Requirements for Common Management are described in clause 6.2.1 of [ITU-T Q.827.1]. The Q.827.1 specification level requirements apply to this Recommendation.

6.2.2 Configuration Management Function Set

6.2.2.1 Overview

In addition to the Basic Managed Entity Configuration, EMS Configuration, and Configuration Management on NE View and Network View described in this Recommendation, the EMS-NMS interface supporting management of Metro Ethernet and EoT Services may also include function sets to manage client layer networks and server layer networks. The definition of these additional

non-Ethernet Layer Network management function sets is outside the scope of this Recommendation.

Configuration Management (CM) deals with the initialization, maintenance, and graceful shutdown of resources within a system. Configuration information is defined and managed (created, retrieved, updated and deleted) using Configuration Management functions. Configuration Management is also responsible for managing relationships among configuration entities and configuration information change notification functions.

6.2.2.2 Configuration Management – ETY related

6.2.2.2.1 ETY Port/Encapsulation Port management

The ports on EoT/MEN system can be classified to:

– ETY Port: usually for user service access in UNI, including FE, GE port;

– Encapsulation Port: ETY like port based on EoT server layer, usually for service transport in NNI.

EMS should support NMS to query and modify the physical characteristics and attributes of both kinds of these ports.

ETY port inherits from physicalPort in [ITU-T M.3100] with the following new attributes:

– Port Type (GET): There are two types: ETY port or Encapsulation port.

– Maximum port speed (GET): This attribute indicates the inherent maximum speed of ETY port/Encapsulation port.

– Configured port speed (GET, REPLACE): This attribute indicates the speed of Ethernet port that is used to transport the Ethernet service. There are five values: auto-negotiation, 10 Mbit/s, 100 Mbit/s, 1 Gbit/s or 10 Gbit/s.

– Duplex mode (GET, REPLACE): This attribute indicates the mode of Ethernet port that is used to transport the Ethernet service, and is only necessary for ETY port. There are three values defined by [ITU-T G.8012]: full duplex, half duplex or auto-negotiation.

– Bridge Pointer (GET): This attribute identifies the Bridge or VLAN Bridge which contains the port.

– If Flow Control (GET, REPLACE): This attribute indicates the usage of MAC Control (PAUSE) by the port. The options are: yes or no.

For Encapsulation ports, two additional attributes are included as following:

– Encapsulation Protocol (GET): This attribute indicates the protocol used to encapsulate Ethernet frames being transported on server layer. There are three options: GFP, LAPS or HDLC.

– Server layer info (GET): Such as server layer type (e.g., SDH VC-n, OTN ODUk, MPLS, ATM), server layer TTP (Trail Termination Point), server layer bandwidth, etc.

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

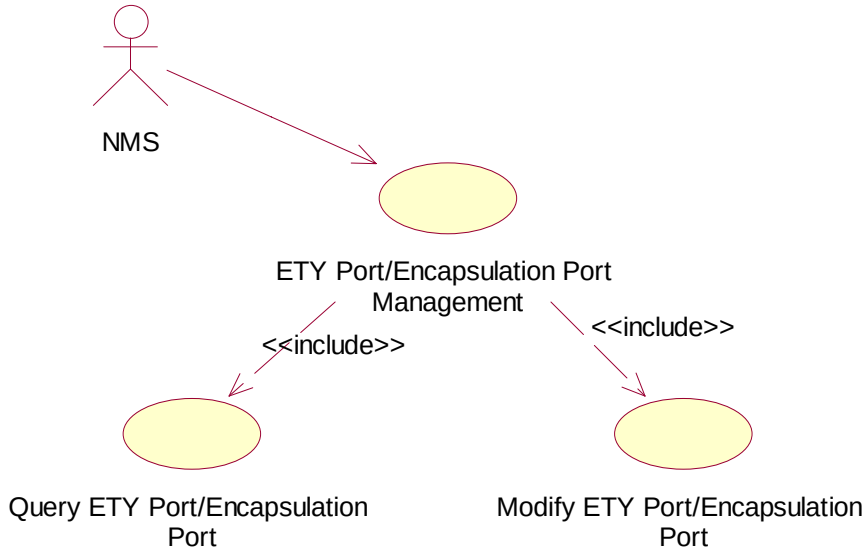

Figure 6-6 – ETY port management function set

6.2.2.2.1.1 Query ETY Port/Encapsulation Port

Name	Query ETY Port/Encapsulation Port
Summary	NMS requests to query ETY Port information of NE from EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved the NE and circuit pack inventory.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a request of query of ETY Port/Encapsulation Port to EMS.
Description	1) NMS sends a request of query of ETY port/Encapsulation Port to EMS 2) EMS returns the ETY port/Encapsulation Port attributes to NMS 3) NMS receives the response from EMS
Ends When	1) EMS returns the ETY Port/Encapsulation Port information to NMS 2) Exception happens
Exceptions	1) Unknown Port 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ETY Port attributes when the query succeeds.

6.2.2.2.1.2 Modify ETY Port/Encapsulation Port

Name	Modify ETY Port/Encapsulation Port
Summary	NMS requests to modify some attributes of ETY Port/Encapsulation Port.
Actor(s)	NMS
Assumptions	NMS has already retrieved the ETY Port/Encapsulation Port inventory information.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETY Port/Encapsulation Port whose attributes are to be modified.
Begins When	NMS sends a request to EMS to modify ETY Port/Encapsulation Port attributes.
Description	1) NMS sends a request to EMS to modify ETY Port/Encapsulation Port attributes 2) EMS modifies relevant attributes of ETY Port/Encapsulation Port 3) EMS forwards AVC Notification to all registered NMSs 4) EMS responds with success indication 5) NMS receives the response from EMS The following attributes of ETY Port/Encapsulation Port are configurable: – Port speed – Duplex mode – If Flow Control
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Object does not exist 2) Attribute is read-only 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and corresponding AVC is sent to NMS registered for this notification.

6.2.2.3 Configuration Management On Network View

6.2.2.3.1 Ethernet Discovery Function Set

The use case diagram for Ethernet Discovery Function Set is shown in Figure 6-7.

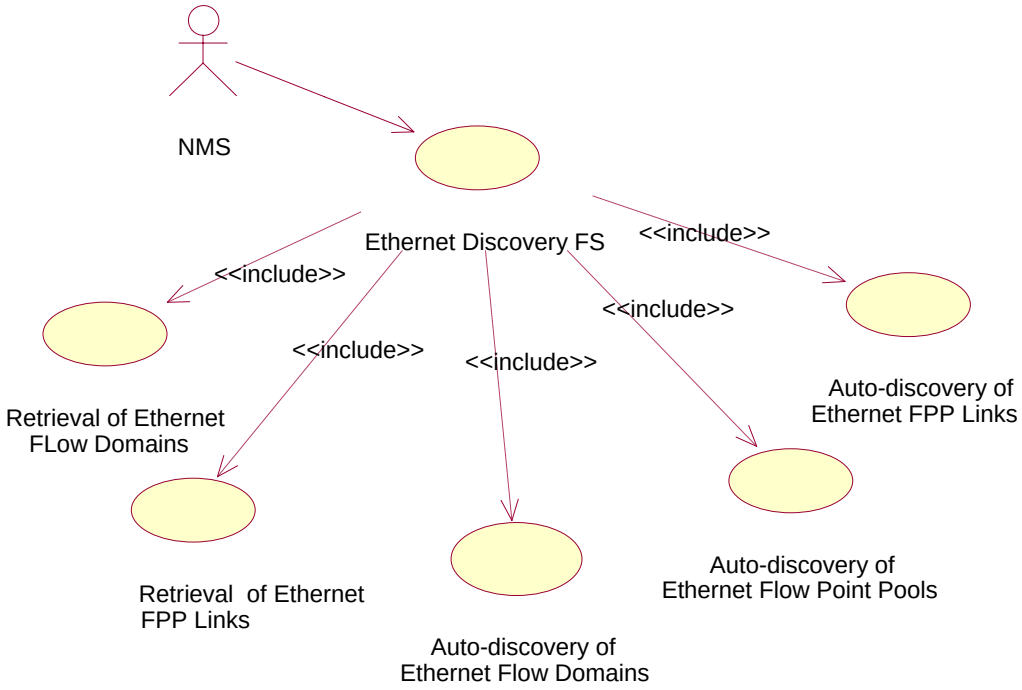

Figure 6-7 – Ethernet discovery function set

6.2.2.3.1.1 Retrieval of Ethernet Flow Domains

Name	Retrieval of Ethernet Flow Domains
Summary	The NMS requests discovery of instances and attributes of all Ethernet Flow Domains managed by the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Domain information.
Pre-Conditions	The communication between NMS and EMS is available.
Begins When	The NMS sends a request to discover instances and attributes of all Ethernet Flow Domains managed by the EMS.
Description	The NMS has a need to discover all Ethernet Flow Domains managed by an EMS. The NMS requests retrieval of the name/identifier or attributes for all instances of the Ethernet Flow Domain object class. The Ethernet Flow Domain may have the following attributes and relationships: – FD ID: This attribute represents a unique value for the ETH flow domain. – User Label: A text string that may be used to describe the object or provide additional information. – Parent ETH Flow Domain: which contains the ETH FD. – ETH FPP List: This attribute represents Flow Domain Interfaces. – ETH FPP Link List: ETH FPP Links contained in the ETH FD.

	– Member ETH Flow Domain List: Partitioned ETH FDs contained in the ETH FD. – Member FDFr/EVC List: FDFrs/EVCs contained in the ETH FD. – Supporting Elements: The elements that support this ETH Flow domain. For example, the NEs and Circuit packs that support this ETH flow domain.
Ends When	1) EMS returns the Ethernet Flow Domain information to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) Invalid Parameter 3) EMS Processing Error
Post-Conditions	The NMS has discovered all Ethernet Flow Domains managed by the EMS. The NMS has current values for the attributes for each instance.

6.2.2.3.1.2 Retrieval of Ethernet FPP Links

Name	Retrieval of Ethernet FPP Links
Summary	The NMS requests discovery of instances and attributes of all Ethernet FPP Links managed by the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet FPP Link information.
Pre-Conditions	The communication between NMS and EMS is available.
Begins When	The NMS sends a request to discover instances and attributes of all Ethernet FPP Links managed by the EMS.
Description	The NMS has a need to discover all Ethernet FPP Links managed by an EMS. The NMS requests retrieval of the name/identifier or attributes for all instances of the Ethernet FPP Link object class. The Ethernet FPP Link may have the following attributes: – FPP Link ID: This attribute represents a unique value for the Ethernet FPP Link. – User Label: A text string that may be used to describe the object or provide additional information. – Link Capacity: The bandwidth of the link. – Usage Cost (Optional): This attribute describes the usage cost allocated to the ETH_Link. – A-End FPP – Z-End FPP
Ends When	1) EMS returns the Ethernet FPP Link information to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) Invalid Parameter 3) EMS Processing Error
Post-Conditions	The NMS has discovered all Ethernet FPP Links managed by the EMS. The NMS has current values for the attributes for each instance.

6.2.2.3.1.3 Auto-discovery of Ethernet Flow Domains

Name	Auto-discovery of Ethernet Flow Domains
Summary	The NMS receives discovery/creation notification including all attributes whenever new instances of Ethernet Flow Domain are created in the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Domain information.
Pre-Conditions	The communication between NMS and EMS is available.
Begins When	A new instance of Ethernet Flow Domain is created in the EMS and the NMS sends a request to discover new instances and attributes of Ethernet Flow Domains managed by the EMS.
Description	The NMS auto-discovers new Ethernet Flow Domains managed by the EMS. The EMS sends the identifier and all attributes for each newly created Ethernet Flow Domains.
Ends When	EMS sends the Ethernet Flow Domain information to NMS
Exceptions	Not applicable.
Post-Conditions	The NMS has discovered new Ethernet Flow Domains managed by the EMS. The NMS has current values for the attributes for each instance.

6.2.2.3.1.4 Auto-discovery of Ethernet Flow Point Pools

Name	Auto-discovery of Ethernet Flow Point Pools
Summary	The NMS receives discovery/creation notification including all attributes whenever new instances of Ethernet Flow Point Pool are created in the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Point Pool information.
Pre-Conditions	The communication between NMS and EMS is available.
Begins When	A new instance of Ethernet Flow Point Pool is created in the EMS and the NMS sends a request to discover new instances and attributes of Ethernet Flow Point Pools managed by the EMS.
Description	The NMS auto-discovers new Ethernet Flow Point Pools managed by the EMS. The EMS sends the identifier and all attributes for each newly created Ethernet Flow Point Pools.
Ends When	The EMS sends the Ethernet Flow Point Pool information to NMS
Exceptions	Not applicable.
Post-Conditions	The NMS has discovered new Ethernet Flow Point Pools managed by the EMS. The NMS has current values for the attributes for each instance.

6.2.2.3.1.5 Auto-discovery of Ethernet FPP Links

Name	Auto-discovery of Ethernet FPP Links
Summary	The NMS receives discovery/creation notification including all attributes whenever new instances of Ethernet FPP Link are created in the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet FPP Link information.
Pre-Conditions	The communication between NMS and EMS is available.

Begins When	A new instance of Ethernet FPP Link is created in the EMS and the NMS sends a request to discover new instances and attributes of Ethernet FPP Links managed by the EMS.
Description	The NMS auto-discovers new Ethernet FPP Links managed by the EMS. The NMS requests retrieval of the name or identifier for all instances of the Ethernet FPP Link object class. The EMS sends the identifier and all attributes for each newly created Ethernet FPP Links.
Ends When	The EMS sends the Ethernet FPP Link information to NMS
Exceptions	Not applicable.
Post-Conditions	The NMS has discovered new Ethernet FPP Links managed by the EMS. The NMS has current values for the attributes for each instance.

6.2.2.3.2 ETH Flow Point Pool Management

The use case diagram for ETH Flow Point Pool Management is shown as follows.

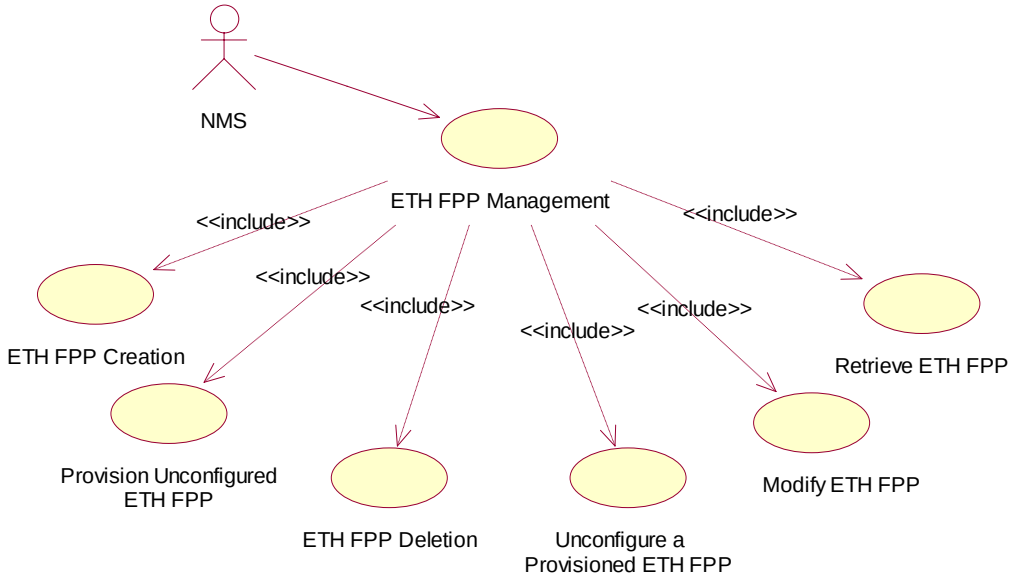

Figure 6-8 – ETH FPP management

6.2.2.3.2.1 ETH Flow Point Pool (FPP) Creation

Name	ETH Flow Point Pool (FPP) Creation
Summary	The NMS creates and configures an ETH FPP to represent the UNI or NNI on a pre-selected port. In most cases, ETH FPPs are created automatically by EMS when physical ports are created, and can be retrieved by NMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Point Pool information.
Pre-Conditions	The NMS has established communication with EMS.
Begins When	The NMS has selected a port (e.g., Generic Transport TTP) and sends a request to provision an ETH_FPP_UNI representing an Ethernet UNI on the port.

Description	The NMS needs to create a new ETH FPP (e.g., UNI, E-NNI) associated with a specific port. The NMS requests the creation of a new Ethernet FPP to be managed by the EMS. As part of the creation request, the NMS provides Ethernet UNI/E-NNI configuration parameters. Based on the creation request, the EMS creates an instance of ETH FPP and returns the name of the new ETH FPP instance. In addition, an Object Creation Notification for the new instance of ETH FPP is autonomously sent from the EMS and received by the NMS. For an ETH FPP representing a UNI or NNI, the following information may be provided by the NMS as part of the creation request: – FPP Type (GET, REPLACE): Indicates that the ETH FPP is a UNI, E-NNI, or Unconfigured. – FPP SubType (GET, REPLACE) (Optional): A string that indicates the detailed FPP sub-type. If the ETH FPP is a UNI, this attribute would be set to: "MEF UNI Type 1", "MEF UNI Type 2" or "MEF UNI Type 3" according to [MEF 11]. Type should be extensible to allow for future FPP sub-types. – User Label (GET, REPLACE). – Phys Address (GET, REPLACE): The [IEEE 802.3] address which is placed in the source-address field of any non-FDFr specific Ethernet frames that originate at this interface. – Ingress Max Assignable Bandwidth (GET, REPLACE). – Egress Max Assignable Bandwidth (GET, REPLACE). – Max Number of Configured FDFrs/EVCs (GET, REPLACE). – Layer2 Control Protocol Processing List (GET, REPLACE): A list of the possible Layer 2 Control protocols processed at this ETH interface, along with the processing alternative (Process, Discard, Pass-to-EVC). – Service Muxing Indicator (GET, REPLACE): Describes if service multiplexing is enabled at the ETH UNI. – Bundling Indicator (GET, REPLACE): There are three bundling options: yes, no and all-to-one. See [ITU-T G.8011]. – Ingress VLAN Assignment All (GET, REPLACE) (Optional): This attribute is an optional attribute that identifies the VLAN-ID assigned to all ingress traffic. An integer from 1 to 4094 inclusive. – Ingress VLAN Assignment Untagged (GET, REPLACE) (Optional): Applicable only to untagged traffic. This one and Ingress VLAN Assignment All are optional. They cannot be valid in the same time. – Ingress VLAN Priority Assignment All (GET, REPLACE) (Optional): This attribute is an optional attribute that identifies the VLAN Priority assigned to all ingress traffic. An integer from 0 to 7 inclusive. – Ingress VLAN Priority Assignment Untagged (GET, REPLACE) (Optional): Applicable only to untagged traffic. This one and Ingress VLAN Priority Assignment All are optional. They cannot be valid in the same time. – Unassigned VLAN ID List: Unique values that are available for assignment when creating new FDFr/EVCs. – Supported By (GET, SET BY CREATE): Relationship with supporting objects. – Client/Server (GET, SET BY CREATE): Relationship with TRANS layer TTP (Encapsulation Port) or ETY layer TTP (ETY Port) for ETH tunnelling. – Flow Domain Interfaces (GET, SET BY CREATE): Relationship with ETH Flow Domain that contains the FPP in a given layer.

	– Ingress Bandwidth Profile (GET, REPLACE): This attribute indicates the ingress bandwidth profile for all ETH services at the ETH FPP in the ingress direction. – Egress Bandwidth Profile (GET, REPLACE) (Optional): This attribute indicates the egress bandwidth profile for all ETH services at the ETH FPP in the egress direction. – mtuSize (GET, REPLACE): This attribute describes the maximum transmission unit size for the ETH FPP.
Ends When	1) EMS returns the creation response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	A new instance of ETH Flow Point Pool is created.

6.2.2.3.2.2 ETH Flow Point Pool (FPP) Deletion

Name	ETH Flow Point Pool (FPP) Deletion
Summary	The NMS deletes an ETH FPP representing the UNI or NNI on a specific port. This operation is conditional. Only the ETH FPP created by NMS can be deleted.
Actor(s)	NMS
Assumptions	The NMS has the authority to delete the Ethernet FPP instance created by the NMS previously.
Pre-Conditions	Communication between NMS and EMS is available.
Begins When	The NMS sends a request to remove from service an ETH_FPP representing an Ethernet UNI or NNI on a port.
Description	The NMS needs to remove from service an ETH FPP (e.g., UNI, E-NNI) associated with a specific port. The NMS requests the deletion of the Ethernet FPP from the EMS. As part of the deletion request, the NMS provides Ethernet UNI/E-NNI identifier. Based on the deletion request, the EMS removes the instance of ETH FPP. In addition, an Object Deletion Notification for the instance of ETH FPP is autonomously sent from the EMS and received by the NMS.
Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter 4) undeletableObjectList
Post-Conditions	The instance of ETH Flow Point Pool is deleted, and associated resources are made available.

6.2.2.3.2.3 Modify ETH FPP

Name	Modify ETH FPP
Summary	NMS requests to modify some attributes of ETH FPP, such as ingress VLAN, VLAN priority, etc., of ETH FPP.
Actor(s)	NMS
Assumptions	NMS has already retrieved the ETH FPP information.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH FPP to be modified.
Begins When	NMS sends a request to EMS to modify ETH FPP attributes.
Description	1) NMS sends a request to EMS to modify ETH FPP attributes of a specific ETH FPP object. 2) EMS modifies relevant attributes of ETH FPP. 3) EMS forwards AVC Notification to all registered NMS. 4) EMS responds with success indication. 5) NMS receives the response from EMS. The attributes that might be configured in this use case include: – FPP Type – FPP SubType – User Label – Multiplexed Access – Bundling – Layer2 Control Protocol Processing List – Ingress VLAN Assignment All – Ingress VLAN Assignment Untagged – Ingress VLAN Priority Assignment All – Ingress VLAN Priority Assignment Untagged – Ingress Bandwidth Profile – Egress Bandwidth Profile – mtuSize
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH FPP 2) Attribute is read-only 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and corresponding AVC is sent to NMS registered for this notification.

6.2.2.3.2.4 Retrieve Ethernet FPP

Name	Retrieve Ethernet FPP
Summary	NMS requests to retrieve instances and attributes of a set of or all of Ethernet Flow Point Pools managed by the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Point Pool information.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends EMS a query of one or more Ethernet FPPs .
Description	1) The NMS requests retrieval of the attributes of one or more or all of Ethernet FPPs. 2) The EMS returns the attributes of the specified Ethernet FPP(s). 3) NMS receives the attributes.
Ends When	1) EMS returns the Ethernet FPP information to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	The NMS has discovered one or all Ethernet Flow Point Pools managed by the EMS. The NMS has current values for the attributes for the instances.

6.2.2.3.3 ELMI Profile Management

An ELMI Profile defines the parameters and state information necessary to manage ELMI for the containing ETH FPP (e.g., UNI). This object is conditionally required if ELMI is supported.

Figure 6-9 shows the functions involved in the ELMI Profile management function set.

The ELMI Profile contains the following parameters:

1) elmiProfileID (GET, SET-BY-CREATE): This attribute identifies the specific EMLI Profile.

2) elmiOperationalState (GET): The ELMI operational state attribute is read-only and indicates the current capability of the ELMI mechanism on the UNI. Values for operational state include: disabled, enabled.

   NOTE 1 – Explore need for third state where ELMI is disabled at the UNI-C.

3) elmiAdministrativeState (GET, REPLACE): This attribute denotes the administrative state of the ELMI mechanism at the ETH_FPP. The values supported are Locked or Unlocked. In the Locked state, the ELMI mechanism on the FPP is disabled.

4) elmiProtocolVersion (GET, REPLACE): This is an 8-bit field that indicates the ELMI protocol version for the FPP (e.g., (0000 0001) indicates ELMI Version 1). Range (1 to 255) Default: (0000 0001).

5) elmiAsyncStatusEnabled (GET, REPLACE): This Boolean attribute indicates whether or not the capability of the UNI-N to generate and send Asynchronous Status is enabled. Default: TRUE.

6) elmiMinAsyncMessageInterval (GET, REPLACE): Minimum Asynchronous Message Interval – Used to specify minimum time interval between asynchronous messages.

   NOTE 2 – Generally set to 1/10th of the UNI-C's T391.

   Range (0 to 3) Default: 1 (second)

7) elmiN393 (GET, REPLACE): Represents the ELMI N393 Status Counter Parameter Threshold – This configurable parameter is a threshold for the Count of Consecutive Errors. Used to determine if ELMI is operational or not. Range from 2 to 10. Default 4.

8) elmiT392 (GET, REPLACE): Represents ELMI T392 Polling Verification Timer (PVT) limit. Configurable with Range 0 and from 5 to 30. Default 15. Value of 0 indicates that polling verification is disabled.

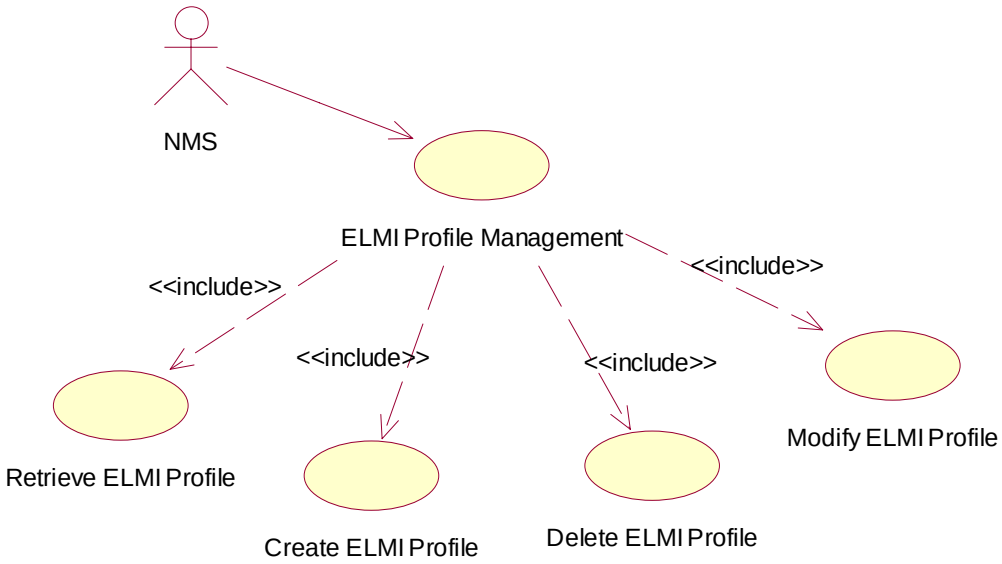

Figure 6-9 – ELMI profile management

6.2.2.3.3.1 Retrieve ELMI Profile

Name	Retrieve ELMI Profile
Summary	NMS requests to retrieve ELMI Profile from EMS.
Actor(s)	NMS
Assumptions	EMS has the list of ELMI Profiles.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a query of one specific or all ELMI Profiles to EMS.
Description	1) NMS sends a query to retrieve one specific or all ELMI Profiles to EMS. 2) EMS returns the ELMI Profile with the following attributes: a) elmiProfileID (GET) b) elmiOperationalState (GET) c) elmiAdministrativeState (GET, REPLACE) d) elmiProtocolVersion (GET, REPLACE) e) elmiAsyncStatusEnabled (GET, REPLACE) f) elmiMinAsyncMessageInterval (GET, REPLACE) g) elmiN393 (GET, REPLACE) h) elmiT392 (GET, REPLACE) 3) NMS receives the response from EMS

Ends When	1) EMS returns the ELMI Profile information to NMS 2) Exception happens
Exceptions	1) Unknown ELMI Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ELMI Profile information when the query succeeds.

6.2.2.3.3.2 Create ELMI Profile

Name	Create ELMI Profile
Summary	NMS requests creation of ELMI Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has the authority to create ELMI profile for future bandwidth assignment.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS requests creation of ELMI Profile to EMS.
Description	1) NMS sends EMS a request of creation of ELMI Profile with parameters including: a) elmiAdministrativeState (GET, REPLACE) b) elmiProtocolVersion (GET, REPLACE) c) elmiAsyncStatusEnabled (GET, REPLACE) (default to TRUE if not provided) d) elmiMinAsyncMessageInterval (GET, REPLACE) e) elmiN393 (GET, REPLACE) (default to 4 if not provided) f) elmiT392 (GET, REPLACE) (0=timer disabled) (default to 10 if not provided) 2) EMS creates ELMI Profile 3) EMS forwards Creation Notification to all registered NMSs 4) EMS responds with new created ELMI Profile ID 5) NMS receives the response from EMS
Ends When	1) EMS returns the creation response to NMS 2) Exception happens
Exceptions	1) EMS Processing Error 2) Invalid Parameter
Post-Conditions	If use case is successful, ELMI Profile is created and corresponding creation notification is sent to NMS registered for this notification.

6.2.2.3.3.3 Delete ELMI Profile

Name	Delete ELMI Profile
Summary	NMS requests deletion of ELMI Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created ELMI Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ELMI Profile to be deleted
Begins When	NMS requests deletion of ELMI Profile to EMS.

Description	1) NMS sends EMS a request of deletion of ELMI Profile with a specific ELMI Profile ID. 2) EMS deletes ELMI Profile. 3) EMS forwards Deletion Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown ELMI Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, the ELMI Profile is deleted and the corresponding deletion notification is sent to NMS registered for this notification.

6.2.2.3.3.4 Modify ELMI Profile

Name	Modify ELMI Profile
Summary	NMS requests to modify attributes of ELMI Profile.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ELMI Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ELMI Profile to be modified.
Begins When	NMS sends a request to EMS to modify ELMI Profile attributes.
Description	1) NMS sends a request to EMS to modify parameters of a specific ELMI Profile, including: a) elmiAdministrativeState (GET, REPLACE) NOTE – Changing the ELMI administrative state will enable or disable the ELMI mechanism on the containing ETH_FPP. b) elmiProtocolVersion (GET, REPLACE) c) elmiAsyncStatusEnabled (GET, REPLACE) d) elmiMinAsyncMessageInterval (GET, REPLACE) e) elmiN393 (GET, REPLACE) f) elmiT392 (GET, REPLACE) 2) EMS modifies relevant attributes of ELMI Profile. 3) EMS forwards AVC Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ELMI Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and corresponding AVC is sent to NMS registered for this notification.

6.2.2.4 Configuration Management on Service View

6.2.2.4.1 ETH FDFr/EVC Management

The use case diagram for ETH FDFr/EVC Management is shown in Figure 6-10.

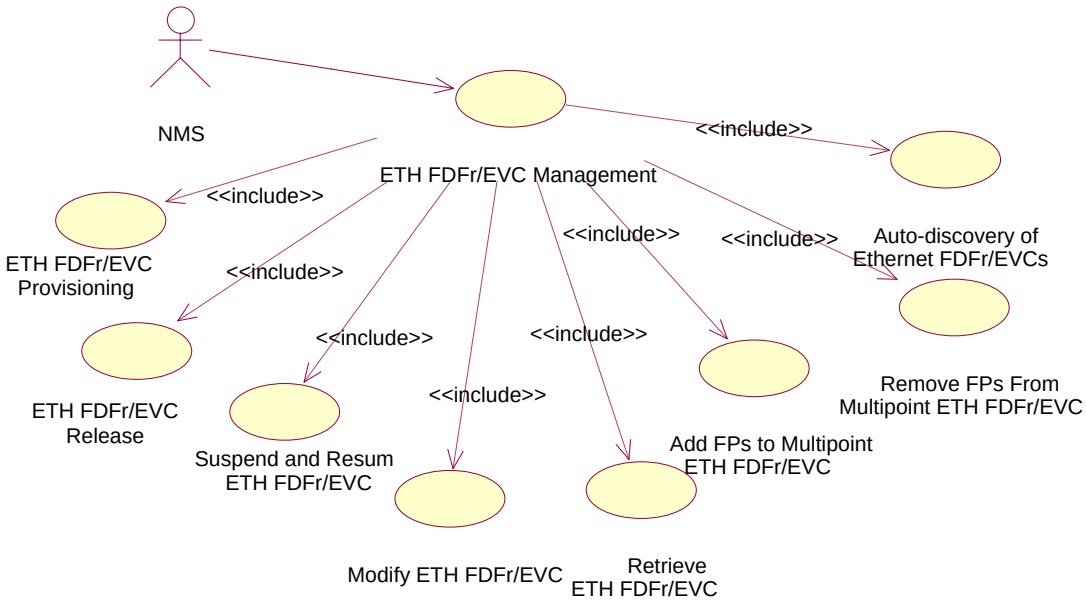

Figure 6-10 – ETH FDFr/EVC management

6.2.2.4.1.1 Auto-discovery of Ethernet FDFr/EVCs

Name	Auto-discovery of Ethernet FDFr/EVCs
Summary	The NMS receives discovery/creation notification including all attributes whenever new instances of Ethernet Flow Domain Fragment are created in the EMS.
Actor(s)	NMS
Assumptions	The NMS has the authority to receive Ethernet Flow Domain Fragment information and retrieve the Ethernet Flow Point information.
Pre-Conditions	The communication between NMS and EMS is available.
Begins When	A new instance of Ethernet Flow Domain Fragment is created in the EMS and the NMS sends a request to discover new instances and attributes of Ethernet Flow Domain Fragments managed by the EMS.
Description	The NMS auto-discovers new Ethernet Flow Domain Fragments managed by the EMS. The EMS sends the identifier and all attributes for each newly created Ethernet Flow Domain Fragments.
Ends When	EMS sends the Ethernet FDFr/EVCs information to NMS
Exceptions	Not applicable.
Post-Conditions	The NMS has discovered new Ethernet Flow Domain Fragments managed by the EMS. The NMS has current values for the attributes for each Ethernet Flow Domain Fragment instance, and for each Ethernet Flow Point instance that terminates an Ethernet Flow Domain Fragment.

6.2.2.4.1.2 ETH FDFr/EVC Provisioning

Name	ETH FDFr/EVC Provisioning
Summary	The NMS provisions (creates) a Flow Domain Fragment Ethernet Virtual Connection representing the edge-to-edge service across an Ethernet Flow Domain. During FDFr/EVC establishment, the EMS creates the FDFr/EVC and associated Flow Points. An ETH FDFr/EVC provides connectivity between the flow points in the fragment.
Actor(s)	NMS
Assumptions	The NMS has the authority to establish Ethernet FDFr/EVCs. NMS has already retrieved the ETH FD information.
Pre-Conditions	The NMS is aware of or able to retrieve the Bandwidth Profile instance names representing the Ethernet Bandwidth Profiles for this connection. Communication between NMS and EMS is available.
Begins When	The NMS sends a request to provision an edge-to-edge FDFr/EVC across a flow domain between two or more than two FPPs. The NMS has selected the FPPs where the FDFr/EVC terminates and is ready to configure FDFr/EVC parameters.
Description	The NMS needs to provision a Flow Domain Fragment Ethernet Virtual Connection representing the edge-to-edge service across an Ethernet Flow Domain. During FDFr/EVC establishment, the NMS configures the parameters of the FDFr/EVC. After determining that there are sufficient resources to fulfil the request, the EMS creates the FDFr/EVC and associated Flow Points. The EMS also establishes relationships for the newly created FDFr/EVC and Flow Points. For provisioning a FDFr/EVC, the NMS provides the following as part of the provisioning request: – Network connectivity – Link type – VLAN ID List – ETH FPP List: This parameter indicates the ETH FPPs mapping to the new ETH FDFr/EVC. For point-to-point FDFr/EVC, it includes A-End ETH FPP (UNI) and Z-End ETH_FPP (UNI). – Trail Endpoint Indicators – Layer2 Control Protocol Disposition List – Unicast Service Frame Delivery – Multicast Service Frame Delivery – Broadcast Service Frame Delivery – User Label – Administrative State – ETH CoS Performance Mapping List – UNI CE-VLAN Id Preservation Indicator – UNI CE-VLAN CoS Preservation Indicator – FDFr/EVC Protection Indicator (optional) – Routing Profile (optional): This parameter indicates the routing restriction information. It is a list of ETH FPPs that are included or excluded in the route.
Ends When	1) EMS returns the creation response to NMS 2) Exception happens

Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	A new instance of ETH Flow Domain Fragment and associated ETH Flow Points are created. And corresponding creation notification is sent to NMS registered for this notification.

6.2.2.4.1.3 ETH FDFr/EVC Release

Name	ETH FDFr/EVC Release
Summary	The NMS releases (deletes) a Flow Domain Fragment Ethernet Virtual Connection representing the edge-to-edge service across an Ethernet Flow Domain. During FDFr/EVC release, the EMS deletes the FDFr/EVC and associated Flow Points.
Actor(s)	NMS
Assumptions	The NMS has the authority to release Ethernet FDFr/EVCs. The NMS has already retrieved or created ETH FDFr/EVC.
Pre-Conditions	Communication between NMS and EMS is available.
Begins When	The NMS sends a request to release a FDFr/EVC across a flow domain. The NMS has selected the FDFr/EVC to be released and is ready to release the FDFr/EVC.
Description	The NMS needs to release a Flow Domain Fragment Ethernet Virtual Connection representing the edge-to-edge service across an Ethernet Flow Domain. The EMS deletes the FDFr/EVC and associated Flow Points.
Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) undeletableObjectList
Post-Conditions	The ETH Flow Domain Fragment and associated ETH Flow Points are deleted, and associated resources are made available.

6.2.2.4.1.4 Suspend and Resume ETH FDFr/EVC

Name	Suspend and Resume ETH FDFr/EVC
Summary	The NMS resumes or temporarily suspends an ETH FDFr/EVC.
Actor(s)	NMS
Assumptions	The NMS has the authority to update the ETH FDFr/EVC instance.
Pre-Conditions	The NMS is aware of or able to retrieve the names or identifiers for the ETH FDFr/EVC instance to be resumed or suspended. Communication between NMS and EMS is available.
Begins When	The NMS sends a request to resume or temporarily suspend an ETH FDFr/EVC.
Description	The NMS needs to resume or temporarily suspend a specific ETH FDFr/EVC. As part of the resume/suspend request, the NMS requests that the Administrative State of a specific ETH FDFr/EVC be set to either locked (suspended) or unlocked (resumed). Based on the resume/suspend request, the EMS updates the Administrative State of the identified ETH FDFr/EVC. In addition, a State Change Notification for the ETH FDFr/EVC is autonomously sent from the EMS and received by the NMS.

Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) Invalid Parameter 3) EMS Processing Error
Post-Conditions	The ETH FDFr/EVC is resumed or suspended.

6.2.2.4.1.5 Modify ETH FDFr/EVC

Name	Modify ETH FDFr/ EVC
Summary	The NMS requests to modify attributes of ETH FDFr/EVC.
Actor(s)	NMS
Assumptions	The NMS has already retrieved or created the ETH FDFr/EVC instance.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH FDFr/EVC to be modified.
Begins When	The NMS sends a request to EMS to modify ETH FDFr/EVC attributes.
Description	1) NMS sends a request to EMS to modify attribute(s) of a specific ETH FDFr/EVC. 2) EMS modifies relevant attribute(s) of the ETH FDFr/EVC. 3) EMS forwards AVC Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) Attribute is read-only 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	The relevant attribute(s) of the ETH FDFr/EVC is updated.

6.2.2.4.1.6 Retrieve ETH FDFr/EVC

Name	Retrieve ETH FDFr/EVC
Summary	NMS requests to retrieve attributes of a specific ETH FDFr/EVC from EMS, or request discovery of instances and attributes of all Ethernet Flow Domain Fragments within a specific Flow Domain managed by the EMS. In addition, the NMS retrieves all attributes of the ETH Flow Points that terminate each Ethernet FDFr/EVC.
Actor(s)	NMS
Assumptions	The NMS has the authority to retrieve the Ethernet Flow Domain Fragment and Ethernet Flow Point information. And NMS has already retrieved the ETH Flow Domain information.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends EMS a query of one specific or all ETH FDFrs/EVCs in an ETH FD.

Description	1) The NMS requests retrieval of the attributes of a specific Ethernet FDFr/EVC, or the name or identifier for all instances of the Ethernet FDFr/EVC object class that are contained in a specific Flow Domain. 2) The EMS returns the attributes of the specific ETH FDFr/EVC or a list of identifiers for all Ethernet Flow Domain Fragments within the specified Flow Domain. 3) NMS receives the attributes, or the list of ETH FDFr identifiers which can be used to query the corresponding attributes for the list of Ethernet FDFr/EVCs. Attributes of ETH FDFr/EVC include: – ETH FDFr/EVC ID (GET): This attribute represents a unique value for the ETH FDFr. – User Label (GET, REPLACE): A text string that may be used to describe the object or provide additional information. – Network connectivity (GET): This attribute indicates the connectivity between Ethernet FPs in the ETH FDFr/EVC. There are three options: pt-pt, mp-mp, pt-mp. (see [ITU-T G.8011]) – Link type (GET): This attribute indicates the characteristics of the link provided by the server layer that is used to transport the Ethernet service. There are two options: Dedicated and shared. – ETH FP List (GET): This attribute indicates the ETH FPs contained in the ETH FDFr/EVC. – Ingress VLAN ID Preservation (GET): This attribute indicates whether the VLAN ID will be the same on ingress and egress to the FDFr/EVC. The options are: Yes or no. – Ingress CoS Preservation (GET): This attribute indicates whether the class of service (priority) of the ETH_CI will be the same on ingress and egress to the FDFr/EVC. The options are: Yes or no. – ETH CoS Performance Mapping List (GET, REPLACE, ADD, REMOVE): This attribute indicates the performance profiles for specified ETH services at the ETH_FDFr_EVC. It is a list of the sequence (ETHServiceClassProfileID, ETHPerformanceProfileID), where ETHServiceClassProfileID may be null which represents all kinds of CoS. – mtuSize (GET, REPLACE): This attribute describes the maximum transmission unit size for the FDFr/EVC. – Administrative State – Operational State – Availability Status 4) For each ETH FDFr, the NMS requests retrieval of all attributes for each ETH Flow Point that terminates the ETH FDFr/EVC.
Ends When	1) EMS returns the ETH FDFr/EVC information to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ETH FDFr/EVC information when the query succeeds. The NMS has discovered one or all Ethernet FDFr/EVCs within a specific Flow Domain managed by the EMS. The NMS has current values for the attributes for the Ethernet FDFr/EVC instance, and for each Ethernet Flow Point instance that terminates an Ethernet Flow Domain Fragment.

6.2.2.4.1.7 Add FPs To Multipoint ETH FDFr/EVC

Name	Add FPs To ETH FDFr/EVC
Summary	NMS requests to add FPs to an existing multipoint ETH FDFr/EVC by mapping FPPs to the ETH FDFr/EVC with corresponding VLAN IDs.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH FDFr/EVC.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH FDFr/EVC for action. 3) NMS knows the object of ETH FPP to be mapped to the ETH FDFr/EVC.
Begins When	NMS sends an action request to EMS to map ETH FPPs to a specific ETH FDFr/EVC.
Description	1) NMS sends an action request to EMS to map ETH FPPs to a specific ETH FDFr/EVC. Input parameters are ETH FDFr/EVC ID and ETH FPP List. 2) EMS creates new ETH FPs in the ETH FDFr/EVC and modifies the corresponding ETH FP List attribute of the ETH FDFr/EVC. 3) EMS forwards AVC Notification of the ETH FDFr/EVC and creation Notifications of new ETH FPs to all registered NMSs. 4) EMS responds with new created ETH FP ID list. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH FDFr/EVC 2) Unknown ETH FPP 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	If use case is successful, new ETH FPs are created and ETH FDFr/EVC attribute is modified, and the corresponding AVC and creation Notifications are sent to the NMS registered for this notification.

6.2.2.4.1.8 Remove FPs From Multipoint ETH FDFr/EVC

Name	Remove FPs From Multipoint ETH FDFr/EVC
Summary	NMS requests to remove FPs from a multipoint ETH FDFr/EVC.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH FDFr/EVC.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH FDFr/EVC for action.
Begins When	NMS sends an action request to EMS to remove ETH FPs from a specific ETH FDFr/EVC.

Description	1) NMS sends an action request to EMS to remove ETH FPs from a specific ETH FDFr/EVC. Input parameters are ETH FDFr/EVC ID and ETH FP List. 2) EMS deletes the ETH FPs in the ETH FDFr/EVC and modifies the corresponding ETH FP List attribute of the ETH FDFr/EVC. 3) EMS forwards AVC Notification of the ETH FDFr/EVC and deletion Notifications of ETH FPs to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH FDFr/EVC 2) Unknown ETH FP 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	If use case is successful, relevant ETH FPs are deleted and ETH FDFr/EVC attribute is modified, and the corresponding AVC and deletion Notifications are sent to the NMS registered for this notification.

6.2.2.4.2 ETH FP Management

The use case diagram for ETH FP Management is shown in Figure 6-11.

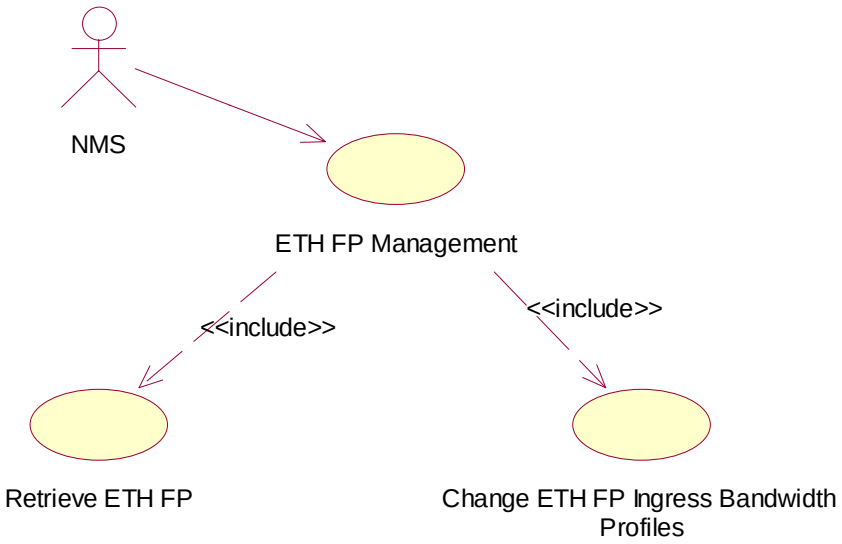

Figure 6-11 – ETH FP management

6.2.2.4.2.1 Retrieve ETH FP

Name	Retrieve ETH FP
Summary	NMS requests to retrieve ETH FP from EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH FDFr/EVC.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a query of ETH FPs in an ETH FDFr/EVC or a query of specific ETH FP to EMS.

Description	1) NMS sends a query of ETH FPs in an ETH FDFr/EVC or a query of specific ETH FP to EMS. 2) EMS returns the ETH FPs with the following attributes: – FP ID (GET): This attribute represents a unique value for the ETH flow point. – FDFr/EVC Pointer (GET): This attribute identifies the ETH FDFr/EVC containing the ETH FP. – Ingress CoS Bandwidth Mapping List (GET, REPLACE, ADD, REMOVE): This attribute indicates the ingress bandwidth profiles for specified ETH services at the ETH FP in the ingress direction (single, or one per CoS). It is a list of the sequence (ETHServiceClassProfileID, ETHBandwidthProfileID), where ETHServiceClassProfileID may be null which represents all kinds of CoS. The Ingress BandwidthProfile List associated with the FP will overwrite that associated with the related FPP. – Egress CoS Bandwidth Mapping List (GET, REPLACE, ADD, REMOVE): This attribute indicates the egress bandwidth profiles for specified ETH services at the ETH FP in the egress direction (single, or one per CoS). It is a list of the sequence (ETHServiceClassProfileID, ETHBandwidthProfileID), where ETHServiceClassProfileID may be null which represents all kinds of CoS. The egress BandwidthProfile List associated with the FP will overwrite that associated with the related FPP. – ETH FPP Pointer (GET): This attribute identifies the ETH FPP which the ETH FP is mapped to. – VLAN ID List (GET, REPLACE, ADD, REMOVE): This attribute indicates the VLAN IDs mapped to the ETH FP. – FDFr/EVC Id – Layer 2 Control Protocol Disposition List (GET, REPLACE, ADD, REMOVE): This attribute provides a list that describes Layer 2 control protocols, along with the frame disposition. – Unicast/Multicast/Broadcast Service Frame Delivery (GET, REPLACE): Describes the service frame delivery option for Unicast/Multicast/Broadcast Service Frames as: Discard, DeliveryUnconditionally, or DeliveryConditionally. – Trail Terminating Indicator (GET, SET-BY-CREATE): Indicates if frame flow terminates at this FP. – Administrative State (GET, REPLACE) – Operational State (GET) – Availability Status (GET) – Alarm Status (GET) – Current Problem List (GET) 3) NMS receives the response from EMS.
Ends When	1) EMS returns the ETH FP attributes to NMS 2) Exception happens
Exceptions	1) Unknown ETH FP 2) Unknown ETH FDFr/EVC 3) EMS Processing Error 4) Invalid Parameter
Post-Conditions	NMS receives ETH FP attributes when the query succeeds.

6.2.2.4.2.2 Change Ethernet Flow Point Ingress Bandwidth Profiles

Name	Change Ethernet Flow Point Ingress Bandwidth Profiles
Summary	The NMS changes the bandwidth profile per CoS on a specific Ethernet Flow Point that terminates an ETH FDFr/EVC.
Actor(s)	NMS
Assumptions	The NMS has the authority to update the Ethernet Flow Point instance.
Pre-Conditions	The NMS has retrieved or is aware of the ETH Flow Point instance name and the ETH Flow Point exists. The NMS is aware of the instance names of the Bandwidth Profiles to be assigned. Communication between NMS and EMS is available.
Begins When	The NMS sends a request to revise the Bandwidth Profile on an Ethernet Flow Point due to a change order.
Description	The NMS needs to change the Bandwidth Profile or one Bandwidth Profile per CoS associated with a specific ETH Flow Point that terminates an ETH FDFr/EVC. As part of the Change Bandwidth Profile request, the NMS identifies a new Bandwidth Profile (or one Bandwidth Profile per CoS) to be associated with the ETH Flow Point. Based on the change request, the EMS determines if there are sufficient resources to fulfil the request and associates the instance of ETH Flow Point with the identified Bandwidth Profile(s). In addition, an Attribute Value Change Notification for the ETH Flow Point is autonomously sent from the EMS and received by the NMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown Managed Entity 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	The ETH Flow Point is associated with the identified Bandwidth Profile(s).

6.2.2.4.3 ETH Bandwidth Profile Management

Bandwidth profile defines traffic parameters that characterize the ETH_CI flow arrival pattern at the UNI or the NNI. For Ethernet, traffic parameters may include: Committed Information Rate (CIR), Committed Burst Size (CBS), Excess Information Rate (EIR), Excess Burst Size (EBS).

Multiple bandwidth profiles may be applied at the UNI. However, only a single type of bandwidth profile may be applied to a given Service Frame at the UNI.

EMS should support NMS to create, delete, query and modify an ETH Bandwidth Profile. Notifications shall be generated and sent to NMS on its creation, deletion and attribute value change.

Figure 6-12 shows the functions involved in the ETH Bandwidth Profile management function set.

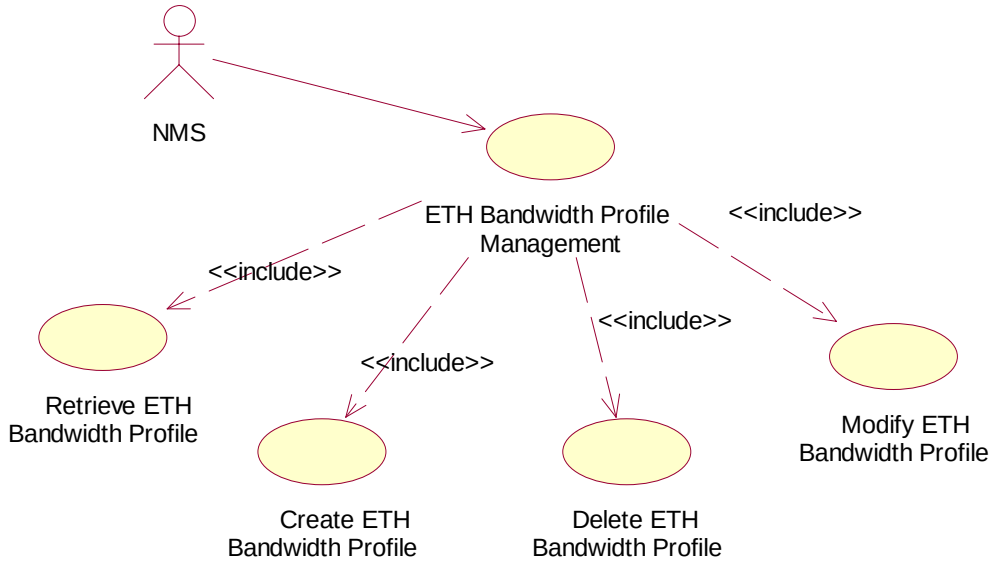

Figure 6-12 – ETH bandwidth profile management function set

6.2.2.4.3.1 Retrieve ETH Bandwidth Profile

Name	Retrieve ETH Bandwidth Profile
Summary	NMS requests to retrieve ETH Bandwidth Profile from EMS.
Actor(s)	NMS
Assumptions	EMS has the list of ETH Bandwidth Profile.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a query of one specific or all ETH Bandwidth Profile to EMS.
Description	1) NMS sends a query of one specific or all ETH Bandwidth Profile to EMS. 2) EMS returns the ETH Bandwidth Profile with the following attributes: – ETH Bandwidth Profile ID (GET) – CIR (GET, REPLACE): This attribute identifies the Committed Information Rate (CIR) in bits per second for one direction of ETH traffic. – CBS (GET, REPLACE): This attribute identifies the Committed Burst Size (CBS) in bytes for one direction of an ETH traffic. – EIR (GET, REPLACE): This attribute identifies the Excess Information Rate (EIR) in bits per second for one direction of ETH traffic. – EBS (GET, REPLACE): This attribute identifies the Excess Burst Size (EBS) in bytes for one direction of ETH traffic. – Color Mode (GET, SET-BY-CREATE): This attribute describes the color mode (CM) to be applied as "color-blind mode" or "color-aware mode". – Coupling Flag (GET, SET-BY-CREATE) (Optional): This attribute describes if yellow frames will be admitted if unused bandwidth is available. 3) NMS receives the response from EMS

Ends When	1) EMS returns the ETH Bandwidth Profile information to NMS 2) Exception happens
Exceptions	1) Unknown ETH Bandwidth Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ETH Bandwidth Profile information when the query succeeds.

6.2.2.4.3.2 Create ETH Bandwidth Profile

Name	Create ETH Bandwidth Profile
Summary	NMS requests creation of ETH Bandwidth Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has the authority to create ETH Bandwidth Profile for future bandwidth assignment.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS requests creation of ETH Bandwidth Profile to EMS.
Description	1) NMS sends EMS a request of creation of ETH Bandwidth Profile with parameters including CIR, CBS, EIR, EBS 2) EMS creates ETH Bandwidth Profile 3) EMS forwards Creation Notification to all registered NMS 4) EMS responds with new created ETH Bandwidth Profile ID 5) NMS receives the response from EMS
Ends When	1) EMS returns the creation response to NMS 2) Exception happens
Exceptions	1) EMS Processing Error 2) Invalid Parameter
Post-Conditions	If use case is successful, ETH Bandwidth Profile is created and corresponding creation notification is sent to the NMS registered for this notification.

6.2.2.4.3.3 Delete ETH Bandwidth Profile

Name	Delete ETH Bandwidth Profile
Summary	NMS requests deletion of ETH Bandwidth Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created ETH Bandwidth Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Bandwidth Profile to be deleted.
Begins When	NMS requests deletion of ETH Bandwidth Profile to EMS.
Description	1) NMS sends EMS a request of deletion of ETH Bandwidth Profile with a specific ETH Bandwidth Profile ID. 2) EMS deletes ETH Bandwidth Profile. 3) EMS forwards Deletion Notification to all registered NMS. 4) EMS responds with success indication. 5) NMS receives the response from EMS.

Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Bandwidth Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, the ETH Bandwidth Profile is deleted and the corresponding deletion notification is sent to the NMS registered for this notification.

6.2.2.4.3.4 Modify ETH Bandwidth Profile

Name	Modify ETH Bandwidth Profile
Summary	NMS requests to modify attributes of ETH Bandwidth Profile.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH Bandwidth Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Bandwidth Profile to be modified.
Begins When	NMS sends a request to EMS to modify ETH Bandwidth Profile attributes.
Description	1) NMS sends a request to EMS to modify CIR, CBS, EIR or EBS of a specific ETH Bandwidth Profile. 2) EMS modifies relevant attributes of ETH Bandwidth Profile. 3) EMS forwards AVC Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Bandwidth Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and the corresponding AVC is sent to the NMS registered for this notification.

6.2.2.4.4 ETH Service Class Profile Management

ETH Service Class Profile defines the way to classify ETH service and a definite service class.

Figure 6-13 shows the functions involved in the ETH Service Class Profile management function set.

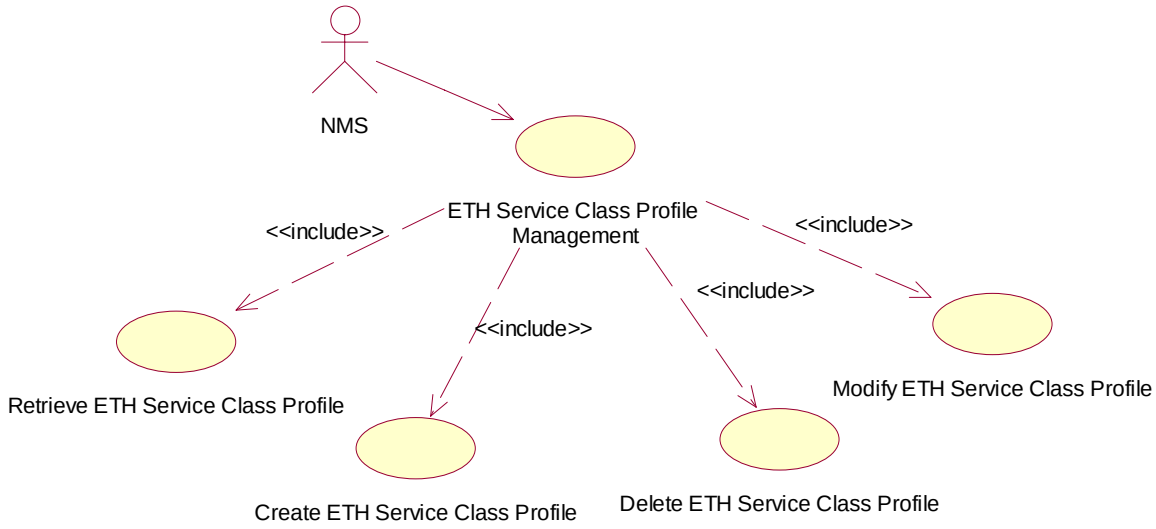

Figure 6-13 – ETH service class profile management function set

6.2.2.4.4.1 Retrieve ETH Service Class Profile

Name	Retrieve ETH Service Class Profile
Summary	NMS requests to retrieve ETH Service Class Profile from EMS.
Actor(s)	NMS
Assumptions	EMS has the list of ETH Service Class Profile.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a query of one specific or all ETH Service Class Profile to EMS.
Description	1) NMS sends a query of one specific or all ETH Service Class Profile to EMS. 2) EMS returns the ETH Service Class Profile with the following attributes: – ETH Service Class ID (GET) – Classify Type (GET, REPLACE): This attribute identifies the characteristic type on which ETH services are classified, such as VLAN ID, VLAN Priority (defined in [IEEE 802.1Q]), EVC, etc. – Classify Value (GET, REPLACE): This attribute lists the characteristic values corresponding to the above classify type to identify a specific service class. 3) NMS receives the response from EMS
Ends When	1) EMS returns the ETH Service Class Profile information to NMS 2) Exception happens
Exceptions	1) Unknown ETH Service Class Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ETH Service Class Profile information when the query succeeds.

6.2.2.4.4.2 Create ETH Service Class Profile

Name	Create ETH Service Class Profile
Summary	NMS requests creation of ETH Service Class Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has the authority to create ETH Service Class profile for future bandwidth assignment.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS requests creation of ETH Service Class Profile to EMS.
Description	1) NMS sends EMS a request of creation of ETH Service Class Profile with parameters including Classification Characteristic and Classification parameters. 2) EMS creates ETH Service Class Profile 3) EMS forwards Creation Notification to all registered NMS. 4) EMS responds with new created ETH Service Class Profile ID 5) NMS receives the response from EMS
Ends When	1) EMS returns the creation response to NMS 2) Exception happens
Exceptions	1) EMS Processing Error 2) Invalid Parameter
Post-Conditions	If use case is successful, ETH Service Class Profile is created and the corresponding creation notification is sent to NMS registered for this notification.

6.2.2.4.4.3 Delete ETH Service Class Profile

Name	Delete ETH Service Class Profile
Summary	NMS requests deletion of the ETH Service Class Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created ETH Service Class Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Service Class Profile to be deleted
Begins When	NMS requests deletion of ETH Service Class Profile to EMS.
Description	1) NMS sends EMS a request of deletion of ETH Service Class Profile with a specific ETH Service Class Profile ID. 2) EMS deletes ETH Service Class Profile. 3) EMS forwards Deletion Notification to all registered NMS. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Service Class Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, the ETH Service Class Profile is deleted and the corresponding deletion notification is sent to the NMS registered for this notification.

6.2.2.4.4.4 Modify ETH Service Class Profile

Name	Modify ETH Service Class Profile
Summary	NMS requests to modify attributes of ETH Service Class Profile.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH Service Class Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Service Class Profile to be modified.
Begins When	NMS sends a request to EMS to modify ETH Service Class Profile attributes.
Description	1) NMS sends a request to EMS to modify Classification Characteristic or Classification parameters of a specific ETH Service Class Profile. 2) EMS modifies relevant attributes of ETH Service Class Profile. 3) EMS forwards AVC Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Service Class Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and the corresponding AVC is sent to the NMS registered for this notification.

6.2.2.4.5 ETH Performance Profile Management

ETH Performance Profile specifies QoS or performances of a definite Class of Service.

Figure 6-14 shows the functions involved in the ETH Performance Profile management function set.

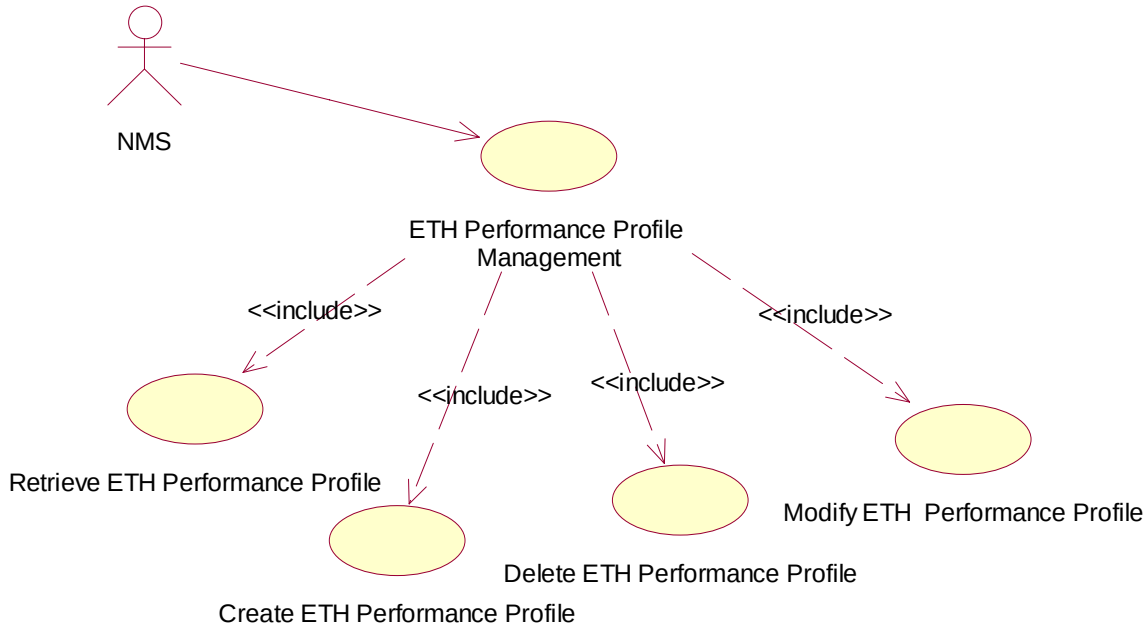

Figure 6-14 – ETH performance profile management function set

6.2.2.4.5.1 Retrieve ETH Performance Profile

Name	Retrieve ETH Performance Profile
Summary	NMS requests to retrieve ETH Performance Profile from EMS.
Actor(s)	NMS
Assumptions	EMS has the list of ETH Performance Profile.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS sends a query of one specific or all ETH Performance Profile to EMS.
Description	1) NMS sends a query of one specific or all ETH Performance Profile to EMS. 2) EMS returns the ETH Performance Profile with the following attributes: – ETH Performance Identifier: This attribute identifies the specific CoS Value described within this profile. – ETH CoS Frame Delay – ETH CoS Frame Delay Variation – ETH CoS Frame Loss Ratio – Availability (Optional): This attribute identifies the Availability objective for the EVC. 3) NMS receives the response from EMS
Ends When	1) EMS returns the ETH Performance Profile information to NMS 2) Exception happens
Exceptions	1) Unknown ETH Performance Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	NMS receives ETH Performance Profile information when the query succeeds.

6.2.2.4.5.2 Create ETH Performance Profile

Name	Create ETH Performance Profile
Summary	NMS requests creation of ETH Performance Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has the authority to create ETH Performance profile for future assignment.
Pre-Conditions	NMS has established communication with EMS.
Begins When	NMS requests creation of ETH Performance Profile to EMS.
Description	1) NMS sends EMS a request of creation of ETH Performance Profile with parameters including: – ETH Perf Identifier – ETH CoS Frame Delay – ETH CoS Frame Delay Variation – ETH CoS Frame Loss Ratio – Availability 2) EMS creates ETH Performance Profile 3) EMS forwards Creation Notification to all registered NMSs. 4) EMS responds with new created ETH Performance Profile ID. 5) NMS receives the response from EMS.

Ends When	1) EMS returns the creation response to NMS 2) Exception happens
Exceptions	1) EMS Processing Error 2) Invalid Parameter
Post-Conditions	If use case is successful, ETH Performance Profile is created and the corresponding creation notification is sent to NMS registered for this notification.

6.2.2.4.5.3 Delete ETH Performance Profile

Name	Delete ETH Performance Profile
Summary	NMS requests deletion of ETH Performance Profile on EMS.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created ETH Performance Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Performance Profile to be deleted
Begins When	NMS requests deletion of ETH Performance Profile to EMS.
Description	1) NMS sends EMS a request of deletion of ETH Performance Profile with a specific ETH Performance Profile ID. 2) EMS deletes ETH Performance Profile. 3) EMS forwards Deletion Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the deletion response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Performance Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, the ETH Performance Profile is deleted and the corresponding deletion notification is sent to the NMS registered for this notification.

6.2.2.4.5.4 Modify ETH Performance Profile

Name	Modify ETH Performance Profile
Summary	NMS requests to modify attributes of ETH Performance Profile.
Actor(s)	NMS
Assumptions	NMS has already retrieved or created the ETH Performance Profile.
Pre-Conditions	1) NMS has established communication with EMS. 2) NMS knows the object of ETH Performance Profile to be modified.
Begins When	NMS sends a request to EMS to modify ETH Performance Profile attributes.
Description	1) NMS sends a request to EMS to modify the following parameters of a specific ETH Performance Profile. – ETH CoS Frame Delay – ETH CoS Frame Delay Variation – ETH CoS Frame Loss Ratio

	2) EMS modifies relevant attributes of ETH Performance Profile. 3) EMS forwards AVC Notification to all registered NMSs. 4) EMS responds with success indication. 5) NMS receives the response from EMS.
Ends When	1) EMS returns the response to NMS 2) Exception happens
Exceptions	1) Unknown ETH Performance Profile 2) EMS Processing Error 3) Invalid Parameter
Post-Conditions	If use case is successful, attribute value from specific object is set and the corresponding AVC is sent to the NMS registered for this notification.

6.2.3 Fault Management Function Set

6.2.3.1 Overview

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

The Fault Management function set handles the detection and isolation of faults and the repair of failed components. A fault condition occurs when a resource fails to function correctly or when an excessive number of errors occur. In addition to the detection and reporting of failures, Fault Management assists in the isolation and diagnosing of faults. This may include performing tests, such as connectivity tests, integrity tests, response time tests, diagnostic tests, etc.

6.2.3.2 Ethernet Alarm Surveillance Function Set

Alarm surveillance provides the capability to monitor failures in near real time. This information, along with other information, allows the Network Management System to determine the nature and severity of the fault. The term 'alarm' actually refers to all types of fault events that are associated with a potential failure.

The communications alarm notification may include:

- Event Time
- Alarm Source (the object instance emitting the notification)
- Alarm Type
- Probable Cause
- Specific Problems (optional)
- Perceived Severity (Allowable values are: indeterminate, critical, major, minor, warning, or cleared)
- Backed Up Status ("True" if backed up) (optional)
- Back Up Object (Will be null if backedUpStatus is "false") (optional)
- Proposed Repair Actions (optional)
- Alarm Effect On Service (True if alarm is service effecting)
- Alarm Description

Alarm probable causes related to Ethernet include the threshold crossed alarms (TCA) of the following counters:

1) Frames Aborted Due to Excessive Collisions
2) Octets Received Bad

3) Octets Transmitted Bad
4) Collision Total Number
5) Alignment Errors
6) Frame Check Sequence Errors
7) Collision Number Within a Timeslot
8) Frames Transmitted Failed for Sequential Collision (over 16 times)
9) Frames Transmitted Delay
10) Carrier Collision Number

6.2.3.2.1 Receiving Ethernet Flow Point Related Alarms

Name	Receiving Ethernet Flow Point Related Alarms
Summary	A communications alarm notification is sent to the NMS whenever an alarm event is detected by the EMS or NE.
Actor(s)	NMS
Assumptions	The NMS has the authority to receive Ethernet Flow Point alarms.
Pre-Conditions	Communications between NMS and EMS is available.
Begins When	The EMS or NE has detected an alarm event.
Description	After the detection of an alarm event, the EMS generates and autonomously sends a communication alarm notification to the NMS. The NMS receives the alarm notification and associates it with the Flow Point instance identified as part of the notification. The Alarm Report described in clause 6.2.4.3.2 of [ITU-T Q.827.1] will be reused in this Recommendation.
Ends When	1) NMS receives the alarm notification 2) Exception happens
Exceptions	EMS Processing Error
Post-Conditions	The NMS receives new alarm information.

6.2.3.2.2 Retrieving Ethernet Flow Point Current Problem List

Summary: The NMS initiates this operation to resynchronize the current problem state of the Ethernet Flow Point instances with the EMS. Alarm Synchronization described in clause 6.2.3.5 is reused for this use case.

6.2.3.3 Configure Alarm Report Filter Function

This use case describes the procedure of the NMS setting alarm filter to EMS. Configure Alarm Report Filter Function uses the "Notification Dispatcher Management" function which is described in clause 6.2.1.2.2 of [ITU-T Q.827.1].

The filter can include the following contents or their combination:

- Alarm Sources (such as NE, SDH MS, TTP, FP);
- Perceived Severity;
- Alarm Type;
- Probable Cause;
- Event Time.

6.2.3.4 ASAP Management

The Specification Level Requirements for the ASAP Management are described in clause 6.2.4.2 of [ITU-T Q.827.1], which will be reused in this Recommendation.

6.2.3.5 Alarm Synchronization

Alarm Synchronization means NMS gets the current alarm summary of EMS according to filter. This action may be triggered manually or automatically. The Retrieve Current Alarm Summary service in ITU-T Rec. Q.821 can be used for this function.

6.2.4 Performance Management Function Set

The Specification Level Requirements for common parts of Performance Management are described in clause 6.2.3 of [ITU-T Q.827.1], which will be reused in this Recommendation.

Performance monitoring is the systematic assessment of a particular entity's ability to carry out its assigned function through the continuous collection and analysis of appropriate performance data. This clause describes the functionality needed on the EMS-NMS interface in support of the Metro Ethernet and EoT Performance Monitoring.

Performance Management Function set includes Performance Measurement Management, Performance Threshold Management and Query History Performance Data.

Measurement data is the main objective of all the other function sets in performance management.

Ethernet related performance information may be categorized in the following performance data sets:

– ETH UNI Anomalies Performance Data Set
  - Undersized Frames
  - Oversized Frames
  - Fragments
  - FCS and Alignment Errors
  - Invalid CE-VLAN ID
– ETH UNI Traffic Performance Data Set
  - Octets Transmitted OK
  - Unicast Frames Transmitted OK
  - Multicast Frames Transmitted OK
  - Broadcast Frames Transmitted OK
  - Octets Received OK
  - Unicast Frames Received OK
  - Multicast Frames Received OK
  - Broadcast Frames Received OK
– ETH Ingress Traffic Management Performance Data Set
  - ingressGreenFrameCount
  - ingressYellowFrameCount
  - ingressRedFrameCount
  - ingressGreenOctetCount
  - ingressYellowOctetCount
  - ingressRedOctetCount

– ETH Egress Traffic Management Performance Data Set
  - egressGreenFrameCount
  - egressYellowFrameCount
  - egressGreenOctetCount
  - egressYellowOctetCount
– ETH Congestion Discards Performance Data Set
  - greenFrameDiscards
  - yellowFrameDiscards
  - greenOctetDiscards
  - yellowOctetDiscards
– ETH ELMI Performance Data Set
  - sumofElmiReliabilityErrors
  - sumofElmiProtocolErrors
  - elmiNonrcptStatusAndStatusEnquiryCount
  - elmiInvalidSeqNumCount
  - elmiProtocolVersionCount
  - elmiTooShortCount
  - elmiMessageTypeErrorCount
  - elmiInfoElementErrorCount

7 Analysis

This clause provides the detailed analysis of the Metro Ethernet Service/EoT EMS-NMS management interface. In the following subclause, the related managed entities and their relationships are fully analysed, and the diagrams in these subclauses 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 modifier 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 Metro Ethernet/EoT management, their names are suffixed by 'E' and with the first letter capitalized. For the managed entities providing just the controlling functions and maybe reused in some other network technology-specific management, 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 clause 7.2.1.1 of [ITU-T Q.827.1].

7.3 Configuration Management Function Set

7.3.1 Managed Entities

7.3.1.1 Class Diagram of Configuration Management Entities

Figures 7-1, 7-2 and 7-3 are the inheritance diagram of the configuration management related entities in Ethernet Discovery Function Set and Metro Ethernet/EoT Service Activation Function Set.

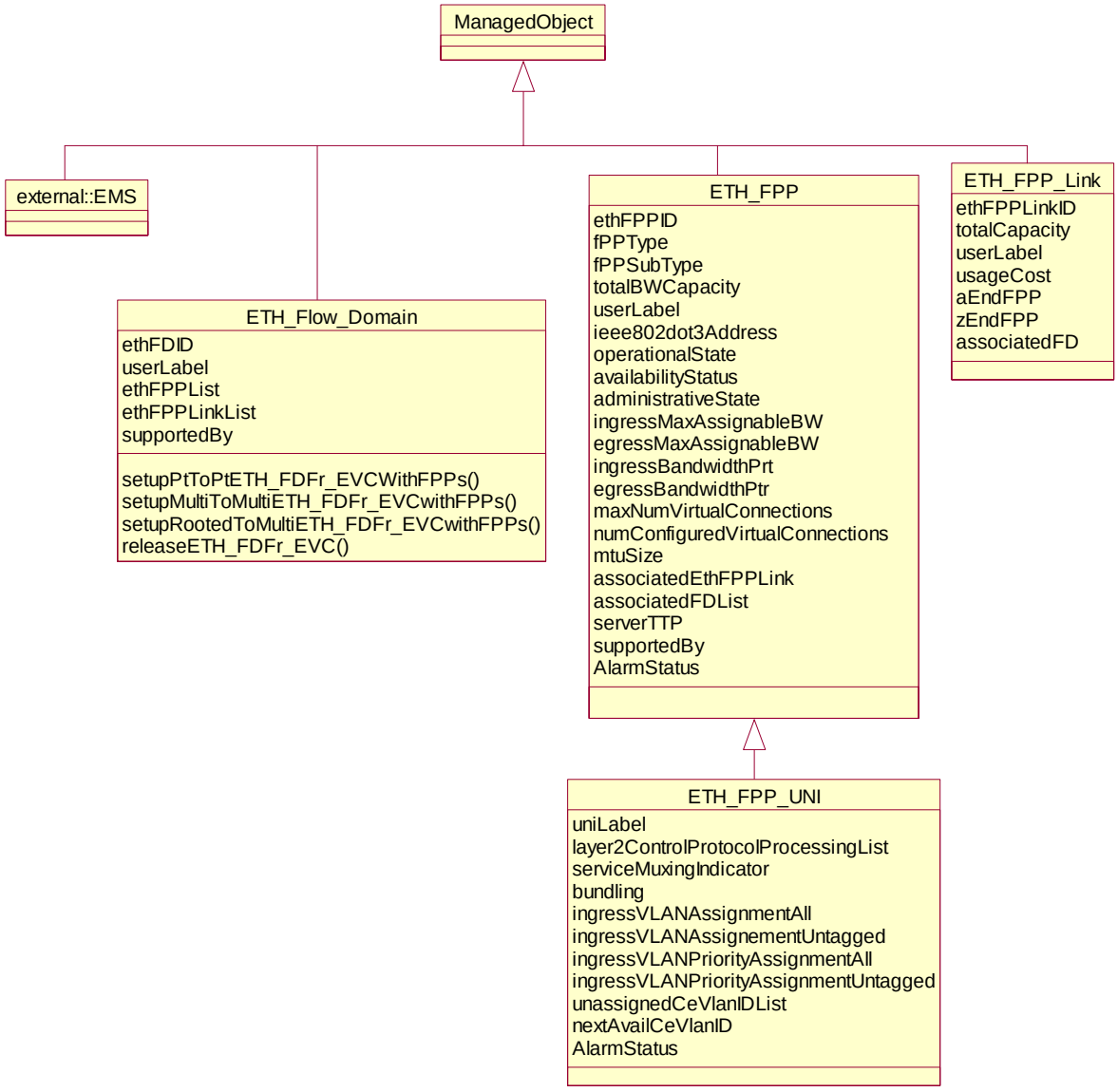

Figure 7-1 – Inheritance diagram of Ethernet managed entities: Topology view

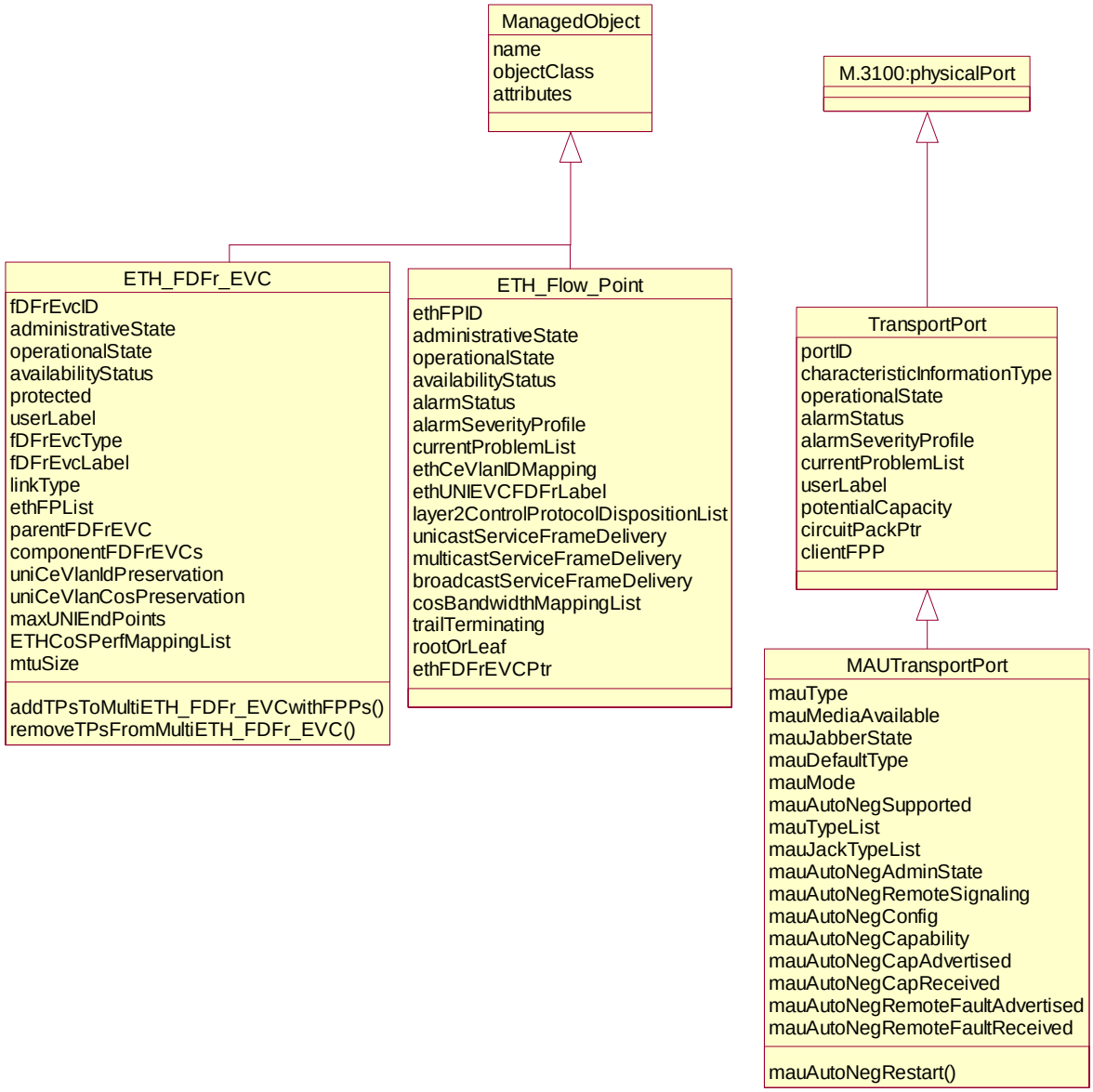

Figure 7-2 – Inheritance diagram of Ethernet managed entities: Connectivity view

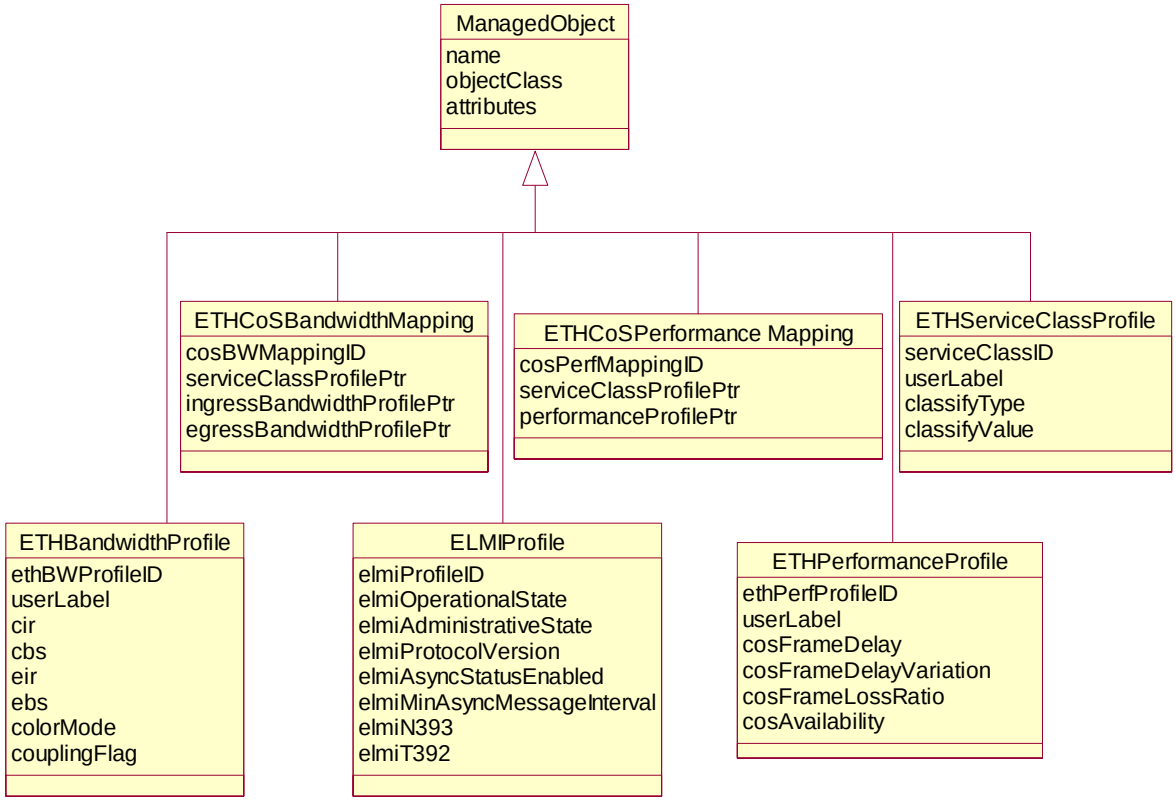

Figure 7-3 – Inheritance diagram of Ethernet managed entities: Reference data

Figures 7-4 and 7-5 show the relationship diagram (including containment) of configuration management entities supporting Metro Ethernet and EoT.

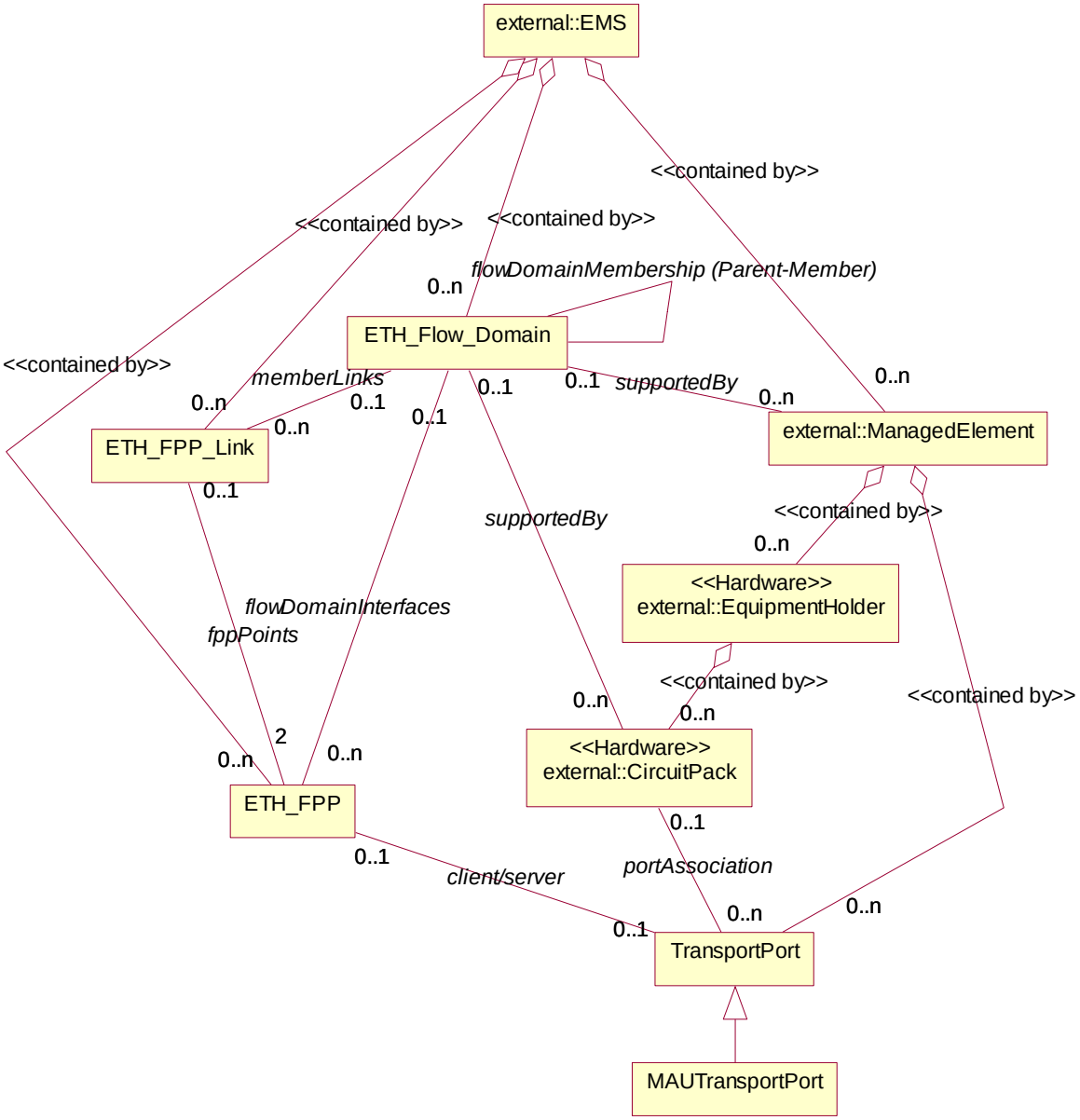

Figure 7-4 – Relationship diagram of Ethernet network view and equipment related

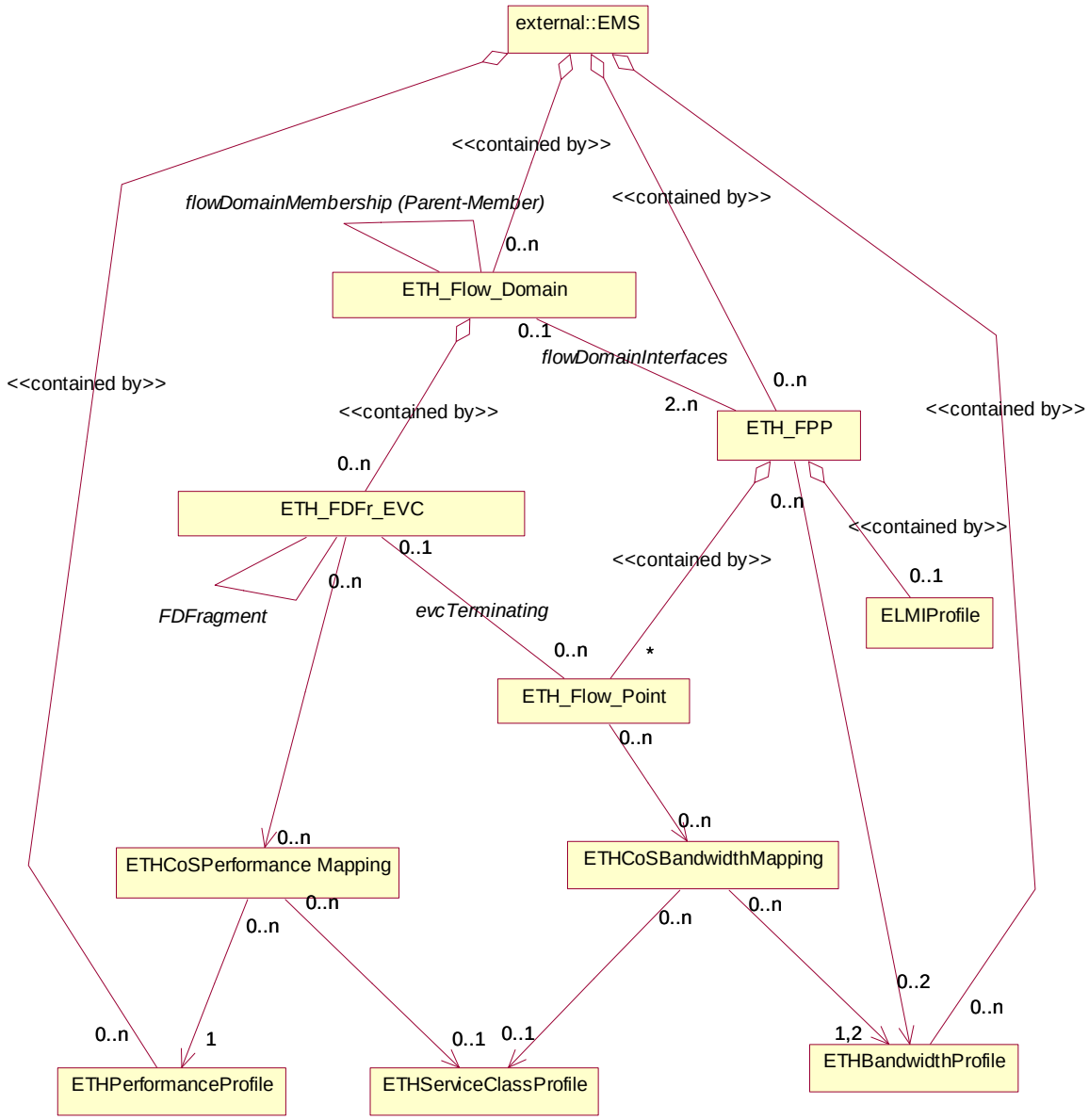

Figure 7-5 – Relationship diagram of Ethernet service configuration managed Entities

7.3.1.2 ETH_Flow_Domain

Behaviour:

An ETH_Flow_Domain (according to [ITU-T G.8010]) is defined by the set of ETH (termination) flow points that are available for the purpose of transferring information. ETH_CI traffic unit (ETH frame) transfers, across the ETH flow domain that corresponds to a particular association between ingress and egress ETH (termination) flow points, need not be present at all times. In general, ETH flow domains may be partitioned into smaller flow domains interconnected by ETH flow point pool links.

An ETH_Flow_Domain is delineated by ETH flow point pools (interfaces). ETH_Flow_Domains are used for making ETH_FDFr_EVCs and representing network topology. The bridge is a special case of an ETH_Flow_Domain that cannot be further partitioned.

Attributes			
Name	**Description**	**Type**	**Qualifier**
ethFDID	This attribute identifies the name of an ETH_Flow_Domain instance.	String[2]	M, R/S
userLabel	A text string that may be used to describe the ETH_Flow_Domain. For example, the managing organization may be described.	String	M, R/W
ethFPPList	The ETH_FPPs that delineate the ETH_Flow_Domain.	Set of Name[3]	M, R/W
ethFPPLinkList	ETH_FPP_Links within the ETH_Flow_Domain that connect ETH_Flow_Domains that are members of this parent ETH_Flow_Domain.	Set of Name	O, R/W
supportedBy	This attribute indicates the elements that support the ETH_Flow_Domain.	Set of Name	M, R/W
Operations/Methods:			
Name	**Description**		
setupPtToPtETH_FDFr_EVCWithFPPs	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain with endpoints coinciding with two interfaces (ETH_FPPs).		
setupMultiToMultiETH_FDFr_EVCwithFPPs	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain whose endpoints coincide with multiple interfaces (ETH_FPPs).		
setupRootedToMultiETH_FDFr_EVCwithFPPs	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain whose endpoints coincide with multiple interfaces (ETH_FPPs).		
releaseETH_FDFr_EVC	This method is used to delete a FDFr/EVC in the ETH_Flow_Domain. The input parameter for this method will be FDFr/EVC id. This method raises the following exceptions: Application Error.		

[2] This String represents the RDN (Relative Distinguished Name) of an ETH_Flow_Domain entity. Same for the other entity's ID attribute.

[3] The Name type is a DN (Distinghished Name). Same for the other parts of this Recommendation.

Relationships:

The ETH_Flow_Domain object is contained under EMS.

An ETH_Flow_Domain object may contain instances of:

- ETH_FDFr_EVC.

ETH_Flow_Domain is associated with:

- **SupportingElements**: ***SupportedBy*** – The elements that support the ETH_Flow_Domain (e.g., ManagedElements). (GET, REPLACE, ADD, REMOVE)
- **ETH_FPPs**: ***FlowDomainInterfaces*** – The ETH_FPPs that delineate the ETH_Flow_Domain. These ETH_FPPs, through the ETH_FPP_Link associated with the ETH_FPP, may connect the ETH_Flow_Domain to other ETH_Flow_Domains. (GET, REPLACE, ADD, REMOVE)
- **ETH_FPP_Links**: ***MemberLinks*** – ETH_FPP_Links within the ETH_Flow_Domain that connect ETH_Flow_Domains that are members of this parent ETH_Flow_Domain. (GET, REPLACE, ADD, REMOVE)
- **ETH_Flow_Domains**: ***FlowDomainMembership*** – An ETH_Flow_Domain may be partitioned into one or more ETH_Flow_Domains and may take one of two roles in this relationship. (The bridge is a special case of an ETH_Flow_Domain that cannot be further partitioned.):
  - Parent ETH_Flow_Domain – The container ETH_Flow_Domain. (GET, REPLACE)
  - Member ETH_Flow_Domains – Partitioned member ETH_Flow_Domains of the parent ETH_Flow_Domain. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.3 ETH_FPP (Flow Point Pool)

Behaviour:

An ETH_FPP consists of a subset of the ETH flow points at the edge of one ETH flow domain that are associated through the ETHLink with a corresponding subset of ETH flow points at the edge of another ETH flow domain or ETH access group for the purpose of transferring ETH characteristic information (ETH Frames). The ETH_FPP at the endpoint of an ETHLink represents the topological relationship and available capacity between a pair of ETH flow domains, or an ETH flow domain and an ETH access group.

This managed entity is used to represent the termination of an ETH Trunk Link or ETH Access Link at the Ethernet-layer. ETH_FPPs are managed entities that represent interfaces, MEF UNIs or EI-NNIs, at the ETH Layer. ETH_FPPs terminate ETHLinks for the purpose of representing topology. ETH_FPPs also contain ETH Flow Points of the ETH FDFr/EVC that are terminated on or traverse the interface. In the ETH layer, an ETH_FPP represents an Ethernet interface associated with an underlying transport (TRAN) facility (e.g., ETY, ATM, MPLS, SONET, etc.). The FPP provides the relationship between an ETH interface and TRAN trail. Note that instead of a transport trail, the ETHLink may represent an ETH Trunk instantiated by an ETH_FDFr_EVC.

Attributes

Name	Description	Type	Qualifier
ethFPPID	This attribute identifies the name of an ETH_FPP instance.	String	M, R/S
fPPType	Indicates that the ETH_FPP is a UNI, SNI, E-NNI, or Unconfigured. Type should be extensible to allow for future FPP types.	ENUM (UNI, SNI, E-NNI, Unconfigured)	M, R/W

fPPSubType	Indicates the detailed FPP sub-type. If the ETH FPP is a UNI, this attribute would be set to: "MEF UNI Type 1", "MEF UNI Type 2" or "MEF UNI Type 3" according to [MEF 11]. Type should be extensible to allow for future FPP sub-types.	String	O, R/W
totalBWCapacity	Total BW supported on the FPP, includes both assigned and unassigned bandwidth. Based on the amount of bandwidth provided by the underlying server layer link.	Integer (Units: bits per second)	O, R
userLabel	A text string that may be used to provide additional information about the ETH_FPP, such as a circuit identifier.	String	M, R/W
ieee802dot3Address	The [IEEE 802.3] address which is placed in the source-address field of any non FDFr/EVC specific Ethernet frames that originate at this interface. This address should be the one most likely to be of use to network management. Based on [IETF RFC 3635] and [IETF RFC 2863] ifPhysAddress.	String	M, R/W
operationalState	The operational state attribute is read-only and indicates the current capability of the ETH_FPP to provide service. Based on [IETF RFC 3635] and [IETF RFC 2863] ifOperStatus. Values for operational state include: disabled, enabled.	ENUM (disabled, enabled)	M, R
availabilityStatus	The availability status attribute is read-only and indicates that the ETH_FPP is functioning properly. May be mapped to [IETF RFC 3635] and [IETF RFC 2863] ifOperStatus. Values for availability status include: inTest, failed, powerOff, degraded, notInstalled.	ENUM (test, failed, powerOff, degraded, notInstalled)	M, R
administrativeState	This attribute denotes the administrative state of the ETH_FPP. This is a read/write attribute. The values supported are Locked or Unlocked. In the Locked state, frame flow through the ETH_FPP is prohibited.	ENUM (locked, unlocked)	M, R/W
ingressMaxAssignable BW	This read-only attribute identifies the maximum amount of bandwidth assignable on the link in the Ingress direction (inbound or towards the ETH FE). The current operational speed of the interface is in bits per second. Based on [IETF RFC 3635] and [IETF RFC 2863] ifSpeed.	Integer (Units: bits per second)	M, R
egressMaxAssignable BW	This read-only attribute identifies the maximum amount of bandwidth assignable on the link in the Egress direction (outbound or away from the ETH FE). The current operational speed of the interface is in bits per second. Based on [IETF RFC 3635] and [IETF RFC 2863] ifSpeed.	Integer (Units: bits per second)	M, R

ingressMaxAssignable CoSBW	Per CoS Maximum amount of assignable bandwidth on the interface in the Ingress direction.	Set of AssignableCoSBWType. (see 7.3.3)	O, R
egressMaxAssignable CoSBW	Per CoS Maximum amount of assignable bandwidth on the interface in the Egress direction.	Set of AssignableCoSBWType. (see 7.3.3)	O, R
ingressBandwidthPtr	This attribute indicates the ingress bandwidth profile for all ETH services at the ETH FPP in the ingress direction.	Name	O, R/W
egressBandwidthPtr	This attribute indicates the egress bandwidth profile for all ETH services at the ETH FPP in the egress direction.	Name	O, R/W
maxNumVirtual Connections	This attribute describes the maximum number of virtual connections (FDFrs/EVCs) that may be supported at the ETH_FPP.	Integer	O, R/W
numConfiguredVirtual Connections	This attribute identifies the number of currently configured virtual connections (FDFrs/EVCs) at the ETH_FPP.	Integer	O, R
mtuSize	This attribute describes the maximum transmission unit size for the ETH_FPP	Integer ≥ 1522	M, R/W
associatedEthFPP_Link	Indicates the ETH_FPP_Link that is terminated by the ETH_FPP.	Name	O, R/W
associatedFDList	Indicates the ETH_Flow_Domains associated with the ETH_FPP.	Set of Name	M, R/W
serverTTP	Indicates the supporting TRANS layer TTP (e.g., TransportPort).	Name	M, R/W
supportedBy	This attribute indicates the element (e.g., CircuitPack or ManagedElement) that supports the ETH_FPP.	Name	M, R/W
AlarmStatus	The alarm status attribute is read-only and indicates the occurrence of an abnormal condition. Values for alarm status include: critical, major, minor, indeterminate, warning, pending and cleared.	ENUM (critical, major, minor, indeterminate, warning, pending, cleared)	M, R
asapPtr	The alarm severity assignment profile associated with the ETH_FPP to assign alarm severity to specific alarms.	Name	M, R/W
currentProblemList	Identifies the current existing problems (probable cause), with severity, associated with the ETH_FPP.	Set of Current ProblemType	M, R

Relationships:

The ETH_FPP object is contained under EMS.

An ETH_FPP object may contain instances of:

- ETH_Flow_Point (that terminates an ETH_FDFr_EVC segment at the ETH_FPP)
- ELMI Profile (conditionally required if the FPP supports ELMI)

ETH_FPP is associated with: • **SupportingElements**: ***SupportedBy*** – The elements that support the ETH_FPP (e.g., CircuitPack). (GET, REPLACE, ADD, REMOVE) • **ETH_FPP_Link**: ***FPPpoints*** – ETH_FPP_Link that is terminated by the ETH_FPP (optionally retrievable from the ETH_FPP). (GET) • ***ServerTTP***: ***Client/Server or EthTunnelling*** – The relationship between the ETH_FPP and the supporting TRAN (could be ETH layer TTP for tunnelling, a TransportPort, etc.) layer termination point. (GET, REPLACE) • **ETH_Flow_Domains**: ***FlowDomainInterfaces*** – The ETH_FPP is one of the ETH_FPPs that delineate the associated ETH_Flow_Domains (a single ETH_FPP_UNI may act as an interface of multiple ETH_Flow_Domains, e.g., both the parent ETH_Flow_Domain and a member ETH_Flow_Domain). (GET, REPLACE, ADD, REMOVE) • **ETHBandwidthProfile**: ***IngressBwCharacterization*** – The ingress bandwidth profile for all service frames at the ETH_FPP in the ingress direction. (GET, REPLACE) • **ETHBandwidthProfile**: ***EgressBwCharacterization*** – The egress bandwidth profile for all service frames at the ETH_FPP in the egress direction. (GET, REPLACE)

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
comminicationsAlarm	M

7.3.1.4 ETH_FPP_UNI

Behaviour: This managed entity is used to represent the ETH_FPP_UNIs that provide MEN/EoT UNI functionality. The ETH_FPP_UNI is a subclass of the general ETH_FPP class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
uniLabel	Describes the UNI within the scope of the service provider domain. The UNI Label attribute is a value that is assigned to the UNI by the Service Provider. It MAY have any string as a value.	String	M, R/W
layer2Control ProtocolProcessing List	A list of the possible Layer 2 Control protocols processed at this UNI interface. Each entry in this list shall describe the control protocol and provide the corresponding destination MAC address along with the processing alternative (Discard, Peer, Pass-to-FDFr/EVC, Peer & Pass-to-FDFr/EVC) – if pass to FDFr/EVC or Peer&Pass is selected, FDFr/EVC shall be identified. Layer 2 Control Protocols include: • [IEEE 802.3] MAC Control Frames (Pause) • Slow Protocols (e.g., LACP) • [IEEE 802.1X] Port Authentication • Generic Attribute Registration Protocol (GARP) • Spanning Tree Protocol (STP) • A protocol to multicast to all bridges in a bridged LAN	Set of CtrlProtocol ProcType (see 7.3.3)	M, R/W

serviceMuxing Indicator	Describes if service multiplexing is enabled at the ETH UNI. Service multiplexing allows incoming frames to be mapped to multiple EVCs based on CE VLAN ID. Must be set to FALSE if allToOneIndicator is set to TRUE.	Boolean	M, R/W
bundling	There are three bundling options: yes, no and all-to-one. See [ITU-T G.8011].	ENUM (yes, no, all-to-one)	M, R/W
ingressVLAN AssignmentAll	This attribute identifies the VLAN-ID assigned to all ingress traffic.	Integer (Range: 1 to 4094)	O, R/W
ingressVLAN AssignmentUntagged	Applicable only to untagged traffic. This one and the above ingressVLANAssignmentAll are optional. They cannot be valid in the same time.	Integer (Range: 1 to 4094)	O, R/W
ingressVLAN PriorityAssignment All	This attribute identifies the VLAN Priority assigned to all ingress traffic.	Integer (Range: 0 to 7)	O, R/W
ingressVLAN PriorityAssignment Untagged	Applicable only to untagged traffic. This one and the above ingressVLANPriorityAssignmentAll are optional. They cannot be valid in the same time.	Integer (Range: 0 to 7)	O, R/W
unassignedCeVlan IDList	The unassignedCeVlanIDList attribute is an optional attribute that represents a list of unique values that are available for assignment as the Customer Edge VLAN ID (CE-VLAN ID) when creating new EVCs. Note that the ethCeVlanIDList attribute of the ETH_Flow_Point object provides the CE-VLAN-IDs within the containing UNI that are assigned or mapped to a specific EVC.	Set of Integer	O, R
nextAvailCeVlanID	Next available unassigned CE-VLAN ID	Integer	O, R

Relationships:

The ETH_FPP_UNI object is contained under EMS.

An ETH_FPP_UNI object may contain instances of:

- ETH_Flow_Point (that terminates an ETH_FDFr_EVC at the ETH_FPP_UNI)
- ELMIProfile (conditionally required if the FPP_UNI supports ELMI)

Associations inherited from ETH_FPP:

- **SupportingElements**: ***SupportedBy*** – The elements that support the ETH_FPP_UNI (e.g., CircuitPack). (GET, REPLACE, ADD, REMOVE)
- **ETH_FPP_Link**: ***FPPpoints*** – ETH_FPP_Link that is terminated by the ETH_FPP_UNI (optionally retrievable from the ETH_FPP_UNI). (GET)
- **ServerTTP**: ***Client/Server or EthTunnelling*** – The relationship between the ETH_FPP_UNI and the supporting TRAN (could be ETH layer Flow Point for tunnelling, a TransportPort, etc.) layer termination point. (GET, REPLACE)
- **ETH_Flow_Domains**: ***FlowDomainInterfaces*** – The ETH_FPP_UNI is one of the ETH_FPP_UNIs that delineate the associated ETH_Flow_Domains (a single ETH_FPP_UNI may act as an interface of multiple ETH_Flow_Domains, e.g., both the parent ETH_Flow_Domain and a member ETH_Flow_Domain). (GET, REPLACE, ADD, REMOVE)
- **ETHBandwidthProfile**: ***IngressBwCharacterization*** – The ingress bandwidth profile for all service frames at the ETH_FPP_UNI in the ingress direction. (GET, REPLACE, ADD, REMOVE)
- **ETHBandwidthProfile**: ***EgressBwCharacterization*** – The egress bandwidth profile for all service frames at the ETH_FPP_UNI in the egress direction. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O

7.3.1.5 ETH_FPP_Link

Behaviour:

The ETH_FPP_Link represents the topological relationship and available capacity between two ETH_Flow_Domains. An ETH Link is terminated by two ETH_FPPs, one in each of the adjacent ETH_Flow_Domains. An ETH Link may be an ETH Access Link or an ETH Trunk Link. There can be multiple topological links between ETH_Flow_Domains.

Attributes

Name	**Description**	**Type**	**Qualifier**
ethFPPLinkID	This attribute identifies the name of an ETH_FPP_Link instance.	String	M, R/S
totalCapacity	Describes the inherent bandwidth capacity of the link in both the a-to-z and z-to-a direction.	Integer (Units: bits per second)	M, R
userLabel	A text string that may be used to provide additional information about the ETH_FPP_Link, such as a circuit identifier.	String	M, R/W
usageCost	An optional attribute that describes the usage cost allocated to the ETH_FPP_Link.	Integer	O, R/W
aEndFPP	A-End FPP that terminates the ETH_FPP_Link.	Name	M, R
zEndFPP	Z-End FPP that terminates the ETH_FPP_Link.	Name	M, R
associatedFD	The ETH_Flow_Domain that is associated with the ETH_FPP_Link.	Name	O, R/W

Relationships:

The ETH_FPP_Link object is contained under EMS.

ETH_FPP_Link is associated with:

- **ETH_FPP**: ***FPPpoints*** – ETH_FPP_Link that is terminated by exactly two ETH_FPPs. The instance of ETH_FPP may take one of two roles in this relationship:
  - A-End ETH_FPP (GET, SET-BY-CREATE)
  - Z-End ETH_FPP (GET, SET-BY-CREATE)
- **ETH_Flow_Domains**: ***MemberLinks*** – The ETH_FPP_Link is a component of an ETH_Flow_Domain. Within an ETH_Flow_Domain and through the associated ETH_FPPs, the ETH_FPP_Link connects two ETH_Flow_Domains. (Optionally retrievable from the ETH_FPP_Link.) (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.6 ETH_FDFr_EVC

Behaviour:

This managed entity represents an ETH Flow Domain Fragment (FDFr) that instantiates an EVC, i.e., a transport entity which transfers information across an ETH_Flow_Domain. It is formed by the association (and mappings) of ETH_Flow_Points at the boundary of the ETH_Flow_Domain.

An ETH_FDFr_EVC in a composite ETH_Flow_Domain may consist of a series of component ETH_FDFr_EVCs. An ETH_FDFr_EVC cannot be created between a composite ETH_Flow_Domain and one of its member ETH_Flow_Domains.

The ETH_FDFr_EVC associates the ETH_Flow_Points identified in the A end of the EvcTerminating relationship and the ETH_Flow_Points listed in the Z end of the EvcTerminating relationship. For rooted multipoint connections, multiple A end (roots) ETH_Flow_Points may be associated with the ETH_FDFr_EVC.

Attributes

Name	Description	Type	Qualifier
fDFrEvcID	This attribute identifies the name of an ETH_FDFr_EVC instance.	String	M, R/S
administrativeState	This attribute denotes the administrative state of the ETH_FDFr_EVC. This is a read/write attribute. The values supported are Locked or Unlocked. In the Locked state, frame flow through the ETH_FDFr_EVC is prohibited.	ENUM (locked, unlocked)	M, R/W
operationalState	This attribute denotes the operational state of the ETH_FDFr_EVC as working "Enabled" or not-working "Disabled".	ENUM (enabled, disabled)	M, R
availabilityStatus	The availability status attribute is read-only and indicates that the ETH_FDFr_EVC is functioning properly. May be mapped to [IETF RFC 2863], The Interfaces Group MIB IfOperstatus. Values for availability status include: inTest, failed, powerOff, degraded, notInstalled.	ENUM (inTest, failed, powerOff, degraded, notInstalled)	M, R
protected	This attribute indicates if the ETH_FDFr_EVC is protected or not at the ETH layer.	Boolean	O, R/S
userLabel	A text string that may be used to provide additional information about the ETH_FDFr_EVC, such as a circuit identifier.	String	M, R/W
fDFrEvcType	Describes the ETH FDFr/EVC as: Connection_MultipointToMultipoint, Connection_PointToPoint, Connection RootedMultipoint	ENUM (mp2mp, p2p, rootedMp)	M, R/S
fDFrEvcLabel	This attribute represents a friendly name for the ETH Virtual Connection.	String	M, R/W
linkType	This attribute indicates the characteristics of the underlying server layer that is used to transport the FDFr/EVC. It describes the bandwidth competition that an Ethernet service instance will encounter within the network. There are two options: dedicated and shared. See [ITU-T G.8011].	ENUM (dedicated, shared)	O, R
ethFPList	Indicates the ETH_Flow_Points that terminate the ETH_FDFr_EVC.	Set of Name	M, R/W

uniCeVlanIdPreservation	This Boolean attribute identifies an EVC where the CE VLAN IDs of egress frames are always identical to the CE VLAN IDs of the corresponding ingress frames. An EVC with more than one CE-VLAN ID mapping to it MUST have the CE-VLAN ID Preservation Service Attribute and the list of CE-VLAN IDs mapped to the EVC MUST be the same at each UNI in the EVC.	Boolean	M, R/W
uniCeVlanCoSPreservation	This Boolean attribute identifies an EVC where the CE VLAN CoS user_priority bits of an egress frame is always identical to the CE VLAN CoS user_priority bits of the corresponding ingress frame.	Boolean	M, R/W
maxUNIEndPoints	This number represents the maximum number of UNI end points of the EVC. (Note this number is set to 2 for point-to-point EVCs.)	Integer ≥ 2	M, R/W
ETHCoSPerf MappingList	This attribute indicates the performance for specific ETH service at the ETH_FDFr_EVC.	Set of Name	O, R/W
mtuSize	This attribute describes the maximum transmission unit size for the EVC.	Integer ≥ 1522	M, R/W

Operations/Methods:

Name	Description
addTPsToMultiETH_FDFr_EVCwithFPPs	This method is used to add endpoints to a multipoint ETH FDFr/EVC across an ETH_Flow_Domain.
removeTPsFromMultiETH_FDFr_EVC	This method is used to remove endpoints from a multipoint ETH FDFr/EVC across an ETH_Flow_Domain.
NONE	

Relationships:

The ETH_FDFr_EVC object is contained under ETH_Flow_Domain.

ETH_FDFr_EVC is associated with:

- **ETH_Flow_Points**: ***EvcTerminating*** – The ETH_FDFr_EVC is terminated by two or more ETH_Flow_Points.
  - Terminating FP List (for multipoint connections, there are multiple terminating FlowPoints, only two for point-to-point connections; for rooted multipoint, the root and leaf ends are identified as an attribute on the flow points). (GET, SET-BY-CREATE, ADD, REMOVE)
- **ETH_FDFr_EVCs**: ***FD Fragment*** – An ETH_FDFr_EVC may be made up of component FD Fragments (ETH_FDFr_EVCs). An ETH_FDFr_EVC may play the following roles in this relationship:
  - Composite ETH_FDFr_EVC – The ETH_FDFr_EVC made up of Component ETH_FDFr_EVCs. (GET, SET-BY-CREATE)
  - Component ETH_FDFr_EVC – The ETH_FDFr_EVCs of the Composite ETH_FDFr_EVC. (GET, SET-BY-CREATE)
- **ETHCoSPerformanceMappings**: ***CoSPerfMappingCharacterization*** – Indicates the performance for specific CoS. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
Optionally, communications alarm may be used to indicate a protection reroute	O

7.3.1.7 ETH_Flow_Point

Behaviour:

This managed entity is used to represent the termination of ETH_FDFr_EVC on an ETH_Flow_Domain (i.e., a G.809 FP). An instance of the ETH_FDFr_EVC managed entity may be used to relate two instances of the ETH_Flow_Point managed entity (i.e., for point-to-point connections), or multiple ETH_Flow_Points for multipoint ETH_FDFr_EVCs.

Instances of this managed entity may be created automatically by the ETH_Flow_Domain, as a result of a flow (ETH_FDFr_EVC) setup request. Similarly, instances of this managed entity may be deleted automatically by the ETH_Flow_Domain, as a result of a release request, or explicitly by the management system.

This managed entity may also represent the point in the ETH_Flow_Domain where the Ethernet Trail (i.e., a G.809 TFP) and associated overhead are terminated/originated (e.g., ETH Frame flow terminates and is adapted into APP layer, the ETH Adaptation Function).

Attributes

Name	Description	Type	Qualifier
ethFPID	This attribute identifies the name of an ETH_Flow_Point instance.	String	M, R/S
administrativeState	This attribute denotes the administrative state of the trail terminating ETH_Flow_Point. This is a read/write attribute. The values supported are Locked and Unlocked.	ENUM (locked, unlocked)	M, R/W
operationalState	This attribute denotes the operational state of the ETH_Flow_Point as working "Enabled" or not-working "Disabled".	ENUM (disabled, enabled)	M, R
availabilityStatus	The availability status attribute is read-only and indicates that the ETH_FDFr_EVC is functioning properly. May be mapped to [IETF RFC 2863], The Interfaces Group MIB IfOperstatus. Values for availability status include: inTest, failed, degraded.	ENUM (inTest, failed, degraded)	M, R
alarmStatus	The alarm status attribute is read-only and indicates the occurrence of an abnormal condition. Values for alarm status include: critical, major, minor, indeterminate, warning, pending and cleared.	ENUM (critical, major, minor, indeterminate, warning, pending, cleared)	M, R
asapPtr	The alarm severity profile associated with the ETH_Flow_Point to assign alarm severity to specific alarms.	Name	M, R/W
currentProblemList	Identifies the current existing problems (probable cause), with severity, associated with the ETH_Flow_Point.	Set of CurrentProblem Type	M, R

ethCeVlanID Mapping	The ethCeVlanIDMapping attribute represents a list of unique values that map each Customer Edge VLAN ID (CE-VLAN ID) to at most one ETH_FDFr_EVC (ETH EVC) for a Service Frame. To support Bundling, multiple CE VLAN IDs may be mapped to a single EVC (or ETH_FDFr_EVC). This is accomplished by providing multiple entries in the ethCeVlanIDList attribute. An EVC with more than one CE-VLAN ID mapping to it MUST have the CE-VLAN ID Preservation Service Attribute, and the list of CE-VLAN IDs mapped to the EVC MUST be the same at each UNI in the EVC. Possible special values of a CE VLAN ID include: "Untagged", "All-to-One" and "AllOthers". If "All-to-One" is used, the allToOneIndicator attribute in the ETH_FPP_UNI should be set to TRUE, and the ETH_FPP_UNI of the UNI shall support only a single ETH_Flow_Point. "AllOthers" indicates that all frames not mapped to other EVCs on the UNI are mapped to the EVC represented by this flow point. The value of this mapping attribute is: a) a list of CE_VLAN_IDs that may include the special valued of "untagged"; b) the special value "allToOne"; or c) the special value "allOthers"	EthCeVlanIDMappingType. (see 7.3.3)	M, R/W
ethUNIEVCFDFr Label	The ethUNIEVCFDFrLabel attribute is an arbitrary string administered by the Service Provider that is used to identify an FDFr/EVC at the UNI. It is intended for management and control purposes.	String	M, R/W
layer2ControlProtocolProcessingList	The layer2ControlProtocolProcessingList attribute provides a list that describes Layer 2 control protocols, along with the frame processing disposition: – Discard: The Service Frame is discarded. – Tunnel: No matter what the content (assuming correct FCS) of the Service Frame, it is delivered across the other (egress) UNI(s).	Set of CtrlProtocol ProcOnFPType. (see 7.3.3)	M, R/W
unicastServiceFrame Delivery	Describes the service frame delivery option for Unicast Service Frames as: Discard, DeliveryUnconditionally, or DeliveryConditionally. In the Type definition, the String is to describe the condition for DeliveryConditionally.	FrameDelivery Type. (see 7.3.3)	M, R/W

multicastServiceFrameDelivery	Describes the service frame delivery option for Multicast Service Frames as: Discard, DeliveryUnconditionally, or DeliveryConditionally. In the Type definition, the String is to describe the condition for DeliveryConditionally.	FrameDelivery Type. (see 7.3.3)	M, R/W
broadcastServiceFrameDelivery	Describes the service frame delivery option for Broadcast Service Frames as: Discard, DeliveryUnconditionally, or DeliveryConditionally. In the Type definition, the String is to describe the condition for DeliveryConditionally.	FrameDelivery Type. (see 7.3.3)	M, R/W
cosBandwidthMappingList	This attribute indicates the bandwidths for different ETH services at the ETH FP.	Set of ETHCoSBandwidthMappingID	M, R/W
trailTerminating	If TRUE, describes Flow Point as a point where frame flow terminates (i.e., a G.809 TFP) and is adapted into the APP layer. Otherwise, shall be set to FALSE.	Boolean	M, R/S
rootOrLeaf	This attribute indicates that the flow point is acting as either a root or leaf, and takes on the value either "Root" or "Leaf." If the type of EVC is Point-to-Point or Multipoint-to-Multipoint, then the UNI Type MUST equal "Root."	ENUM (root, leaf)	M, R/W
ethFDFrEVCPtr	This attribute identifies the ETH FDFr/EVC terminated by the ETH FP.	Name	M, R

Relationships:

The ETH_Flow_Point object is contained under ETH_FPP.

ETH_Flow_Point is associated with:

- **ASAP**: ***SeverityAssignment*** – The ETH_Flow_Point may be associated with an alarm severity assignment profile in order to assign alarm severity to specific alarms. (GET, REPLACE)
- **ETH_FDFr_EVC**: ***EvcTerminating*** – ETH_FDFr_EVC that is terminated by two or more ETH_Flow_Points. Each associated ETH_Flow_Point may be either:
  - A-End FP (GET, SET-BY-CREATE)
  - Z-End FPs (for multipoint connections there are multiple z-end FPs, only one for point-to-point connections) (GET, SET-BY-CREATE)
- **ETHCoSBandwidthMapping**: ***CoSBWMappingCharacterization*** – Indicates the bandwidth for specific CoS in the ingress and egress direction. (GET, REPLACE, ADD, REMOVE)
- **EAFProfiles**[4]: ***AdaptationCharacterization*** – The ETH_Flow_Point (trail terminating) may be associated with adaptation profiles (TBD). (GET, REPLACE)
- **APPLinkEnd**[5]: ***Client/Server*** – The ETH_ Flow_Point (trail terminating) may be associated with an APP Layer Link End (TBD). (GET, REPLACE, ADD, REMOVE)

4 The detailed definition of the EAFProfile object class is for future study.

5 The detailed definition of the APPLinkEnd object class is for future study.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
comminicationsAlarm	M

7.3.1.8 ETHBandwidthProfile (TrafficConditioner)

Behaviour:

This managed entity specifies traffic and QoS parameters for virtual connections. A single profile provides traffic parameters for virtual connections. A single profile provides parameters described as ingress or egress parameters via the association from the referring managed entity (e.g., ETH_FPP_UNI, ETH_Flow_Point). For Ethernet, traffic parameters may include: Committed Information Rate (CIR), Committed Burst Size (CBS), Excess Information Rate (EIR), Excess Burst Size (EBS), the coupling flag admission option for yellow colored frames (CF), and the color mode (CM) indicating whether the color-aware or color-blind mode is employed.

Instances of this managed entity are created automatically by the EMS upon initialization. Instances of this managed entity are also created and deleted by request of the managing system.

Attributes

Name	Description	Type	Qualifier
ethBWProfileID	This attribute identifies the name of an ETHBandwidthProfile instance.	String	M, R/S
userLabel	This attribute is a friendly name for the specific Bandwidth Category described within this profile.	String	O, R/W
cir	This attribute identifies the Committed Information Rate (CIR) in bits per second for one direction of an ETH EVC.	Integer (Units: bits per second)	M, R/S
cbs	This attribute identifies the Committed Burst Size (CBS) in bytes for one direction of an ETH EVC.	Integer (Units: bytes)	M, R/S
eir	This attribute identifies the Excess Information Rate (EIR) in bits per second for one direction of an ETH EVC.	Integer (Units: bits per second)	M, R/S
ebs	This attribute identifies the Excess Burst Size (EBS) in bytes for one direction of an ETH EVC.	Integer (Units: bytes)	M, R/S
colorMode	This attribute describes the color mode (CM) to be applied as "color-blind mode" or "color-aware mode". Takes only one of two possible values, TRUE or FALSE. A value of FALSE will indicate color blind mode is in effect.	Boolean	M, R/S

couplingFlag	The optional coupling flag (CF) attribute describes if yellow frames will be admitted if unused bandwidth is available. When CF is set to 0, the volume of the yellow service frames admitted to the network cannot exceed EIR. When CF is set to 1, the volume of the yellow service frames admitted to the network is bounded by CIR + EIR depending on the volume of the offered green Service Frames. In both cases, the burst size of the yellow service frames admitted to the network is bounded by EBS.	Boolean	O, R/S

Relationships:

The ETHBandwidthProfile object is contained under EMS.

ETHBandwidthProfile is associated with:

- **ETH_FPPs**: ***BandwidthCharacterization*** – The ingress bandwidth profiles that characterize ETH_FPP_UNIs in the ingress direction. (GET, REPLACE)
- **ETHCoSBandwidthMapping**: ***ingressCoSBandwidthCharacterization*** – Mapping the ingress bandwidth profile to specific ETH service. (GET, REPLACE, ADD, REMOVE)
- **ETHCoSBandwidthMapping**: ***egressCoSBandwidthCharacterization*** – Mapping the egress bandwidth profile to specific ETH service. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:

objectCreation	O
objectDeletion	O

7.3.1.9 ETHPerformanceProfile

Behaviour:

This managed entity specifies performance objectives for Availability, Frame Delay Performance, Frame Delay Variation Performance, and Frame Loss Ratio Performance as specified in clause 6.7 of [MEF 10.1].

Service Frame delivery performance is specified for all Service Frames transported within an FDFr with a particular Class of Service instance. The Class of Service instance is identified by a Class of Service Identifier associated with each Service Frame. The Class of Service Identifier MUST be derived from either: The FDFr to which the Service Frame is mapped, OR the combination of the FDFr to which the Service Frame is mapped and a set of one or more CE-VLAN CoS values.

Attributes

Name	Description	Type	Qualifier
ethPerfProfileID	This attribute identifies the name of an ETHPerformanceProfile instance.	String	O, R/S
userLabel	This is a friendly name for specific performance profile.	String	O, R/S
cosFrameDelay	This attribute identifies the Frame Delay objective for Service Frames. Frame Delay is defined as the time elapsed from reception at the ingress UNI of the first bit of the ingress Service Frame until the transmission of the last bit of the Service Frame at the egress UNI.	Integer (Units: bits per second)	M, R/S

cosFrameDelay Variation	This attribute identifies Frame Delay Variation (FDV) objective for Service Frames. FDV is a measure of the variation in the Frame Delay between a pair of Service Frames.	Integer (Units: bytes)	M, R/S
cosFrameLossRatio	This attribute identifies the Frame Loss Ratio objective for Service Frames. The definition of Frame Loss Ratio Performance for a particular Class of Service instance on a Point-to-Point EVC is based on the number of Service Frames that arrive at an ingress UNI during the interval T and that should be delivered to the egress UNI according to the Service Frame Delivery service attributes and whose level of Bandwidth Profile compliance is determined to be Green.	Integer (Units: bits per second)	M, R/S
cosAvailability	This attribute identifies the Availability objective for the EVC. Availability Performance is the percentage of time within a specified time interval during which the Frame Loss Ratio Performance is small. As an example, a service provider can define the availability performance to be measured over a month and the value for the Availability Performance objective to be 99.9%.	Float (percentage)	O, R/S

Relationships:

The ETHCoSPerformanceProfile object is contained under EMS.

ETHPerformanceProfile is associated with:

- **ETHCoSPerformanceMapping**: ***CoSPerformanceCharacterization*** – Mapping the performance profile to specific ETH services. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:

objectCreation	O
objectDeletion	O

7.3.1.10 ETHServiceClassProfile

Behaviour:

This managed entity specifies profile of CoS, defines the way to classify ETH service and a definite CoS.

Attributes

Name	Description	Type	Qualifier
serviceClassID	This attribute identifies the name of a service class instance	String	M, R/S
userLabel	This is a friendly name for a specific service class category.	String	O, R/S
classifyType	This attribute identifies the characteristic type on which ETH services are classified, such as VLAN ID, VLAN Priority (defined in [IEEE 802.1Q]), EVC, etc. The classifyType is extensible.	String ("VlanID", "VlanPriority", "EVCID")	M, R/W

classifyValue	This attribute lists the characteristic values corresponding to the above classifyType to identify a specific service class. This attribute identifies the name of an ETHBandwidthProfile instance. Each service class is expressed in a string. Each string for one parameter. For VlanID, the following notation is allowed: "5-100" represents all IDs between 5 to 100 including 5 and 100	Set of String	M, R/W
NONE			

Relationships:

The ETHServiceClassProfile object is contained under EMS.

ETHServiceClassProfile is associated with:

- **ETHCoSBandwidthMapping**: ***CoSCharacterization*** – To characterize the CoS type at the bandwidth mapping. (GET, REPLACE, ADD, REMOVE)
- **ETHCoSPerformanceMapping**: ***CoSCharacterization*** – To characterize the CoS type at the performance mapping. (GET, REPLACE, ADD, REMOVE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.11 ETHCoSBandwidthMapping

Behaviour:

This managed entity indicates the bandwidth of specified CoS.

Attributes

Name	Description	Type	Qualifier
cosBWMappingID	This attribute identifies the name of an ETHCoSBandwidthMapping instance	String	M, R/S
serviceClassProfilePtr	This attribute indicates the ETHServiceClassProfile.	Name	O, R/W
ingressBandwidth ProfilePtr	This attribute indicates the ingress ETHBandwidthProfile for the specified CoS. If the above cosProfile is null, this ETHBandwidthProfile is for all services.	Name	M, R/W
egressBandwidth ProfilePtr	This attribute indicates the egress ETHBandwidthProfile for the specified CoS. If the above cosProfile is null, this ETHBandwidthProfile is for all services.	Name	O, R/W

Relationships:

The ETHCoSBandwidthMapping object is contained under EMS.

ETHCoSBandwidthMapping is associated with:

- **ETH_Flow_Points**: ***CoSBWMappingCharacterization*** – The ETH_Flow_Points where the bandwidth for specific CoS in the ingress and egress direction is applied. (GET, REPLACE, ADD, REMOVE)
- **ETHBandwidthProfile**: ***ingressCoSBandwidthCharacterization*** – Mapping the ingress bandwidth profile to specific ETH service. (GET, REPLACE)
- **ETHBandwidthProfile**: ***egressCoSBandwidthCharacterization*** – Mapping the egress bandwidth profile to specific ETH service. (GET, REPLACE)
- **ETHServiceClassProfile**: ***CoSCharacterization*** – To characterize the CoS type at the bandwidth mapping. (GET, REPLACE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.12 ETHCoSPerformanceMapping

Behaviour:

This managed entity indicates expected service performances of specified CoS.

Attributes

Name	Description	Type	Qualifier
cosPerfMappingID	This attribute identifies the name of an ETHCoSPerformanceMapping instance	String	M, R/S
serviceClassProfilePtr	This attribute indicates the ETHServiceClassProfile.	Name	O, R/W
performanceProfilePtr	This attribute indicates the service performance for the specified CoS. If the above cosProfile is null, this ETHPerformanceProfile is for all services.	Name	M, R/W

Relationships:

The ETHCoSBandwidthMapping object is contained under EMS.

ETHCoSBandwidthMapping is associated with:

- **ETH_FDFr_EVC**: ***CoSPerfMappingCharacterization*** – The ETH_FDFr_EVC where the performance for specific CoS is applied. (GET, REPLACE)
- **ETHPerformanceProfile**: ***CoSPerformanceCharacterization*** – Mapping the performance profile to specific ETH services. (GET, REPLACE)
- **ETHServiceClassProfile**: ***CoSCharacterization*** – To characterize the CoS type at the bandwidth mapping. (GET, REPLACE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O

7.3.1.13 ELMIProfile

Behaviour:

This managed entity describes the ELMI attributes associated with the containing ETH_FPP. ELMI is described in [MEF 16]. This managed entity is conditionally required if ELMI is supported on the containing ETH_FPP.

Attributes

Name	Description	Type	Qualifier
elmiProfileID	This attribute identifies the specific ELMI Profile.	String	M, R/S
elmiOperationalState	The ELMI operational state attribute is read-only and indicates the current capability of the ELMI mechanism on the FPP. Values for operational state include: disabled, enabled.	ENUM (disabled, enabled)	M, R
elmiAdministrative State	This attribute denotes the administrative state of the ELMI mechanism at the ETH_FPP. This is a read/write attribute. The values supported are Locked or Unlocked. In the Locked state, the ELMI mechanism on the FPP is disabled.	ENUM (locked, unlocked)	M, R/W
elmiProtocolVersion	8-bit field that indicates the ELMI protocol version (e.g., (0000 0001) indicates ELMI Version 1).	Integer Range (1 to 255) Default: (0000 0001)	M, R/W
elmiAsyncStatus Enabled	This Boolean attribute indicates whether or not the capability of the FPP to generate and send Asynchronous Status is enabled.	Boolean Default: TRUE	M, R/W
elmiMinAsync MessageInterval	Minimum Asynchronous Message Interval – Used to specify minimum time interval between asynchronous messages. NOTE – Generally set to 1/10th of the UNI-C's T391.	Integer Range (0 to 3) Default: 1 (second)	M, R/W
elmiN393	Represents the ELMI N393 Status Counter Parameter Threshold – This configurable parameter is a Threshold for the Count of Consecutive Errors. Used to determine if ELMI is operational or not. Range from 2 to 10. Default 4.	Integer Range (2 to 10) Default: 4 (consecutive errors)	M, R/W
elmiT392	Represents ELMI T392 Polling Verification Timer (PVT) limit. Configurable with Range 0 and from 5 to 30. Default 15. Value of 0 indicates that polling verification is disabled.	Integer Range (0, 5 to 30) Default: 15 (seconds)	M, R/W

Operations/Methods:

Name	Description
NONE	

Relationships:

The ELMIProfile object is contained under ETH_FPP and subclasses.

Reportable Notifications:	
objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O

7.3.1.14 TransportPort

Behaviour:

The TransportPort managed entity may be used to generically represent the underlying transport termination (e.g., DS3, SONET, SDH, etc.). An instance of FPP may point to an instance of TransportPort to represent the association between an interface and the transport supporting facility. The TransportPort object is similar to the PTP object defined in the TMF's MTMN model and is similar to the genericTransportTTP object defined in [ITU-T M.3100]. These objects may be used to instantiate the TransportPort.

Usually a TransportPort supports a single ETH_FPP (UNI or NNI); however, if MEF Transport Multiplexing Function is used, it is possible that multiple ETH UNIs may be supported from a single TransportPort.

Attributes

Name	Description	Type	Qualifier
portID	This attribute identifies the specific TransportPort object instance.	String	M, R/S
characteristicInformationType	The characteristicInformationType attribute describes the transport type provided by the TransportPort.	Object Identifier	M, R/S
operationalState	This attribute denotes the operational state of the TransportPort as working "Enabled" or not-working "Disabled".	ENUM (disabled, enabled)	M, R
alarmStatus	The availability status attribute is read-only and indicates the occurrence of an abnormal condition. Values for alarm status include: critical, major, minor, indeterminate, warning, pending and cleared.	ENUM (critical, major, minor, indeterminate, warning, pending, cleared)	M, R
asapPtr	The alarm severity profile associated with the TransportPort to assign alarm severity to specific alarms.	Name	M, R/W
currentProblemList	Identifies the current existing problems (probable cause), with severity, associated with the TransportPort.	Set of Current ProblemType	M, R
userLabel	The userLabel attribute provides the friendly name of the port represented by the TransportPort.	String	M, R/W
potentialCapacity	The potentialCapacity attribute describes the bandwidth capacity that is supported by the TransportPort. This attribute is conditional, it is present if the TransportPort is a rate adaptive technology.	Integer (Units: bits per second)	M, R
circuitPackPtr	The CircuitPack that supports the TransportPort	Name	M, R

clientFPP	The FPP in the client layer supported by the TransportPort.	Name	M, R/W

Relationships:

The TransportPort object is contained under *ManagedElement*.

TransportPort is associated with:

- **ASAP**: ***SeverityAssignment*** – The TransportPort may be associated with an alarm severity assignment profile in order to assign alarm severity to specific alarms. (GET, REPLACE)
- **CircuitPack**: ***PortAssociation*** – The CircuitPack that supports the TransportPort. (GET)
- **ClientFPP**: ***Client/Server*** – The relationship between the TransportPort and the FPP in the client layer supported by the Generic Transport TTP. For example, this may point to the ETH_FPP_UNI (or MPLS FPP) supported by a SDH path. (GET, REPLACE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
communicationAlarm	O

7.3.1.15 MAUTransportPort

Behaviour:

The MAUTransportPort managed entity may be used to generically represent the ETY Port and the underlying transport termination of the Ethernet Medium Attachment Unit. An instance of MAUTransportPort may point to an instance of ETH_FPP_UNI to represent the association between an interface and the supporting MAU.

Attributes

Name	Description	Type	Qualifier
mauType	The mauType attribute identifies the MAU type. An initial set of MAU types are defined in [IETF RFC 3636]. The assignment of OBJECT IDENTIFIERs to new types of MAUs is managed by the IANA. If the MAU type is unknown, the object identifier unknownMauType OBJECT IDENTIFIER ::= { 0 0 } is returned. Based on [IETF RFC 3636] IfMauType.	String (Object Identifier in SNMP for this type.)	M, R
mauMediaAvailable	Link integrity state of the MAU Transport Port. May take on the following values as described in [IETF RFC 3636]: other, unknown, available, notAvailable, remoteFault, invalidSignal, remoteJabber, remoteLinkLoss, remoteTest, offline, autoNegError, pmdLinkFault, wisFrameLoss, wisSignalLoss, pcsLinkFault, excessiveBER, dxsLinkFault, and pxsLinkFault.	ENUM: (As listed in the description)	M, R
mauJabberState	The mauJabberState attribute represents the jabbering state of the MAU. This attribute may take on the following values as described in [IETF RFC 3636]: other, unknown, noJabber, and jabbering	ENUM (other, unknown, noJabber, and jabbering)	M, R

mauDefaultType	The mauDefaultType attribute identifies the default administrative baseband MAU type, to be used in conjunction with the operational MAU type denoted by mauType. The set of possible values for this object is the same as the set defined for the mauType attribute. Based on [IETF RFC 3636] ifMauDefaultType.	String (Object Identifier in SNMP for this type.)	M, R
mauMode	Full Duplex, or Auto negotiation	ENUM (Full_Duplex, Auto_Neg)	M, R
mauAutoNeg Supported	This attribute indicates whether or not auto-negotiation is supported on this MAU. Based on [IETF RFC 3636] ifMauAutoNegSupported	Boolean	M, R/W
mauTypeList	This attribute identifies the set of possible [IEEE 802.3] types that the MAU could be.	Bit String as in [IETF RFC 3636] ifMauTypeList Bits	M, R
mauJackTypeList	This attribute identifies interface jack types that the MAU provides. Values described in [IETF RFC 3636] JackType include: other, rj45, rj45S, db9, bnc, fAUI, mAUI, fiberSC, fiberMIC, fiberST, telco, mtrj, hssdc, fiberLC.	Set of ENUM (As listed in the description)	M, R
mauAutoNegAdmin State	Allows the auto-negotiation function of the MAU to be enabled or disabled.	ENUM (enabled, disabled)	M, R
mauAutoNegRemote Signaling	This attribute indicates whether the remote end of the link is using auto-negotiation signalling. It takes the value detected (1) if and only if, during the previous link negotiation, FLP Bursts were received.	ENUM (detected, notdetected)	M, R
mauAutoNegConfig	Indicates the current status of the auto-negotiation process. May take on the following values as described in [IETF RFC 3636]: other, configuring, complete, disabled, or parallelDetectFail.	ENUM (other, configuring, complete, disabled, parallelDetect Fail)	M, R
mauAutoNeg Capability	Identifies the set of capabilities of the local auto-negotiation entity.	Bit String as in [IETF RFC 3636] ifMauAuto NegCapability Bits	M, R
mauAutoNegCap Advertised	Identifies the set of capabilities advertised by the local auto-negotiation entity.	Bit String as in [IETF RFC 3636] ifMauAuto NegCapAdvert isedBits	M, R

mauAutoNegCap Received	Identifies the set of capabilities received from the remote auto-negotiation entity.	Bit String as in [IETF RFC 3636] ifMauAuto NegCap ReceivedBits	M, R
mauAutoNegRemote FaultAdvertised	Identifies any local fault indications that this MAU has detected and will advertise at the next auto-negotiation interaction. May take on the following values as described in [IETF RFC 3636]: noError, offline, linkFailure, or autoNegError.	ENUM (noError, offline, linkFailure, autoNegError)	M, R
mauAutoNegRemote FaultReceived	Identifies any fault indications received from the far end of a link by the local auto-negotiation entity. May take on the following values as described in [IETF RFC 3636]: noError, offline, linkFailure, or autoNegError.	ENUM (noError, offline, linkFailure, autoNegError)	M, R

Operations/Methods:

Name	Description
mauAutoNegRestart	This method will force auto-negotiation to begin link renegotiation. Based on [IETF RFC 3636] ifMauAutoNegRestart.

Relationships:

The MAUTransportPort object is contained under *ManagedElement*.

MAUTransportPort is associated with:

- **ASAP**: ***SeverityAssignment*** – The MAUTransportPort may be associated with an alarm assignment severity profile in order to assign alarm severity to specific alarms. (GET, REPLACE)
- **CircuitPack**: ***PortAssociation*** – The CircuitPack that support the MAUTransportPort. (GET, REPLACE, ADD, REMOVE)
- **ClientFPP (ETH_FPP_UNI)**: ***Client/Server*** – The relationship between the MAUTransportPort and the FPP in the client layer supported by the MAUTransportPort. For example, this may point to the ETH_FPP_UNI supported by a GigE path. (GET, REPLACE)

Reportable Notifications:

objectCreation	O
objectDeletion	O
attributeValueChange	O
stateChange	O
communicationsAlarm	O

7.3.1.16 ManagedElement

The ManagedElement entity is described in [ITU-T M.3100], which will be reused in this Recommendation.

7.3.1.17 EquipmentHolder

The EquipmentHolder entity is described in [ITU-T M.3100], which will be reused in this Recommendation.

7.3.1.18 CircuitPack

The CircuitPack entity is described in [ITU-T M.3100], which will be reused in this Recommendation.

7.3.1.19 ASAP

The ASAP entity is described in [ITU-T Q.827.1], which will be reused in this Recommendation.

7.3.2 Management Operations

7.3.2.1 setupPtToPtETH_FDFr_EVCWithFPPs

Owner Entity	ETH_Flow_Domain		
Description	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain with endpoints coinciding with two interfaces (ETH_FPPs).		
Operation fields	**Name**	**Description**	**Type**
Input parameters	aETH_FPP	Indicates the a-end parameters.	EvcEndParametersType (see 7.3.3)
	zETH_FPP	Indicates the z-end parameters.	EvcEndParametersType (see 7.3.3)
	ethEVCName	The ethEVCName is a string that is a unique identifying value for the ETH Virtual Connection.	String
	administrativeState	This parameter is used to activate (unlock) or deactivate (lock) this managed entity. In the Locked state, frame flow through the ETH_FDFr_EVC is prohibited.	ENUM (locked, unlocked)
	eVCProtected (optional)	This parameter indicates if the ETH_FDFr_EVC is protected or not at the ETH layer.	Boolean
	userLabel	A text string that may be used to provide additional information about the ETH_FDFr_EVC, such as a circuit identifier.	String
	uniCeVlanId Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean
	uniCeVlanCoS Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean
	layer2ControlProtocol DispositionList	See the attribute description of ETH_FPP_UNI.	Set of CtrlProtocol ProcType. (see 7.3.3)
	unicastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	Framedelivery Type. (see 7.3.3)
	multicastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	broadcastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	routingCriteria (optional)	This parameter indicates the routing restriction information. It is a list of ETH FPPs that are included or excluded in the route.	Struct { fPPincluded:Set of Name, fPPexcluded: Set of Name}

Output parameters	a-EndFPid	The a-end ETH_Flow_Point created by EMS.	Name
	z-EndFPid	The z-end ETH_Flow_Point created by EMS.	Name
	ETH_FDFr_EVCId	The ETH_FDFr_EVC created by EMS.	Name
	administrativeState	See above Input parameters.	ENUM (locked, unlocked)
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	
	Create Error	The creation of ETH_FDFr_EVC error occurs during EMS processing.	
	InvalidTransport ServiceCharacteristics	Transport service related parameters are invalid.	
	incorrectTermination Points	a-end or z-end ETH_FPP is incorrect.	
	CommunicationError	Communication error occurs.	

7.3.2.2 setupMultiToMultiETH_FDFr_EVCwithFPPs

Owner Entity	ETH_Flow_Domain		
Description	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain whose endpoints coincide with multiple interfaces (ETH_FPPs).		
Operation fields	**Name**	**Description**	**Type**
Input parameters	zETH_FPPs	Indicates the parameters of z-ends.	Set of EvcEnd ParametersType (see 7.3.3)
	ethEVCName	The ethEVCName is a string that is a unique identifying value for the ETH Virtual Connection.	String
	administrativeState	This parameter is used to activate (unlock) or deactivate (lock) this managed entity. In the Locked state, frame flow through the ETH_FDFr_EVC is prohibited.	ENUM (locked, unlocked)
	eVCProtected (optional)	This parameter indicates if the ETH_FDFr_EVC is protected or not at the ETH layer.	Boolean
	userLabel	A text string that may be used to provide additional information about the ETH_FDFr_EVC, such as a circuit identifier.	String
	uniCeVlanId Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean

	uniCeVlanCoS Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean
	layer2ControlProtocol DispositionList	See the attribute description of ETH_FPP_UNI.	Set of CtrlProtocol ProcType. (see 7.3.3)
	unicastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	multicastService FrameDelivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	broadcastService FrameDelivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	routingCriteria (optional)	This parameter indicates the routing restriction information. It is a list of ETH FPPs that are included or excluded in the route.	Struct { FPPincluded:Set of Name, FPPexcluded: Set of Name}
Output parameters	z-EndNetwork FPidList	The ETH_Flow_Points created by EMS.	Set of Name
	ETH_FDFr_EVCId	The ETH_FDFr_EVC created by EMS.	Name
	administrativeState	See above Input parameters.	ENUM (locked, unlocked)
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	
	Create Error	The creation of ETH_FDFr_EVC error occurs during EMS processing.	
	InvalidTransport ServiceCharacteristics	Transport service related parameters are invalid.	
	incorrectTermination Points	a-end or z-end ETH_FPP is incorrect.	
	CommunicationError	Communication error occurs.	

7.3.2.3 setupRootedToMultiETH_FDFr_EVCwithFPPs

Owner Entity	ETH_Flow_Domain		
Description	This method is used to set up an ETH FDFr/EVC across an ETH_Flow_Domain whose endpoints coincide with multiple interfaces (ETH_FPPs).		
Operation fields	**Name**	**Description**	**Type**
Input parameters	aETH_FPPs	Indicates the parameters of a-ends.	Set of EvcEndParametersType (see 7.3.3)
	zETH_FPPs	Indicates the parameters of z-ends.	Set of EvcEnd ParametersType (see 7.3.3)
	ethEVCName	The ethEVCName is a string that is a unique identifying value for the ETH Virtual Connection.	String

	administrativeState	This parameter is used to activate (unlock) or deactivate (lock) this managed entity. In the Locked state, frame flow through the ETH_FDFr_EVC is prohibited.	ENUM (locked, unlocked)
	eVCProtected (optional)	This parameter indicates if the ETH_FDFr_EVC is protected or not at the ETH layer.	Boolean
	userLabel	A text string that may be used to provide additional information about the ETH_FDFr_EVC, such as a circuit identifier.	String
	uniCeVlanId Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean
	uniCeVlanCoS Preservation	See the attribute description of ETH_FDFr_EVC.	Boolean
	layer2ControlProtocol DispositionList	See the attribute description of ETH_FPP_UNI.	Set of CtrlProtocol ProcType. (see 7.3.3)
	unicastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	multicastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	broadcastServiceFrame Delivery	See the attribute description of ETH_Flow_Point.	FrameDelivery Type. (see 7.3.3)
	routingCriteria (optional)	This parameter indicates the routing restriction information. It is a list of ETH FPPs that are included or excluded in the route.	Struct {fPPincluded: Set of Name, fPPexcluded: Set of Name}
Output parameters	a-EndFPid	The a-end ETH_Flow_Point created by EMS.	Name
	z-EndNetworkFPidList	The ETH_Flow_Points created by EMS.	Set of Name
	ETH_FDFr_EVCId	The ETH_FDFr_EVC created by EMS.	Name
	administrativeState	See above Input parameters.	ENUM (locked, unlocked)
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	
	Create Error	The creation of ETH_FDFr_EVC error occurs during EMS processing.	
	InvalidTransportService Characteristics	Transport service related parameters are invalid.	
	incorrectTermination Points	a-end or z-end ETH_FPP is incorrect.	
	CommunicationError	Communication error occurs.	

7.3.2.4 releaseETH_FDFr_EVC

Owner Entity	ETH_Flow_Domain		
Description	This method is used to delete a FDFr/EVC in the ETH_Flow_Domain.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	ETH_FDFr_EVC ID	This parameter specifies the ETH_FDFr_EVC.	Name
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	

7.3.2.5 addTPsToMultiETH_FDFr_EVCwithFPPs

Owner Entity	ETH_FDFr_EVC		
Description	This method is used to add endpoints to a multipoint ETH FDFr/EVC across an ETH_Flow_Domain.		
Operation fields	Name	Description	Type
Input parameters	zETH_FPP_UNIList	Indicates the parameters of z-end ETH_FPP_UNIs.	Set of Struct { evcEnd Parameters: EvcEndParametersType, mode:ENUM (root, leaf) }
Output parameters	z-EndNetworkFPidList	The ETH_Flow_Points created by EMS.	Set of Name
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	
	Create Error	The creation of ETH_FDFr_EVC error occurs during EMS processing.	

7.3.2.6 removeTPsFromMultiETH_FDFr_EVC

Owner Entity	ETH_FDFr_EVC		
Description	This method is used to remove endpoints from a multipoint ETH FDFr/EVC across an ETH_Flow_Domain.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	z-EndNetworkFPidList	The input parameters for removing TPs from a multipoint ETH FDFr/EVC.	Set of Name
Output parameters	–		
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	
	Create Error	The creation of ETH_FDFr_EVC error occurs during EMS processing.	

7.3.2.7 mauAutoNegRestart

Owner Entity	MAUTransportPort		
Description	This method will force auto-negotiation to begin link renegotiation. Based on [IETF RFC 3636] ifMauAutoNegRestart		
Operation fields	**Name**	**Description**	**Type**
Input parameters	–	–	–
Output parameters	–	–	–
Return Value	–	Success indication	Boolean
Exceptions raised	EMSProcessingError	Error occurs during EMS processing.	

7.3.3 Data type definition

This clause defines the compound types that are used in this Recommendation, such as the operation input or output parameters.

Type Name	Description	Type Definition

AssignableCoSBWType	Indicates the assignable bandwidth per CoS, where the Name is a pointer to ETHServiceClassProfile object.	Struct
		{
		serviceClass: Name,
		bandwidth: Integer (Units: bits per second)
		}

CtrlProtocolProcType	Indicates the layer 2 control protocol processing.
	In an Ethernet frame, the EtherType field (two octets, defined in [IEEE 802.3]) indicates the nature of the MAC client protocol. It may be used along with the destination MAC address to identify some Ethernet Layer 2 Control Protocols.
		Struct
		{
		controlProtocol: String,
		destMAC: String,
		etherType: String,
		processing: ENUM (Discard, Peer, Pass, Peer&Pass),
		fDFrEVCPtr: Name // used only when processing is set to Pass or Peer&Pass
		}

CtrlProtocolProcOnFPType	Indicates the layer 2 control protocol processing for the ETH_Flow_Points.	Struct
		{
		layer2Protocol: String,
		frameDisposition: ENUM (discard, tunnel)
		}

CurrentProblemType	Identifies the problem (probable cause), with severity. This type is defined in [ITU-T M.3100].	Struct
		{
		problem: ProbableCause,
		alarmStatus: AlarmStatus
		}

EthCeVlanIDMappingType	Indicates the VLAN ID mapping, where String can be a VLAN_ID or "untagged".	Choice of
		{
		Set of String, // String is a <CE_VLAN_ID>, "untagged" can also be used
		ENUM ("allToOne", "allOthers")
		}

EvcEndParametersType	Indicates the a-end or z-end parameters of an EVC, e.g., when creating an EVC. In Type Definition, the evcEndETH_FPP specifies the a-end or z-end ETH_FPP.
	The trailEndpointIndicator indicates the trailTerminating attribute of the a-end or z-end ETH_Flow_Point.
	The ceVLANIdMapping specifies the ethCeVlanIDMapping attribute in the a-end or z-end ETH_Flow_Point.
	The endEthUNIEVCName is an arbitrary string administered by the Service Provider that is used to identify an FDFr/EVC at the UNI. It is intended for management and control purposes.
	The ethCoSBandwidthMapping indicates the cosBandwidthMappingList attribute at the a-end or z-end ETH_Flow_Point
		Struct
		{
		evcEndETH_FPP: Name,
		trailEndpointIndicator: Boolean,
		ceVLANIdMapping: EthCeVlanIDMappingType,
		endEthUNIEVCName: String,
		ethCoSBandwidthMapping: Set of Name
		}

FrameDeliveryType	Indicates the service frame delivery option	Struct
		{
		deliveryOption: ENUM (discard, deliverUnconditionally, deliverConditionally),
		condition: String //used only when option is "deliverConditionally"
		}

7.4 Performance Management Function Set

The common part for the analysis of Performance management FS can be found in clause 7.3 of [ITU-T Q.827.1]. In this Recommendation, only the performance measurement parameters for Metro Ethernet and EoT specific management are provided.

7.4.1 Performance Measurement Parameters

7.4.1.1 ETH UNI Anomalies Performance Data Set

Behaviour: The set of UNI abnormality measurements collected at each ETH_FPP_UNI.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
Undersized Frames	Number of frames, where the frame size was smaller than 64 octets, received at the MEN from the UNI.	Integer, optionally thresholded	M, R
Oversized Frames	Number of oversized frames (frames greater than 1522 octets) received at the MEN from the UNI.	Integer, optionally thresholded	M, R
Fragments	Number of fragmented frames received at the MEN from the UNI.	Integer, optionally thresholded	M, R
FCS and Alignment Errors	Number of CRC and alignment errored frames received at the MEN from the UNI.	Integer, optionally thresholded	M, R
Invalid CE-VLAN ID	Number of frames received with an invalid CE-VLAN ID.	Integer, optionally thresholded	M, R

7.4.1.2 ETH UNI Traffic Performance Data Set

Behaviour: The set of UNI traffic measurements collected at each ETH_FPP_UNI.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
Octets Transmitted OK	Number of octets (not including IPG) that the MEN sent to the UNI.	Integer	M, R
Unicast Frames Transmitted OK	Number of Unicast Frames that the MEN sent to the UNI.	Integer	M, R
Multicast Frames Transmitted OK	Number of Multicast Frames that the MEN sent to the UNI.	Integer	M, R
Broadcast Frames Transmitted OK	Number of Broadcast Frames that the MEN sent to the UNI.	Integer	M, R
Octets Received OK	Number of octets (not including IPG) that the UNI sent to the MEN.	Integer	M, R
Unicast Frames Received OK	Number of Unicast Frames that the UNI sent to the MEN.	Integer	M, R
Multicast Frames Received OK	Number of Multicast Frames that the UNI sent to the MEN.	Integer	M, R
Broadcast Frames Received OK	Number of Broadcast Frames that the UNI sent to the MEN.	Integer	M, R

7.4.1.3 ETH Ingress Traffic Management Performance Data Set

Behaviour:			
The set of Ingress Traffic Management performance measurements on a per entity (per UNI, per CoS per UNI, per EVC, or per CoS per EVC) basis for each entity that enforces traffic management at Ingress direction (CE to MEN).			
Attributes			
Name	**Description**	**Type**	**Qualifier**
ingressGreenFrame Count	The amount of green frames sent by the ingress UNI to the MEN.	Integer	M, R
ingressYellowFrame Count	The amount of yellow frames sent by the ingress UNI to the MEN.	Integer	O, R
ingressRedFrame Count	The amount of red (discarded) frames at the ingress UNI.	Integer	O, R
ingressGreenOctet Count	The amount of green octets sent by the ingress UNI to the MEN.	Integer	O, R
ingressYellowOctet Count	The amount of yellow octets sent by the ingress UNI to the MEN.	Integer	O, R
ingressRedOctet Count	The amount of red (discarded) octets at the ingress UNI.	Integer	O, R

7.4.1.4 ETH Egress Traffic Management Performance Data Set

Behaviour:			
The set of Egress Traffic Management performance measurements on a per entity (per UNI, per CoS per UNI, per EVC, or per CoS per EVC) basis for each entity that enforces traffic management at the Egress direction (MEN to CE).			
Attributes			
Name	**Description**	**Type**	**Qualifier**
egressGreen FrameCount	The amount of green frames received by the egress UNI from the MEN.	Integer	M, R
egressYellow FrameCount	The amount of yellow frames received by the egress UNI from the MEN.	Integer	O, R
egressGreen OctetCount	The amount of green octets received by the egress UNI from the MEN.	Integer	O, R
egressYellow OctetCount	The amount of yellow octets received by the egress UNI from the MEN.	Integer	O, R

7.4.1.5 ETH Congestion Discards Performance Data Set

Behaviour: The set of Congestion Discards performance measurements on a per congestible resource (e.g., per UNI, per CoS per UNI, per EVC, or per CoS per EVC) basis in both the ingress and egress direction.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
greenFrameDiscards	The amount of green frames discarded due to congestion.	Integer	M, R
yellowFrame Discards	The amount of yellow frames discarded due to congestion.	Integer	O, R
greenOctetDiscards	The amount of green octets discarded due to congestion.	Integer	M, R
yellowOctetDiscards	The amount of yellow octets discarded due to congestion.	Integer	O, R

7.4.1.6 ETH ELMI Performance Data Set

Behaviour: The set of ELMI reliability and protocol error measurements collected at each ETH_FPP on which ELMI is supported and enabled.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
sumofElmiReliability Errors	Thresholded sum of ELMI Reliability Errors on the FPP, including: Non-receipt of STATUS/STATUS ENQUIRY and Invalid Sequence Numbers.	Integer, thresholded	O, R
sumofElmiProtocol Errors	Thresholded sum of ELMI Protocol Errors on the FPP, including: Protocol Version Errors, Message too shorts, Message type errors, Information element errors.	Integer, thresholded	O, R
elmiNonrcptStatus AndStatusEnquiry Count	Number of Non-receipt of STATUS/STATUS ENQUIRY events	Integer	O, R
elmiInvalidSeqNum Count	Number of Invalid Sequence Numbers events	Integer	O, R
elmiProtocolVersion Count	Number of ELMI Protocol Version Errors detected at the FPP.	Integer	O, R
elmiTooShortCount	Number of ELMI Message Too Short Errors detected at the FPP.	Integer	O, R
elmiMessageType ErrorCount	Number of ELMI Message Type Errors detected at the FPP.	Integer	O, R
elmiInfoElement ErrorCount	Number of ELMI Information Element Errors (Information element out of sequence, Duplicate information element, Missing Mandatory information element, Mandatory information element error, Unexpected information element) detected at the FPP.	Integer	O, R

7.4.1.7 MAU Termination Performance Data Set

Behaviour: The set of MAU Termination performance measurements for each Transport Layer Port that represents the underlying transport termination of the Ethernet Medium Attachment Unit.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
ifMauMediaAvailableStateExits	Number of times the MAU leaves the available state (based on [IETF RFC 3636] ifMauMediaAvailableStateExits)	Integer	M, R
ifMauJabberingStateEnters	Number of times the MAU enters the jabbering state (based on [IETF RFC 3636] ifMauJabberingStateEnters)	Integer	M, R
ifMauFalseCarriers	Number of false carrier events during idle (based on [IETF RFC 3636] ifMauFalseCarriers)	Integer	M, R

7.5 Fault Management Function Set

The common part for the analysis of Fault management FS can be found in clause 7.4 of [ITU-T Q.827.1].

Appendix I

Table of managed entities

(This appendix does not form an integral part of this Recommendation)

Table I.1 – Managed entities

Managed entity name in this Recommendation	Statement
ManagedElement	Externally defined in [ITU-T M.3100]
Equipment	Externally defined in [ITU-T M.3100]
EquipmentHolder	Externally defined in [ITU-T M.3100]
CircuitPack	Externally defined in [ITU-T M.3100]
EMS	Externally defined in [ITU-T Q.827.1/Amd.1]
Alarm Severity Assignment Profile	Externally defined in [ITU-T Q.827.1]
ETH_Flow_Domain	Defined in this Recommendation
ETH_FPP	Defined in this Recommendation
ETH_FPP_UNI	Defined in this Recommendation
ETH_FPP_Link	Defined in this Recommendation
ETH_FDFr_EVC	Defined in this Recommendation
ETH_Flow_Point	Defined in this Recommendation
ETHBandwidthProfile	Defined in this Recommendation
ETHCoSMappingProfile	Defined in this Recommendation
ETHCoSPerformanceProfile	Defined in this Recommendation
TransportPort	Defined in this Recommendation
MAUTransportPort	Defined in this Recommendation

Appendix II

Examples for the combined use of ETHServiceClassProfile, ETHBandwidthProfile and ETHPerformanceProfile

(This appendix does not form an integral part of this Recommendation)

Figure II.1 shows a point-to-point ETH_FDFr_EVC from UNI A to UNI Z. A Gold service is defined by ETHServiceClassProfile. The expected performance of this Gold service in ETH_FDFr_EVC 1 is specified in ETHCoSPerformanceMapping. The expected bandwidth of this Gold service is specified in ETHCoSBandwidthMapping referred by ETH_Flow_Point 1 and 2 which are the A and Z ends of ETH_FDFr_EVC 1.

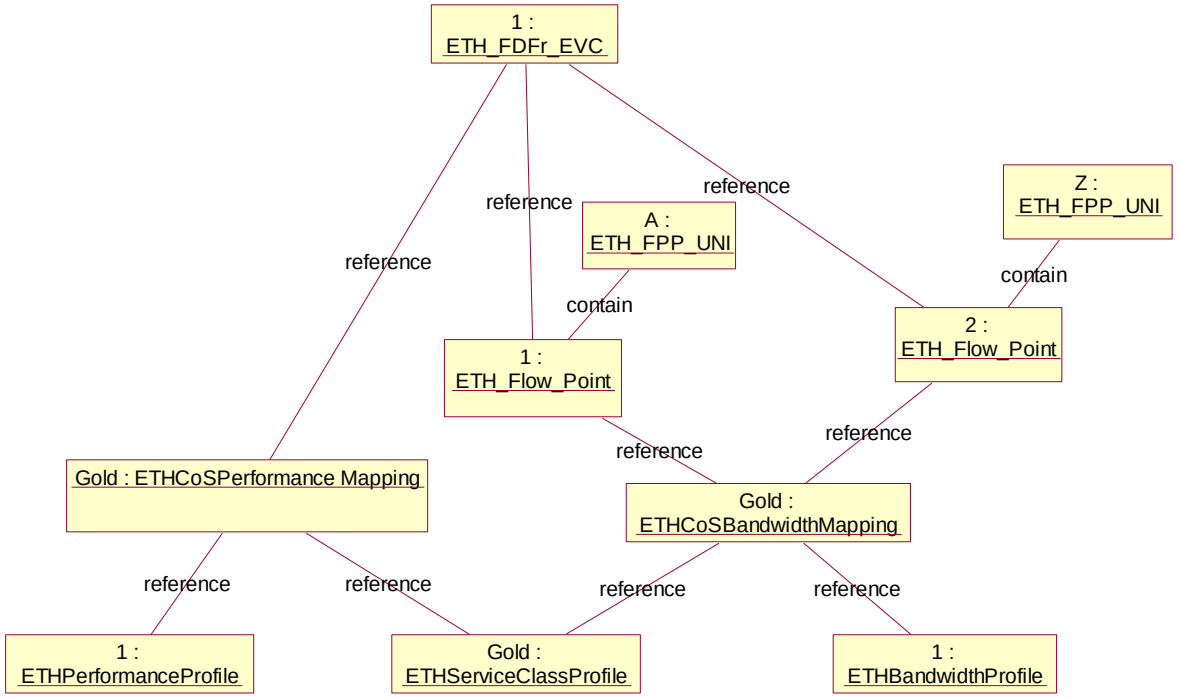

Figure II.1 – Example in object diagram

Appendix III

Informational: State Management Mapping

(This appendix does not form an integral part of this Recommendation)

The logical MIB described in this appendix makes use of the state model from [ITU-T X.731]. To help in mapping operational state information from SNMP-based models to the Q.840.1 EMS-NMS model, this appendix provides a mapping between the IfOperStatus from [IETF RFC 2863] and [ITU-T X.731]'s Operational State and Availability Status. Table III.1 provides a mapping between the IETF RFC 2863 IfOperStatus and X.731 Operational State and the supplemental Availability Status. The Q.840.1 model uses the X.731 Operational State in cases where a "working" or "Enabled"/"not-working" or "Disabled" state is needed. In cases where, in addition to the "Enabled"/"Disabled" states, supplemental status information is needed, such as a "degraded" and/or an "in-test" state, X.731 Availability Status is used along with Operational State.

Table III.1 – Mapping of operational state information

IETF RFC 2863 IfOperStatus	ITU-T X.731 Operational State	ITU-T X.731 Availability Status
up(1)	Enabled	---
down(2)	Disabled	Failed
	Disabled	Power off
	Disabled	Off-Line
testing(3)	Enabled	In Test
unknown(4)	Enabled	---
dormant(5)	Enabled or Disabled	Off Duty
notPresent(6)	Disabled	Not Installed
lowerLayerDown(7)	Disabled	Dependency
–	Enabled	Degraded

Also note that in this Recommendation, the X.731 Administrative State ("locked" or "unlocked") is used where a configurable administrative state needs to be reflected. The mapping between X.731 Administrative State and IETF RFC 2863 ifAdminStatus is direct for the "up" and "down" states. The IETF RFC 2863 ifAdminStatus of "up" is mapped to X.731 Administrative State of "unlocked". The IETF RFC 2863 ifAdminStatus of "down" is mapped to the X.731 Administrative State of "locked".

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