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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.

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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*.
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- [ITU-T G.805] ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.
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- [ITU-T X.731] ITU-T Recommendation X.731 (1992), *Information technology – Open Systems Interconnection – Systems Management: State management function*.
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- [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
ETY _n	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.

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.

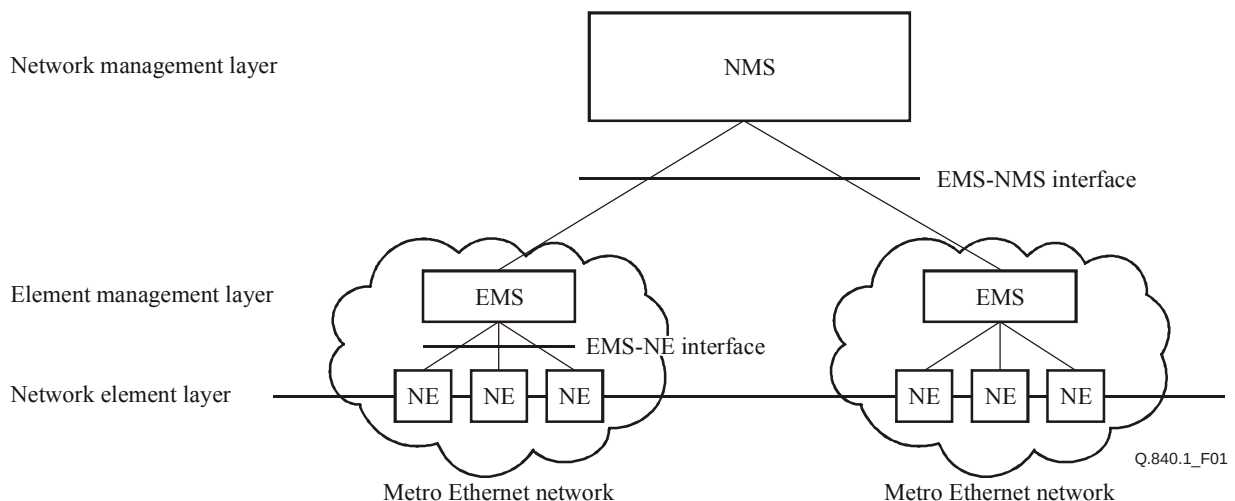


Figure 5-1 – Network-level management architecture

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.

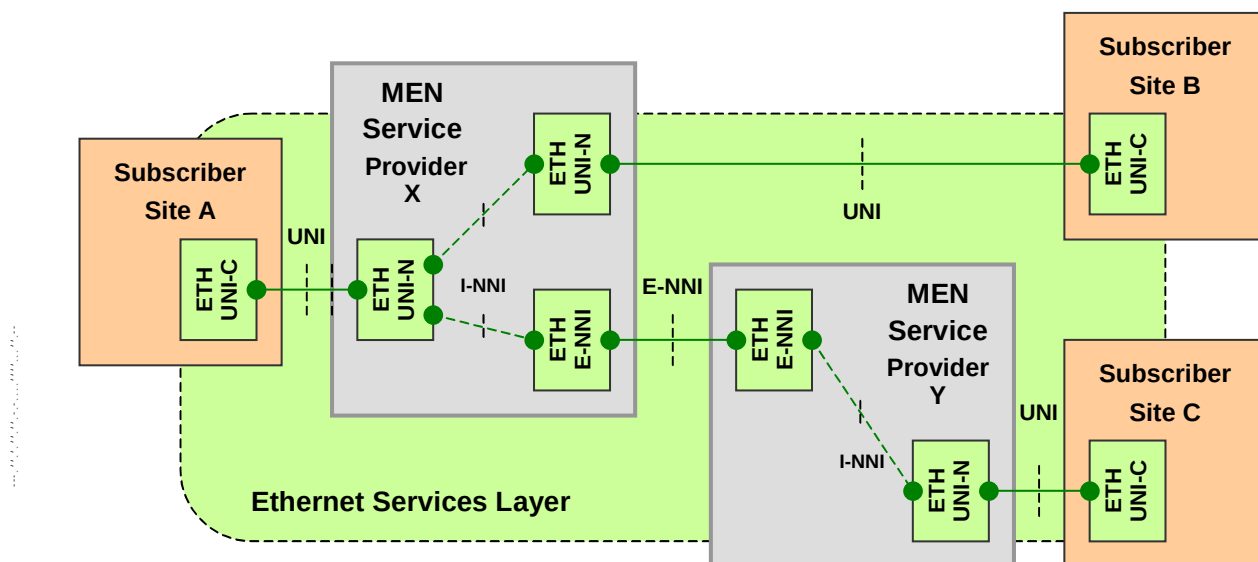


Figure 5-2 – ETH layer interfaces and reference points

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.

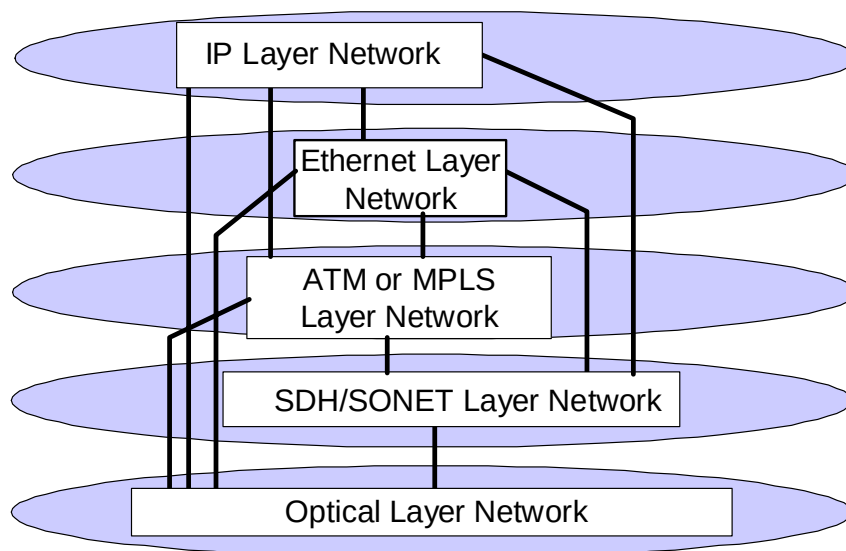


Figure 5-3 – Network layering example

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.

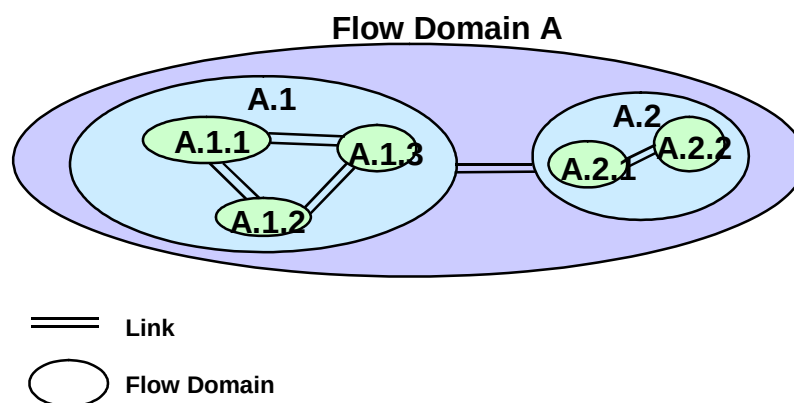


Figure 5-4 – Partitioning example

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.

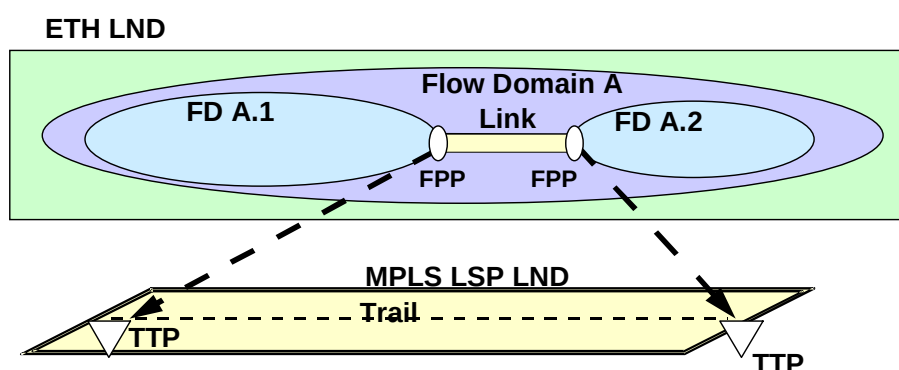


Figure 5-5 – Topological elements

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).

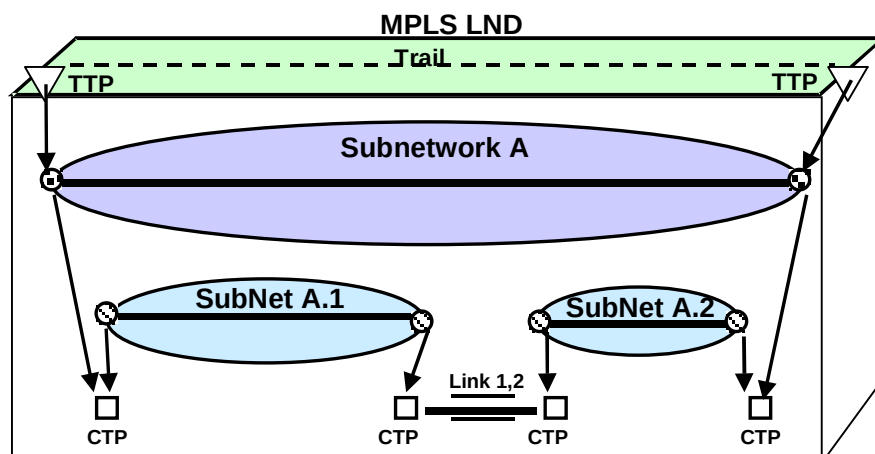


Figure 5-6 – Connection elements

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.

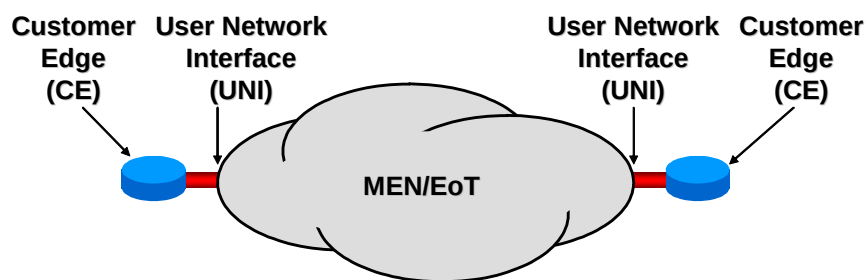


Figure 5-7 – Ethernet services model [MEF 6] [MEF 10.1]

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.

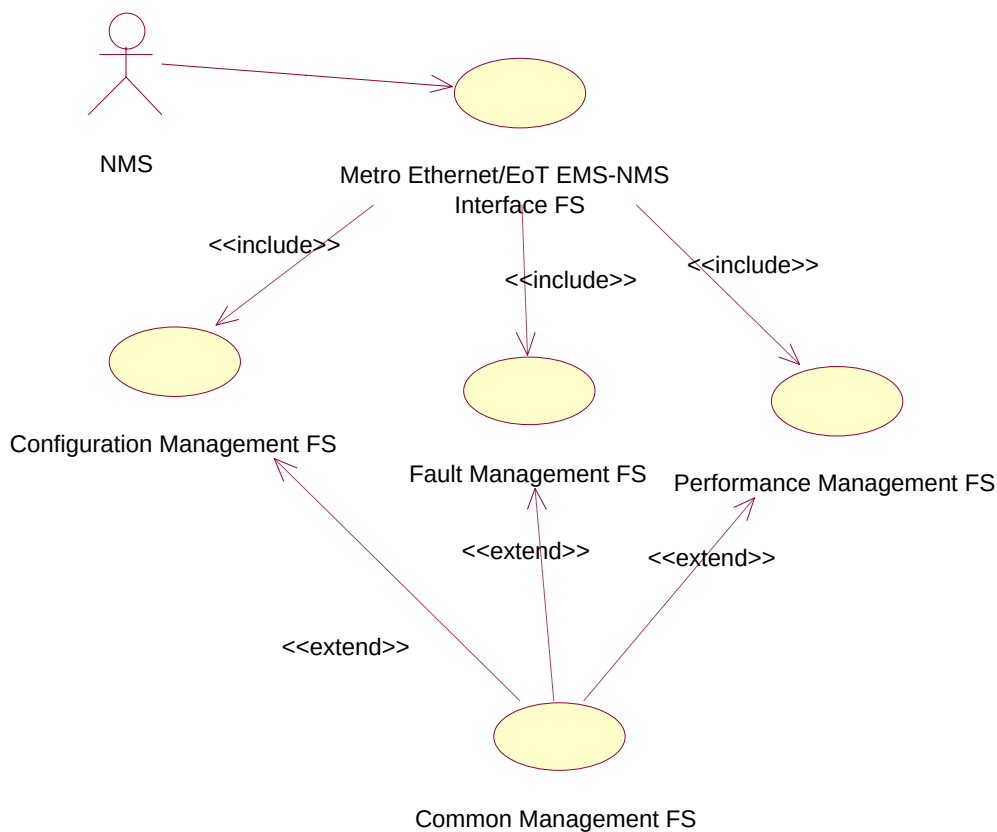


Figure 6-1 – Metro Ethernet/EoT management interface function set

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].

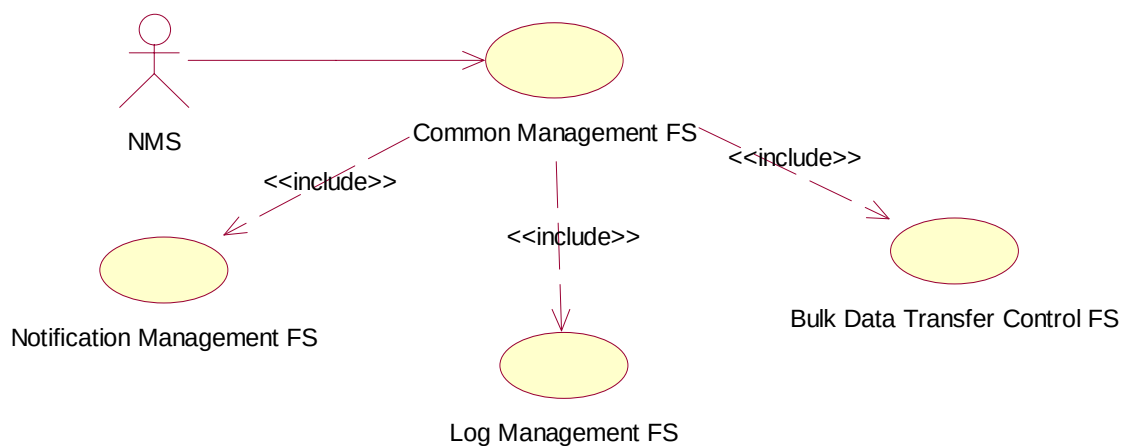


Figure 6-2 – Common management function set overview

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

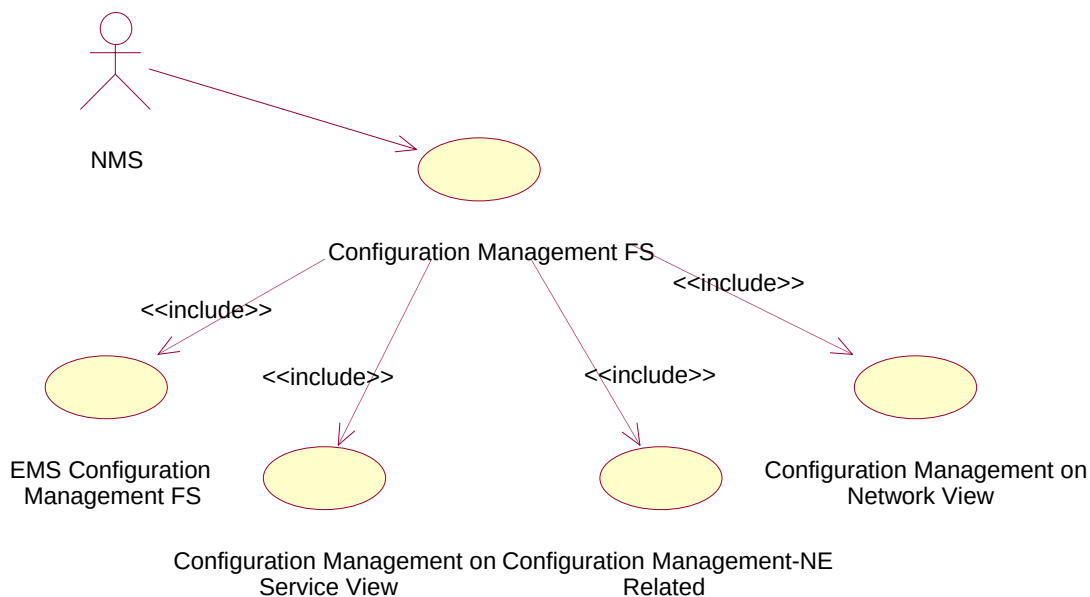


Figure 6-3 – Configuration management function set

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

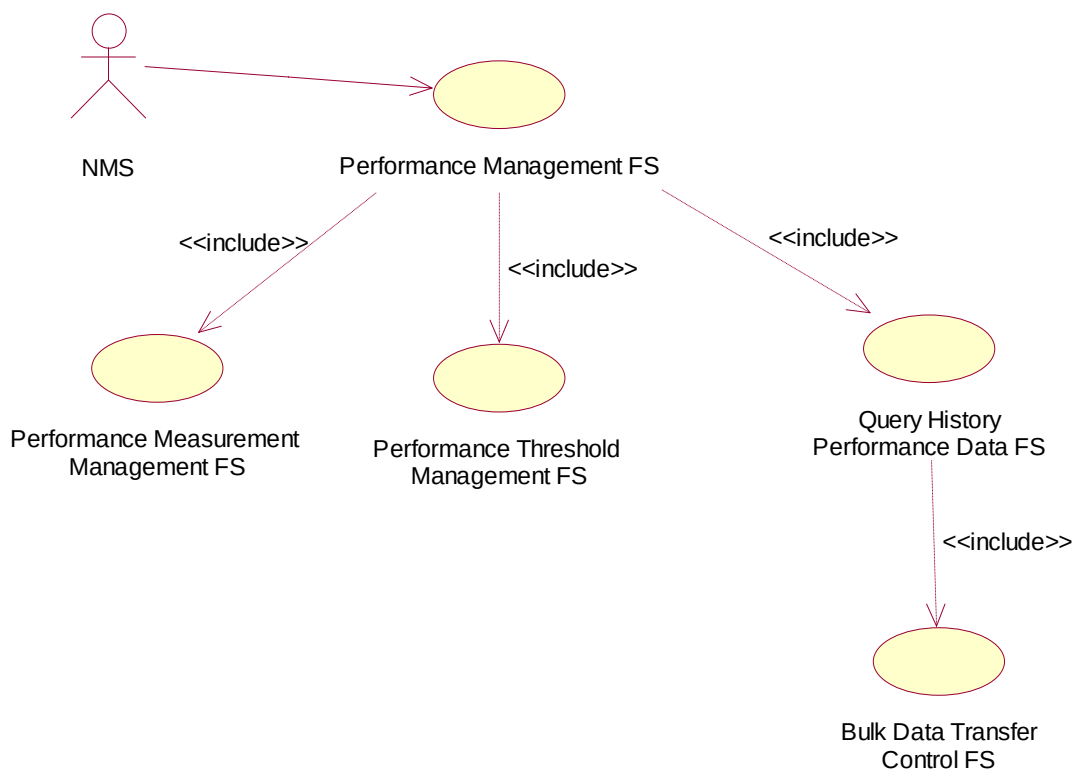


Figure 6-4 – Performance management function set

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

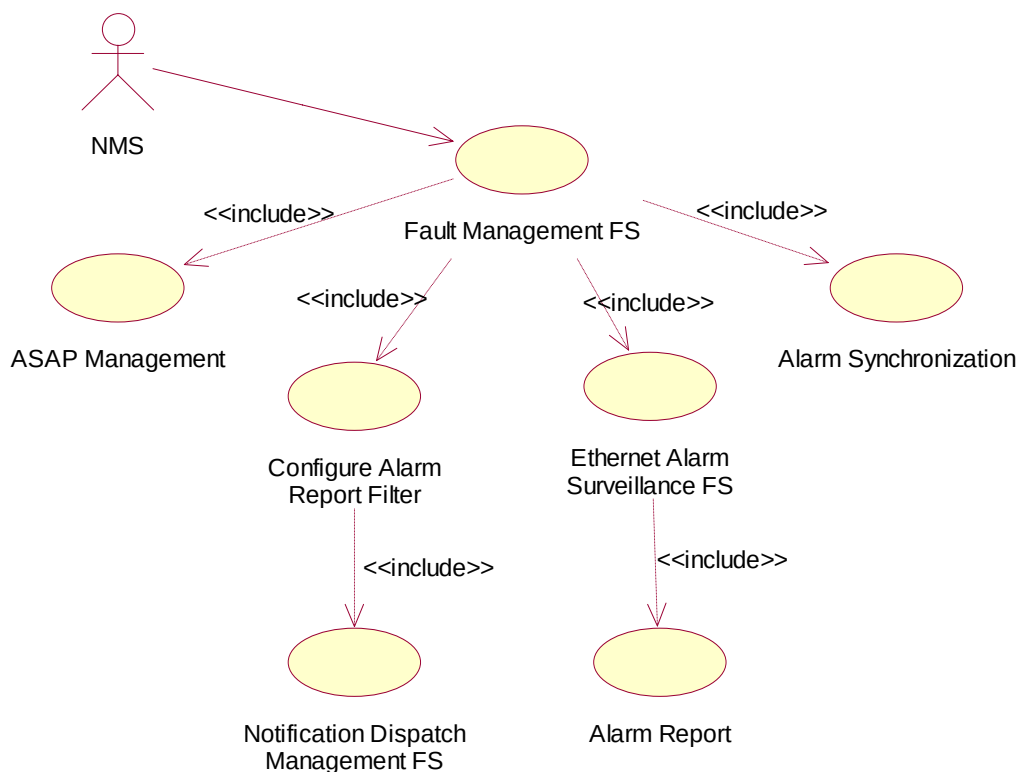


Figure 6-5 – Fault management function set

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.

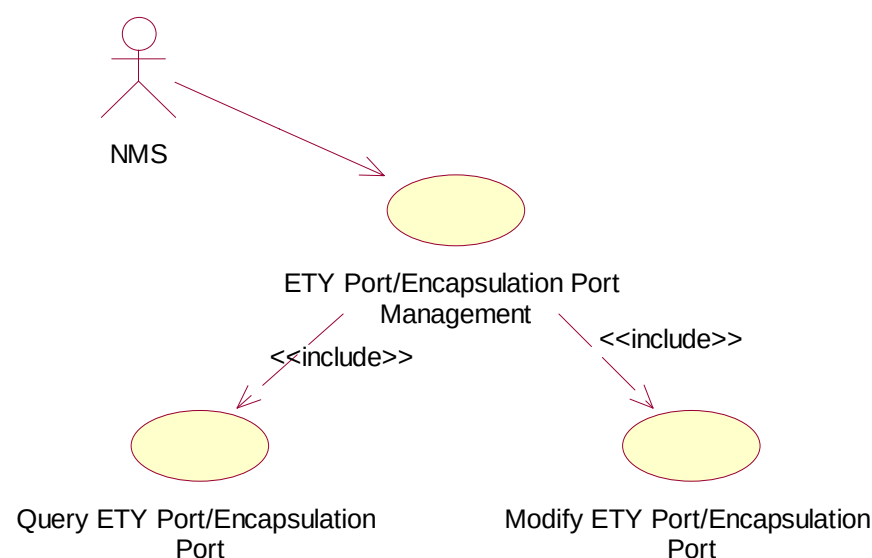


Figure 6-6 – ETY port management function set

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.

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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.

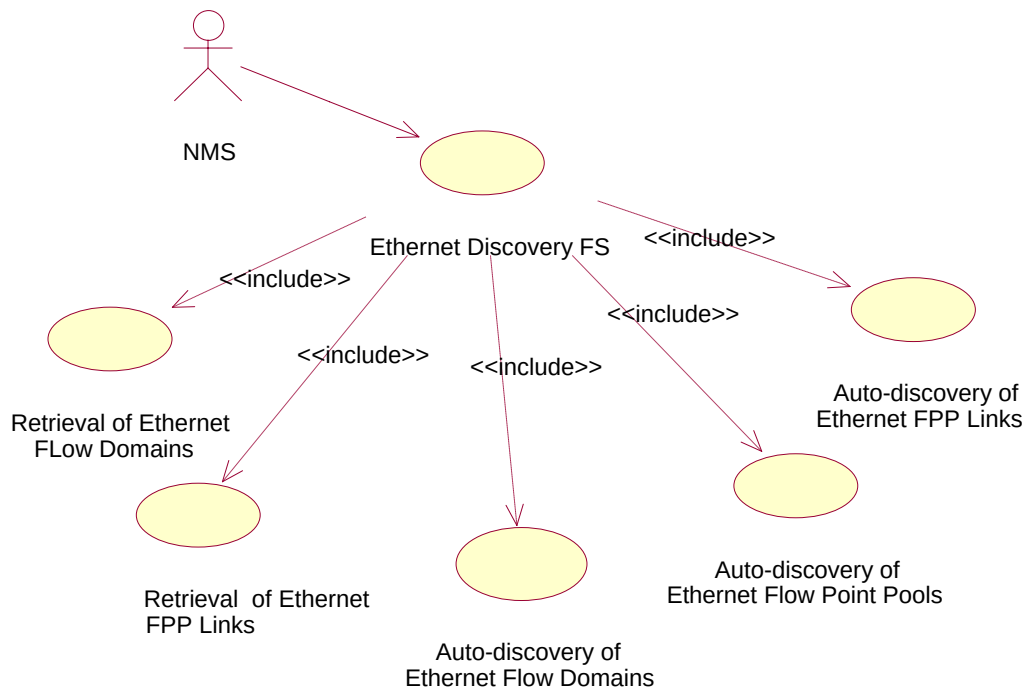


Figure 6-7 – Ethernet discovery function set

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.

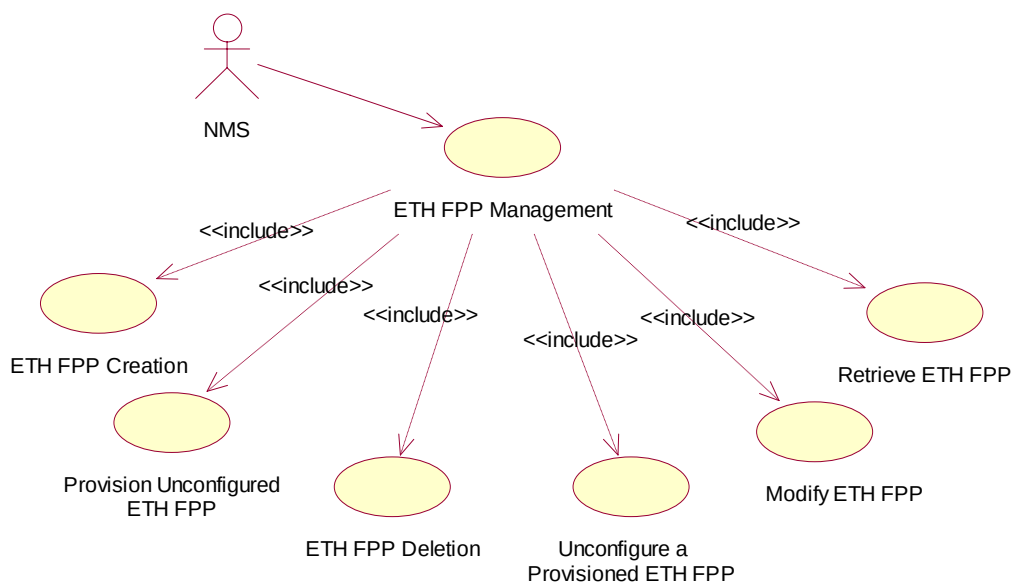


Figure 6-8 – ETH FPP management

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.
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