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Title: Interface Requirements for Ethernet Passive Optical Networks

Summary :

This contribution provides an Ethernet Passive Optical Networks (EPON) management interface between Element Management System provided to manage network resources conforming to a network owner Network Management System.

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Interface Requirements For Ethernet Passive Optical Networks

Table of Contents

Introduction

This contribution provides a draft recommendation for a UML description of a management interface between Element Management System provided along with network resources. Generally speaking the Element Management System means EMS and the Network Management System means NMS. However, the Element Management System is required to present a "network view" of connection management to the Network Management System and so it was deemed necessary for clarity to use the terminology adopted in naming the systems involved. This Technology is called Ethernet Passive Optical Network (EPON) equipment.

This document follows the UML requirements process proposed by ITU-T Recommendation M.3020. It is anticipate that this contribution might stimulate brief discussion in Study Group 4 on the detailed management content for EPON equipment.

Introduction and Background

This Recommendation contains a management interface between Element Management System and Network Management System. This work defines part of the management aspects for network resources similar to APON or BPON resource and other relative resources with EPON technology.

Keywords (optional)

UML, EPON, APON, BPON

Interface Requirements for Broadband Passive Optical Network

1 Scope

This contribution provides a draft recommendation for a UML description of a management interface between Element Management System provided along with network resources. Generally speaking the Element Management System means EMS and the Network Management System means NMS. However, the Element Management System is required to present a "network view" of connection management to the Network Management System and so it was deemed necessary for clarity to use the terminology adopted in naming the systems involved. This Technology is called Ethernet Passive Optical Network (EPON) equipment.

This document follows the UML requirements process proposed by ITU-T Recommendation M.3020. It is anticipate that this contribution might stimulate brief discussion in Study Group 4 on the detailed management content for EPON equipment.

2 References

2.1 Related Recommendations

Ed note: This does not have the cross references set up.

The following Recommendations should be referred to in connection with this Recommendation:

[1] ITU-T Recommendation G983.1 (1998), *Broadband optical access systems based on Passive Optical Networks (PON)*

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

[3} ITU-T Recommendation M.3200 (1998), *TMN management services: overview*.

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

[5] *Unified Modelling Language*, Section 1 of OMG Modelling, OMG Doc. No.Formal/99-06-01.

[6] ITU-T Recommendation Q.834.1 (2001), *Network element view information model for ATM-PON system.*

[7] ITU-T Recommendation Q.834.2 (2001), *Network view information model for ATM-PON system.*

3 Definitions

For the purposes of this Recommendation, the following definitions apply:

3.1 Terms imported from M.3010

The following terms from M.3010 are used in this Recommendation.

- User

- TMN management service
- TMN management function set

3.2 Terms imported from UML

The following terms from UML are used in this Recommendation.

– Actor
– Class
– Class Diagram
– Sequence Diagram
– Use Case
– Use Case Diagram

3.3 New Terms

Include - An include relationship from Use Case A to Use Case B indicates that an instance of the Use Case A will also contain the behaviour as specified by B.

Communicate – A communicate relationship from Actor A to Use Case B indicates that an interaction relationship from Actor A to Use Case B.

EPON resource – EPON network resources that need to be managed. These resources can be physical and logical.

3.4 Abbreviations

For the purposes of this Recommendation, the following abbreviations are used:

APON	ATM Passive Optical Network
ATM	Asynchronous Transfer Mode
BPON	Broadband Passive Optical Network
CCITT	Consultative Committee on International Telephone & Telegraph
CORBA	Common Object Request Broker Architecture
DCN	Data Communications Network
EM	Element Management
EML	Element Management Layer
EM-OSF	Element Management Layer Operating System Function
EMS	Element Management System
EPON	Ethernet Passive Optical Network
FSAN	Full Services Access Network
GARP	Generic Attribute Registration Protocol
GDMI	Guidelines for the Definition of Management Interface
GMRP	GARP Multicast Registration Protocol
GUI	Graphical User Interface

IP	Internet Protocol
ITU	International Telecommunication Union
MIB	Management Information Base
NE	Network Element
NEL	Network Element Layer
NM	Network Management
NML	Network Management Layer
NM-OSF	Network Management Layer Operating System Function
NMS	Network Management System
OAM&P	Operations, Administration, Maintenance and Provisioning
ODN	Optical Distribution Network
OLT	Optical Line Terminal
OMG	Object Management Group
ONU	Optical Network Unit
OS	Operations System
OSF	Operations System Function
PON	Passive Optical Network
RMON	Remote Network Monitoring
SM	Service Management
SML	Service Management Layer
SM-OSF	Service Management Layer Operating System Function
SMS	Service Management System
STP	Spanning Tree Protocol
TMN	Telecommunication Management Network
UNI	User-Network Interface
UML	Unified Modelling Language
VLAN	Virtual LAN

4 GDMI Template

4.1 Scope

The scope of this recommendation includes management aspects for EPON system. The EPON system can be classified as an Access and Terminal Equipment Network. The management services covered by this recommendation include aspects of configuration management, alarm management, performance management and service management. Figure 4-1 below shows the Q interface addressed in this recommendation.

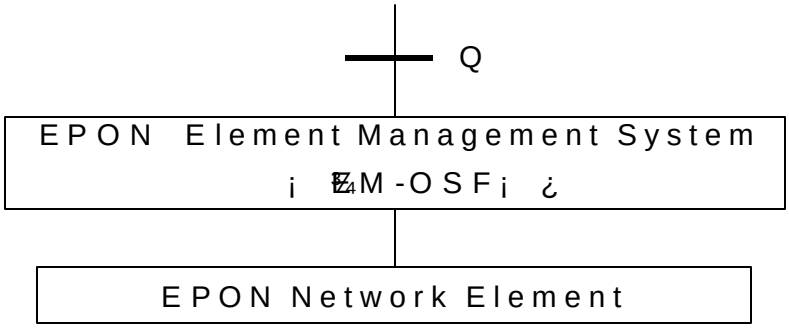


Figure 4-1: Reference Interface

4.2 Requirements

4.2.1 Business Level Requirements

4.2.1.1 Actor Roles

There are several actors mentioned in the high-level Use Case Diagrams provided in Section 5.2.1.3. These actors include the following: Network Management System, Element Management System. Figure 4-2 below provides a brief definition of the roles that these actors play.

Actor	**Roles**
Network Management System	A higher level management system which interact with lower level management system called Element Management System to perform a management.
Element Management System	A lower level management system to manage NE directly.

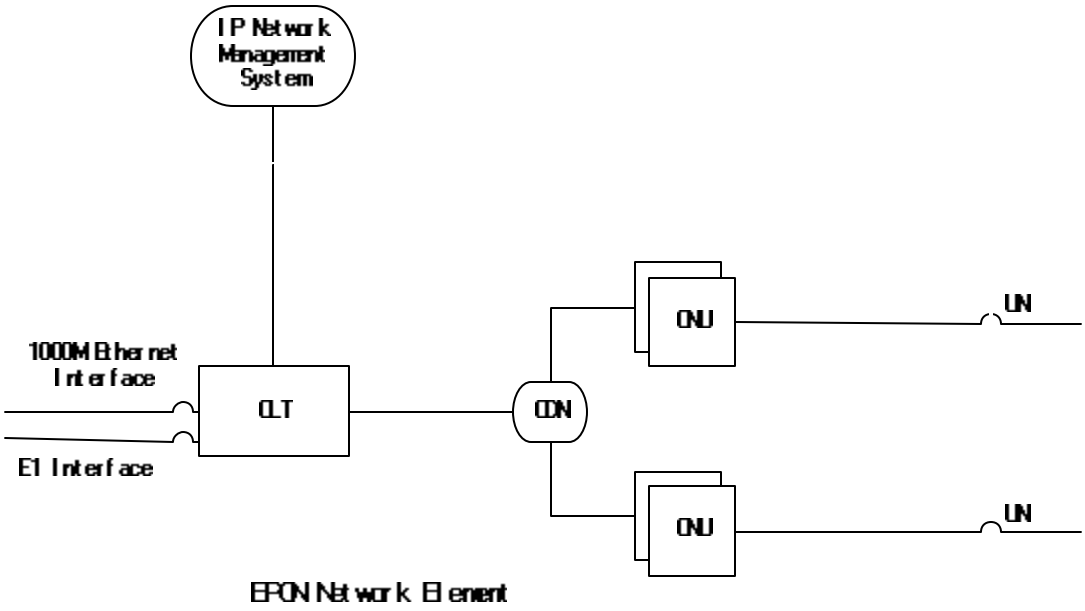
Figure 4-2: Actors and Roles

4.2.1.2 Telecommunications resources

Figure 4-3 below illustrates the EPON System Architecture. The operation system linked to the OLT in the figure is the Element Management System. This system is provided along with the equipment to a network owner operator. This recommendation does not specify the management communications interface between the OLT and the Element Management System. Consequently both the Element Management System and the managed EPON equipment are viewed as relevant telecommunications resources in this recommendation.

The OLT (or Optical Line Terminal) is a head-end digital terminal commonly located in the central office or some controlled environment structure. The ODN (Optical Distribution Network) is a point to multi-point

fibre infrastructure employing a passive splitter or coupler device for the fan out. The ONU provides the access network line termination function.



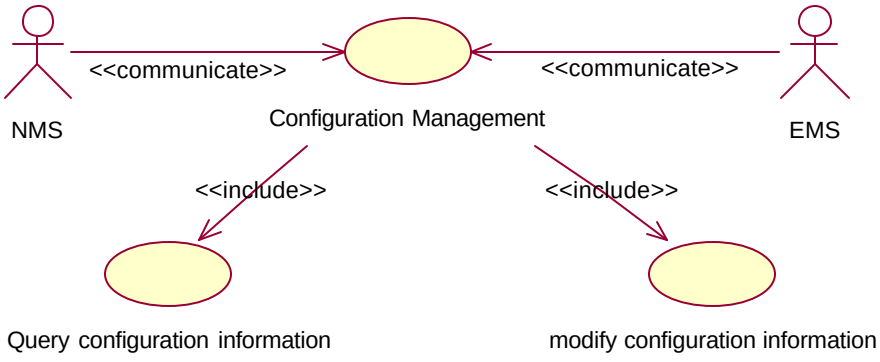


Figure 4-4: Configuration Management

The second overview Use Case Diagram shows the interactions involved in alarm management. The alarm management use case includes alarm level management, event trap management, alarm information handle, such as query history alarm information and clear, acknowledge some real alarm information and also alarm information show.

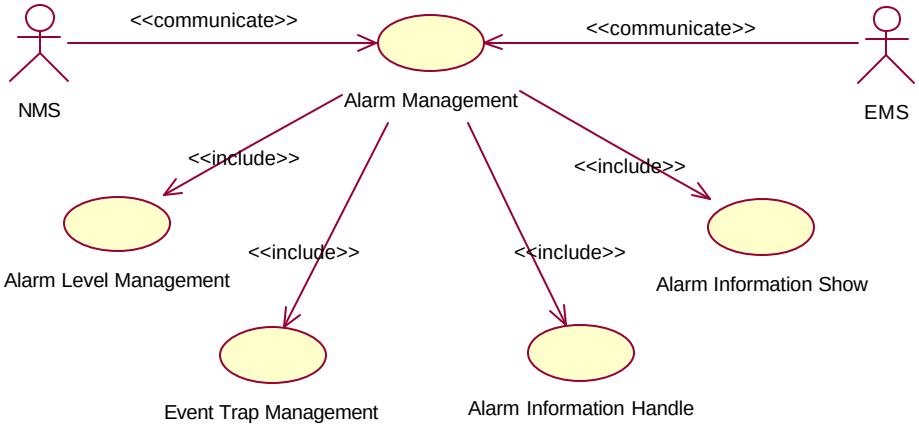


Figure 4-5: Alarm Management

The third overview Use Case Diagram shows interactions involved in performance management. The performance management use case includes collect performance data and performance threshold management.

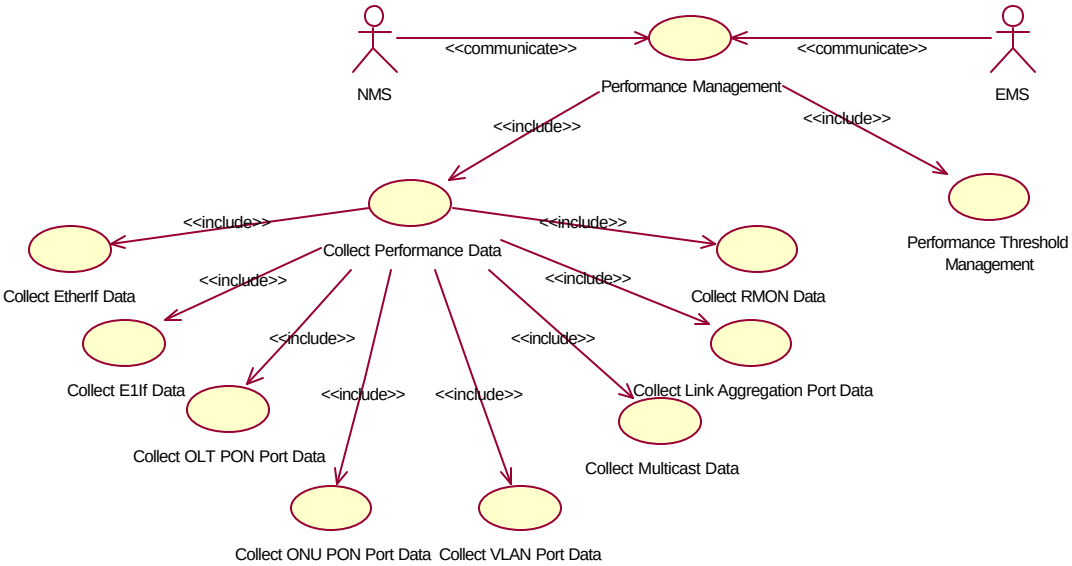


Figure 4-6: Performance Management

The next six Use Case Diagram shows interactions involved in service management. The performance management use case includes the following use cases, such as OLT test, other service management, and user port management. Below this Use Case Diagram are the detailed Diagram for each section.

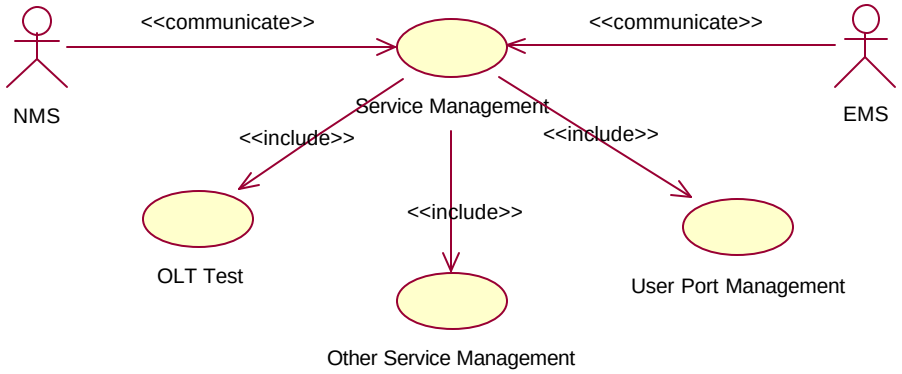


Figure 4-7: Service Management

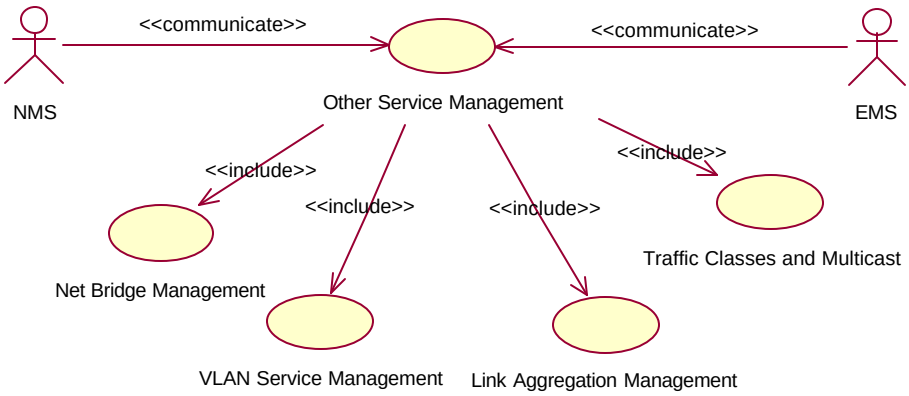


Figure 4-8: Other Service Management

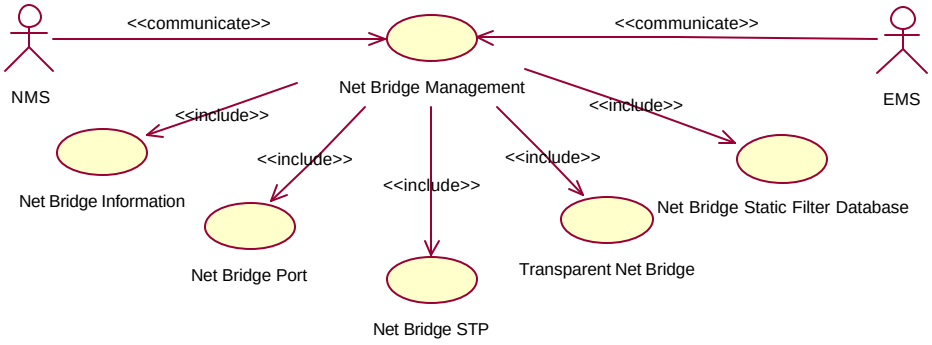


Figure 4-9: Bridge Management

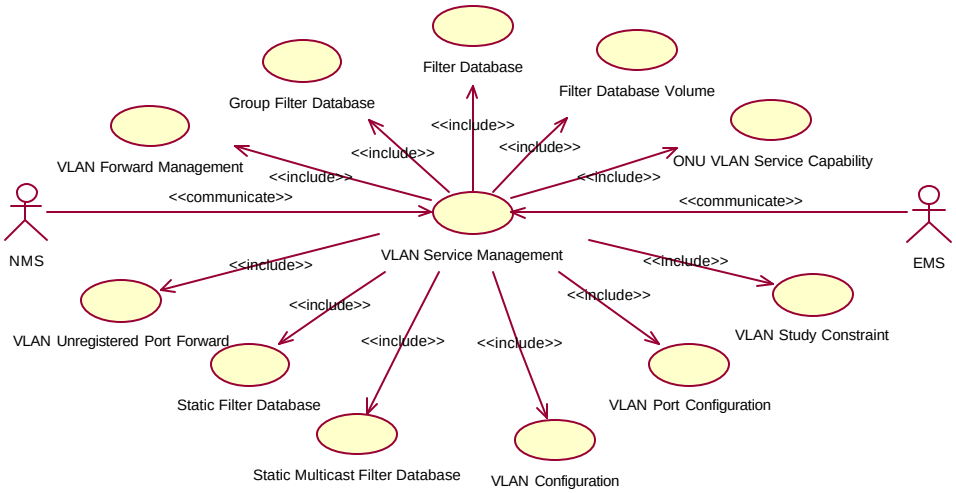


Figure 4-10: VLAN Service Management

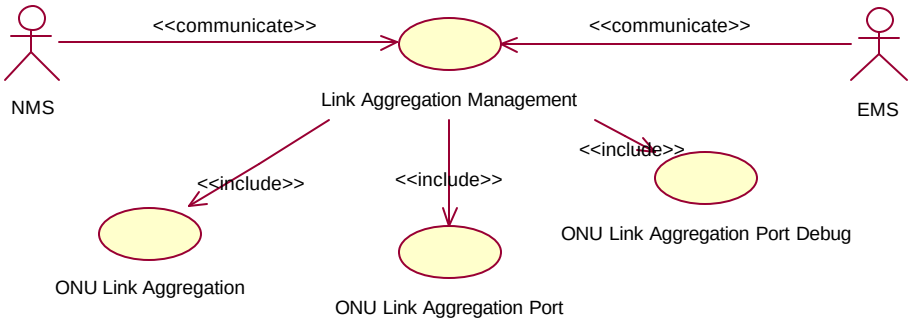


Figure 4-11: Link Aggregatio n Management

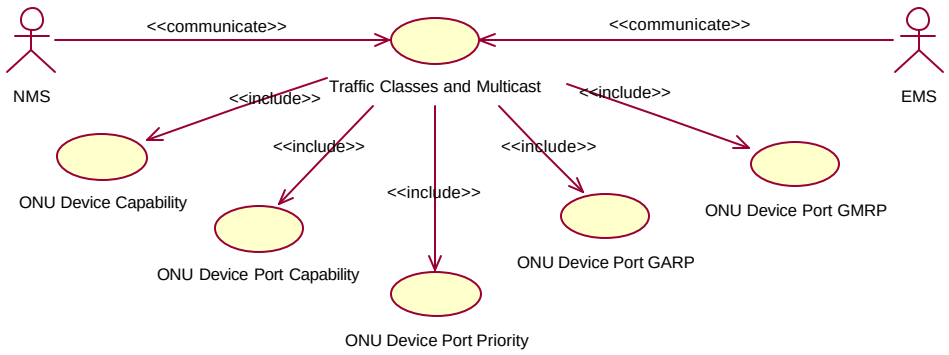


Figure 4-11: Traffic Classes and Multicast

4.2.2 Specification Level Requirements

This section contains textual details for each of the Use Cases shown in the high-level Use Case diagrams of the previous section. The details are provided to clarify the roles of external actors and telecommunications resources, to establish the basis for interactive diagrams in the Analysis Section, and to refine the previous high level Use Case diagrams to a specification level. Use case details include the following components:

- Summary – short summary of use case functionality referencing TMN functionality as needed
- Actors – actors are listed as shown in Figure 5-2 followed by parenthetical role characteristic
- Preconditions – identifies the trigger for the use case commencement
- Description – detailed textual rendition of the functionality of the use case including stops where exceptions can occur
- Exceptions – identifies unsuccessful completion circumstances for the use case

4.2.2.1 Configuration Management

Summary: The Element Management System (EMS) queries or modifies the attributes of the EPON resources on request of the NMS. These resources include nodes (OLT, ONU, Splitter) , ports (OLT PON, ONU PON, E1 , Ethernet) and logical entities (E1 connection, ONU logic connection) .

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query or modify the attribute information of the EPON resources, These resources include nodes (OLT, ONU, Splitter), ports (OLT PON, ONU PON , E1 , Ethernet) and Logic entities (E1 connection, ONU logic connection) .The request must include the unique ID of the managed object.

The Element Management System then search the configuration information database to get the attribute information of the specified managed object and return them back to the Network Management System.

Or, the Element Management System send the modified data back to the configuration information database, and then return the success or fail information to the Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.2 Collect Performance Data

Summary: The Element Management System (EMS) queries the performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.3 Collect EtherIf Data

Summary: The Element Management System (EMS) queries the Ethernet interface performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the Ethernet interface performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include ifInOctets, ifInUcastPkts, ifInDiscards, IfInErrors, ifInUnknownProtos, ifOutOctets, ifOutUcastPkts, ifOutDiscards and ifOutErrors. See rfc2358.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.4 Collect E1If Data

Summary: The Element Management System (EMS) queries the E1 interface performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applic ations has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the E1 interface performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include LineErroredSeconds(LES), ControlledSlipSeconds (CSS), Errored Seconds (ES), BurstyErroredSeconds (BES), SeverelyErroredSeconds(SES), SeverelyErroredFramingSecond (SEFS), DegradedMinutes and UnavailableSeconds (UAS). See rfc2495.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.5 Collect OLT PON Port Data

Summary: The Element Management System (EMS) queries the OLT PON port performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the OLT PON port performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include OltPONIfBERUp, OltPONIfBERUpMax, OltPONIfBERDown and OltPONIfBERDownMax, Those performance information parameters are not defined in any RFC or IEEE document. Their description is showing below:

Performance Parameter Name	Description
OltPONIfBERUp	Upward BER value
OltPONIfBERUpMax	Upward BER value threshold
OltPONIfBERDown	Downward BER value
OltPONIfBERDownMax	Downward BER value threshold

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.6 Collect ONU PON Port Data

Summary: The Element Management System (EMS) queries the ONU PON port performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the ONU PON port performance information .This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include OnuPONIfBERUp, OnuPONIfBERUpMax, OnuPONIfBERDown and OnuPONIfBERDownMax, Those performance information parameters are not defined in any RFC or IEEE document. Their description is showing below:

Performance Parameter Name	Description
OnuPONIfBERUp	Upward BER value
OnuPONIfBERUpMax	Upward BER value threshold
OnuPONIfBERDown	Downward BER value
OnuPONIfBERDownMax	Downward BER value threshold

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.7 Collect VLAN Port Data

Summary: The Element Management System (EMS) queries the VLAN port performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the VLAN port performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include dot1qTpVlanPortInFrames, dot1qTpVlanPortOutFrames, dot1qTpVlanPortInDiscards, dot1qTpVlanPortInOverflowFrames, dot1qTpVlanPortOutOverflowFrames, dot1qTpVlanPortInOverflowDiscards, dot1qTpVlanPortHCInFrames, dot1qTpVlanPortHCOutFrames, and dot1qTpVlanPortHCInDiscards. See rfc2674.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.8 Collect Multicast Data

Summary: The Element Management System (EMS) queries the multicast performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the multicast performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include dot1dTpHCPortInFrames, dot1dTpHCPortOutFrames, dot1dTpHCPortInDiscards, dot1dTpPortInOverflowFrames, dot1dTpPortOutOverflowFrames and dot1dTpPortInOverflowDiscards. See rfc2674.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc

4.2.2.9 Collect Link Aggregation Port Data

Summary: The Element Management System (EMS) queries the link aggregation port performance information on request of the NMS.

Actors: EPON NMS, EPON EMS

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the link aggregation port performance information . This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include dot3adAggPortStatsLACPDUsRx, dot3adAggPortStatsMarkerPDUsRx, dot3adAggPortStatsMarkerResponsePDUsRx, dot3adAggPortStatsUnknownRx, dot3adAggPortStatsIllegalRx, dot3adAggPortStatsLACPDUsTx, dot3adAggPortStatsMarkerPDUsTx and dot3adAggPortStatsMarkerResponsePDUsTx.See IEEE 802.3ad.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc

4.2.2.10 Collect RMON Data

Summary: The Element Management System (EMS) queries the RMON performance information on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query the RMON performance information. This request must include the unique ID of the managed object.

The Element Management System then search the performance information database to get the information of the specified managed object and return them back to the Network Management System.

The performance information should include

etherStatsDataSource, etherStatsDropEvents, etherStatsOctets, etherStatsPkts, etherStatsBroadcastPkts, etherStatsMulticastPkts, etherStatsCRCAlignErrors, etherStatsUndersizePkts, etherStatsOversizePkts, etherStatsFragments, etherStatsJabbers, etherStatsCollisions, etherStatsPkts64Octets, etherStatsPkts65to127Octets, etherStatsPkts128to255Octets, etherStatsPkts256to511Octets, etherStatsPkts512to1023Octets and etherStatsPkts1024to1518Octets. See rfc1757.

Exceptions: IDNotExist, RequestTime out, NoOperationRight, CommnicationError, etc

4.2.2.11 Performance Threshold Management

Summary: The Element Management System (EMS) queries or sets or modifies the performance threshold data on request of the NMS.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Element Management application, NMS and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to query or set or modify the performance threshold data. This request must include the unique ID of the managed object.

The Element Management System then the performance threshold data of the specified managed object and return them back to the Network Management System.

Or, the Element Management System sets or modifies the threshold data, then return the success of fail information to the Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, etc.

4.2.2.12 Alarm Level Management

Summary: Network Management System can define the alarm level of all kinds of alarms which trap by lower Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to show or modify alarm level information of the alarm trap by Element Management System. Then GUI will show alarm with relative alarm level.

Exceptions: NoOperationRight, DatabaseOperationError, etc.

4.2.2.13 Alarm Information Handle

Summary: Network Management System queries the history alarm information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update history alarm information for the EPON NEs, such as OLT, ONU, Splitter and other logical entities, such as connections between physical equipments. This request must include the unique ID of the managed object.

The Element Management System then search the history alarm information database to get or update information for specialized managed object and return them back to Network Management System.

AlarmType:

TrapType Name	Description
power33OltAlarm	OLT side 3.3v power alarm
power33OltAlarmClear	OLT side 3.3v power resume
power33OnuAlarm	ONU side 3.3v power alarm
power33OnuAlarmClear	ONU side 3.3v power resume
power12OltAlarm	OLT side 12v power alarm
power12OltAlarmClear	OLT side 12v power resume
power12OnuAlarm	ONU side 12v power alarm
power12OnuAlarmClear	ONU side 12v power resume
sigLosOltAlarm	OLT side PON interface signal lost alarm
sigLosOltAlarmClear	OLT side PON interface signal lost resume
sigLosOnuAlarm	ONU side PON interface signal lost alarm
sigLosOnuAlarmClear	ONU side PON interface signal lost resume
rcvOltAlarm	OLT side PON interface no received light alarm
rcvOltAlarmClear	OLT side PON interface no received light resume
rcvOnuAlarm	ONU side PON interface no received light alarm
rcvOnuAlarmClear	ONU side PON interface no received light resume
sndOltAlarm	OLT side PON interface no sending light alarm
sndOltAlarmClear	OLT side PON interface no sending light resume
sndOnuAlarm	ONU side PON interface no sending light alarm

sndOnuAlarmClear	ONU side PON interface no sending light resume
syncLosOltAlarm	OLT side PON interface lost synchronization alarm
syncLosOltAlarmClear	OLT side PON interface lost synchronization resume
syncLosOnuAlarm	ONU side PON interface lost synchronization alarm
syncLosOnuAlarmClear	ONU side PON interface lost synchronization resume
berOltAlarm	OLT side PON interface BER performance alarm
berOltAlarmClear	OLT side PON interface BER performance resume
berOnuAlarm	ONU side PON interface BER performance alarm
berOnuAlarmClear	ONU side PON interface BER performance resume
rcvGbEAlarm	OLT/ONU side Gb Ethernet interface received no light alarm
rcvGbEAlarmClear	OLT/ONU side Gb Ethernet interface received no light resume
sndGbEAlarm	OLT/ONU side Gb Ethernet interfaces sending no light alarm
sndGbEAlarmClear	OLT/ONU side Gb Ethernet interfaces sending no light resume
feAlarm	ONU side fast Ethernet interface fault alarm
feAlarmClear	ONU side fast Ethernet interface fault resume
losE1Alarm	OLT/ONU side E1 interface spur track lost alarm
losE1AlarmClear	OLT/ONU side E1 interface spur track lost resume
aisE1Alarm	OLT/ONU side E1 interface AIS alarm
aisE1AlarmClear	OLT/ONU side E1 interface AIS resume
syncE1Alarm	OLT/ONU side E1 interface frame lost synchronization alarm
syncE1AlarmClear	OLT/ONU side E1 interface frame lost

	synchronization resume
gLosE1Alarm	OLT/ONU side E1 interface group track signal lost alarm
gLosE1AlarmClear	OLT/ONU side E1 interface group track signal lost resume
checkE1Alarm	OLT/ONU side E1 interface check alarm
checkE1AlarmClear	OLT/ONU side E1 interface check resume
regFail	ONU register failure
regSucc	ONU register succeed

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.14 Event Trap Management

Summary: Network Management System handles real alarm trap information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when Network Management System received a real alarm trap from Element Management System, the real alarm trap may be trapped by all kinds of physical entities, such as OLT, ONU, Splitter and other logical entities, such as connections between physical equipments. This request must include the unique ID of the managed object and the trap id which indicates the probably causes.

The Network Management System then stores the alarm information into alarm database and sends a message to GUI to update user interface so that it could catch user's eye.

Exceptions: CommnicationError, DatabaseOperationError, etc.

4.2.2.15 Net Bridge Information

Summary: Network Management System queries the basic information of the net bridge through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update net bridge basic information for the specified OLT equipment. This request must include the

unique ID of the OLT managed object and other relative parameters such as dot1dBaseBridgeAddress, dot1dBaseNumPorts, and dot1dBaseType. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.16 Net Bridge Port

Summary: Network Management System queries the basic information of the net bridge port through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update net bridge port basic information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dBasePort, dot1dBasePortIfIndex, dot1dBasePortCircuit, dot1dBasePortDelayExceededDiscards, dot1dBasePortMtuExceededDiscards. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.17 Net Bridge STP

Summary: Network Management System queries the STP information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update STP information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dStpProtocolSpecification, dot1dStpPriority, dot1dStpTimeSinceTopologyChange, dot1dStpTopChanges, dot1dStpDesignatedRoot, dot1dStpRootCost, dot1dStpRootPort, dot1dStpMaxAge, dot1dStpHelloTime, dot1dStpHoldTime, dot1dStpForwardDelay, dot1dStpBridgeMaxAge, dot1dStpBridgeHelloTime, dot1dStpBridgeForwardDelay. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.18 Net Bridge STP Port

Summary: Network Management System queries the STP port information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update STP port information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dStpPort, dot1dStpPortPriority, dot1dStpPortState, dot1dStpPortEnable, dot1dStpPortPathCost, dot1dStpPortDesignatedRoot, dot1dStpPortDesignatedCost, dot1dStpPortDesignatedBridge, dot1dStpPortDesignatedPort, dot1dStpPortForwardTransitions. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.19 Transparent Net Bridge

Summary: Network Management System queries the transparent net bridge information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update transparent net bridge information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dTpLearnedEntryDiscards, dot1dTpAgingTime, dot1dTpFdbAddress, dot1dTpFdbPort, dot1dTpFdbStatus, dot1dTpPort, dot1dTpPortMaxInfo, dot1dTpPortInFrames, dot1dTpPortOutFrames, dot1dTpPortInDiscards. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.20 Net Bridge Static Filter Database

Summary: Network Management System queries the transparent net bridge static filter database information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the NMS makes a request to the Element Management System to get or update transparent net bridge static filter database information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dStaticAddress, dot1dStaticReceivePort, dot1dStaticAllowedToGoTo, dot1dStaticStatus. For details, see to RFC 1493.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.21 ONU VLAN Service Capability

Summary: Network Management System queries the ONU VLAN service capability information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU VLAN service capability information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanVersionNumber, dot1qMaxVlanId, dot1qMaxSupportedVlans, dot1qNumVlans, dot1qGvrpStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get information for specialized managed object or sends a message to NE directly to get information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.22 Filter Database Volume

Summary: Network Management System queries the filter information database capability information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update filter information database capability information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qFdbId, dot1qFdbDynamicCount. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.23 Filter Database

Summary: Network Management System queries the filter information database information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update filter information database information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qFdbId, dot1qTpFdbAddress, dot1qTpFdbPort, dot1qTpFdbStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.24 Group Filter Database

Summary: Network Management System queries the group filter information database information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update group filter information database information for the

specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanIndex, dot1qTpGroupAddress, dot1qTpGroupEgressPorts, dot1qTpGroupLearnt. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.25 VLAN Forward Management

Summary: Network Management System queries the VLAN forward management information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN forward management information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanIndex, dot1qForwardAllPorts, dot1qForwardAllStaticPorts, dot1qForwardAllForbiddenPorts. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.26 VLAN Unregistered Port Forward

Summary: Network Management System queries the VLAN unregistered port forward management information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN unregistered port forward management information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanIndex, dot1qForwardUnregisteredPorts, dot1qForwardUnregisteredStaticPorts, dot1qForwardUnregisteredForbiddenPorts. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.27 Static Filter Database

Summary: Network Management System queries the VLAN static unicast filter information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN static unicast filter information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qFdbId, dot1qStaticUnicastAddress, dot1qStaticUnicastReceivePort, dot1qStaticUnicastAllowedToGoTo, dot1qStaticUnicastStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.28 Static Multicast Filter Database

Summary: Network Management System queries the VLAN static multicast filter information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN static multicast filter information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanIndex, dot1qStaticMulticastAddress, dot1qStaticMulticastReceivePort, dot1qStaticMulticastStaticEgressPorts, dot1qStaticMulticastForbiddenEgressPorts, dot1qStaticMulticastStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.29 VLAN Configuration

Summary: Network Management System queries the VLAN configuration information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN configuration information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qVlanNumDeletes, dot1qNextFreeLocalVlanIndex, dot1qConstraintSetDefault, dot1qConstraintTypeDefault, dot1qVlanTimeMark, dot1qVlanFdbId, dot1qVlanCurrentEgressPorts, dot1qVlanCurrentUntaggedPorts, dot1qVlanStatus, dot1qVlanCreationTime, dot1qVlanStaticName, dot1qVlanStaticEgressPorts, dot1qVlanForbiddenEgressPorts, dot1qVlanStaticUntaggedPorts, dot1qVlanStaticRowStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.30 VLAN Port Configuration

Summary: Network Management System queries the VLAN port configuration information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN port configuration information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qPvid, dot1qPortAcceptableFrameTypes, dot1qPortIngressFiltering, dot1qPortGvrpStatus, dot1qPortGvrpFailedRegistrations, dot1qPortGvrpLastPduOrigin. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.31 VLAN Study Constraint

Summary: Network Management System queries the VLAN study constraint information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update VLAN study constraint information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1qConstraintVlan, dot1qConstraintSet, dot1qConstraintType, dot1qConstraintStatus. For details, see to RFC 2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.32 ONU Link Aggregation

Summary: Network Management System queries the link aggregation information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update link aggregation information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot3adAggIndex, dot3adAggMACAddress, dot3adAggActorSystemPriority, dot3adAggActorSystemID, dot3adAggAggregateOrIndividual, dot3adAggActorAdminKey, dot3adAggActorOperKey, dot3adAggPartnerSystemPriority, dot3adAggPartnerSystemID, dot3adAggPartnerOperKey, dot3adAggCollectorMaxDelay, dot3adAggPortListPorts. For details, see to IEEE 802.3ad.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.33 ONU Link Aggregation Port

Summary: Network Management System queries the link aggregation port protection information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update link aggregation port protection information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot3adAggPortIndex, dot3adAggPortActorSystemPriority, dot3adAggPortActorSystemID, dot3adAggPortActorAdminKey, dot3adAggPortActorOperKey, dot3adAggPortPartnerAdminSystemPriority, dot3adAggPortPartnerAdminSystemID, dot3adAggPortPartnerOperSystemPriority, dot3adAggPortPartnerOperSystemID, dot3adAggPortPartnerAdminKey, dot3adAggPortPartnerOperKey, dot3adAggPortSelectedAggID, dot3adAggPortAttachedAggID, dot3adAggPortActorPort, dot3adAggPortActorPortPriority, dot3adAggPortPartnerAdminPort, dot3adAggPortPartnerOperPort, dot3adAggPortPartnerAdminPortPriority, dot3adAggPortPartnerOperPortPriority, dot3adAggPortActorAdminState, dot3adAggPortActorOperState, dot3adAggPortPartnerOperState, dot3adAggPortPartnerAdminState, dot3adAggPortAggregateOrIndividual. For details, see to IEEE 802.3ad.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.34 ONU Link Aggregation Port Debug

Summary: Network Management System queries the link aggregation port debug information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update link aggregation port debug information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot3adAggPortIndex, dot3adAggPortDebugRxState, dot3adAggPortDebugLastRxTime, dot3adAggPortDebugMuxState, dot3adAggPortDebugMuxReason, dot3adAggPortDebugActorChurnState, dot3adAggPortDebugPartnerChurnState, dot3adAggPortDebugActorChurnCount, dot3adAggPortDebugActorChurnCount, dot3adAggPortDebugActorSyncTransitionCount, dot3adAggPortDebugPartnerSyncTransitionCount, dot3adAggPortDebugActorChangeCount, dot3adAggPortDebugPartnerChangeCount, . For details, see to IEEE 802.3ad.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.35 ONU Device Capability

Summary: Network Management System queries the ONU device capability information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU device capability information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dDeviceCapabilities, dot1dTrafficClassesEnabled, dot1dGmrpStatus. For details, see to RFC2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.36 ONU Device Port Capability

Summary: Network Management System queries the ONU device port capability information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU device port capability information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dPortCapabilities. For details, see to RFC2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.37 ONU Device Port Priority

Summary: Network Management System queries the ONU device port priority information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU device port priority information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dPortDefaultUserPriority, dot1dPortNumTrafficClasses, dot1dUserPriority, dot1dRegenUserPriority, dot1dTrafficClassPriority, dot1dTrafficClass, dot1dPortOutboundAccessPriority. For details, see to RFC2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.38 ONU Device Port GARP

Summary: Network Management System queries the ONU device port GARP information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU device port GARP information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dPortGarpJoinTime, dot1dPortGarpLeaveTime, dot1dPortGarpLeaveAllTime. For details, see to RFC2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.2.2.39 ONU Device Port GMRP

Summary: Network Management System queries the ONU device port GMRP information through Element Management System.

Actors: EPON NMS, EPON EMS.

Preconditions: The Network Management System has been installed. Connectivity between the Network Element Management application, NMS systems, and all required GUI client applications has been provided.

Description: This use case begins when the Network Management System makes a request to the Element Management System to get or update ONU device port GMRP information for the specified OLT equipment. This request must include the unique ID of the OLT managed object and other relative parameters such as dot1dPortGmrpStatus , dot1dPortGmrpFailedRegistrations, dot1dPortGmrpLastPduOrigin. For details, see to RFC2674.

The Element Management System then searches the service information database to get or update information for specialized managed object or sends a message to NE directly to get or update information. After that, return collected information back to Network Management System.

Exceptions: IDNotExist, RequestTimeout, NoOperationRight, CommnicationError, DatabaseOperationError, etc.

4.3 Analysis

Detailed class, sequence, and state change diagrams will be offered only for those situations where an interface to an external actor exists or for those cases that these details are necessary to explain behaviour.

4.3.1 Configuration management

The following class diagram shows the aggregation relationships between the configuration classes.

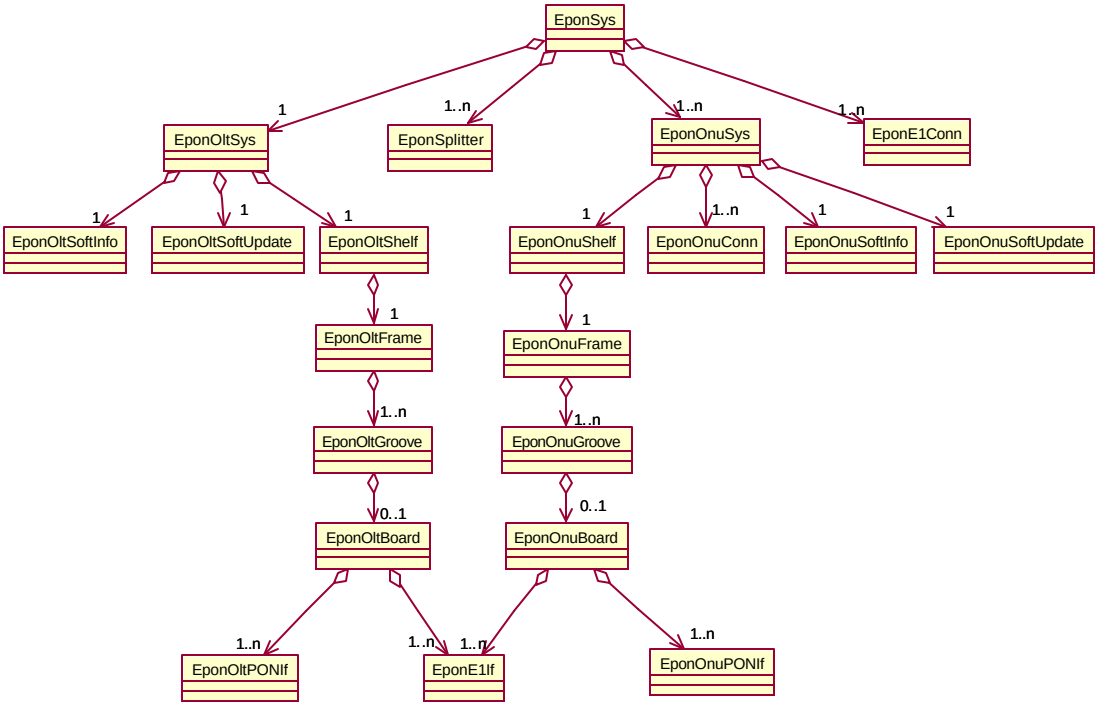


Figure 4-12: Configuration Management Class Diagram

The following sequence diagram shows the interactions between NMS and EMS when query or modify the attribute information in configuration management.

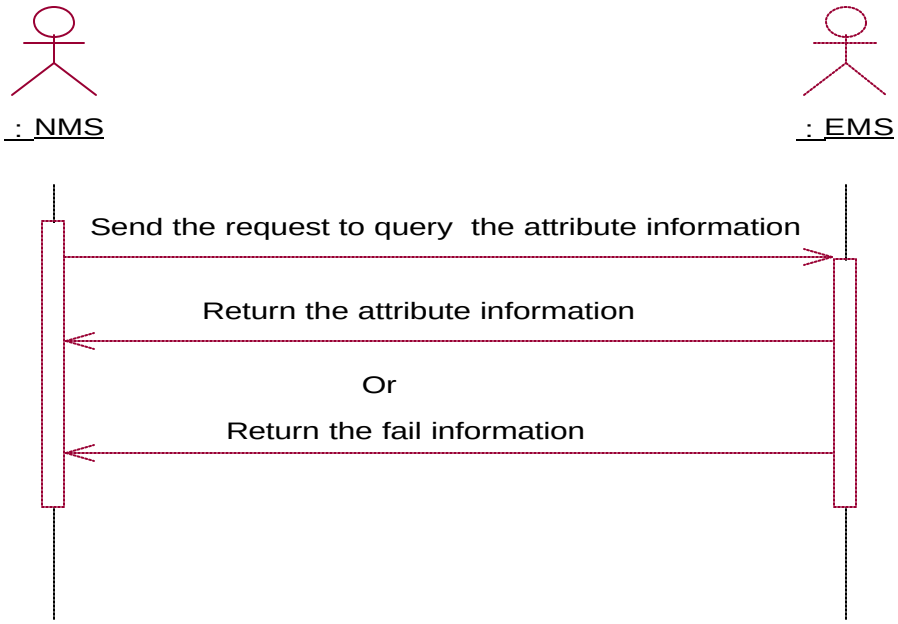


Figure 4-13: Configuration Management - Query Diagram

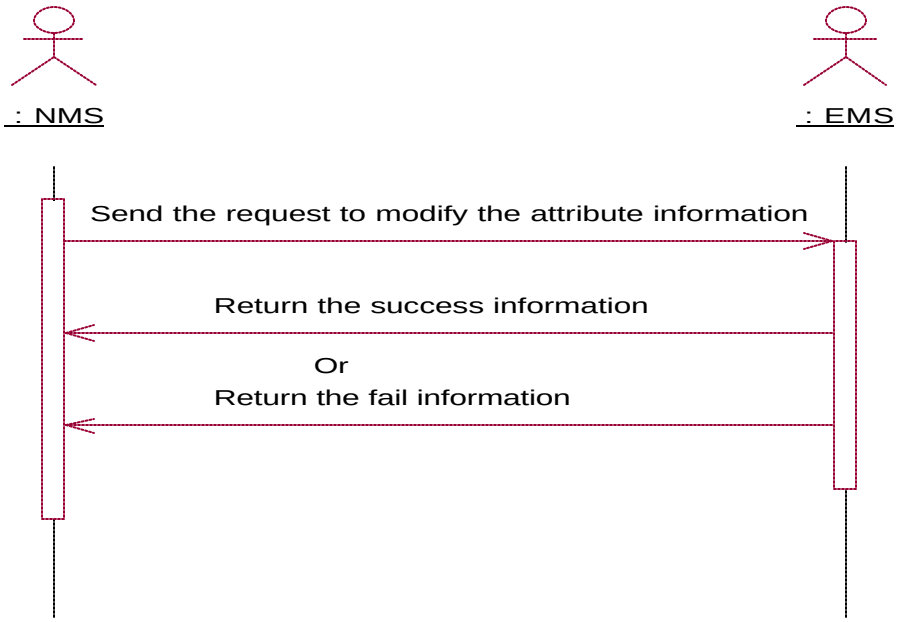


Figure 4-14: Configuration Management - Modify Diagram

4.3.2 Alarm management

The following diagram show interactions between NMS and EMS about alarm trap information.

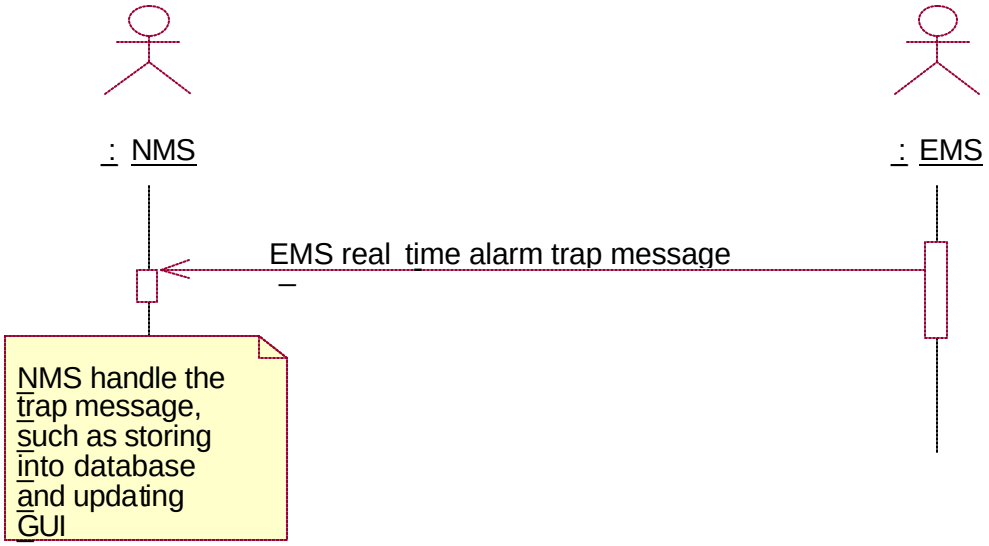


Figure 4-15: Alarm Management Diagram

4.3.3 Performance management

The following diagram show interactions between NMS and EMS about performance information collection.

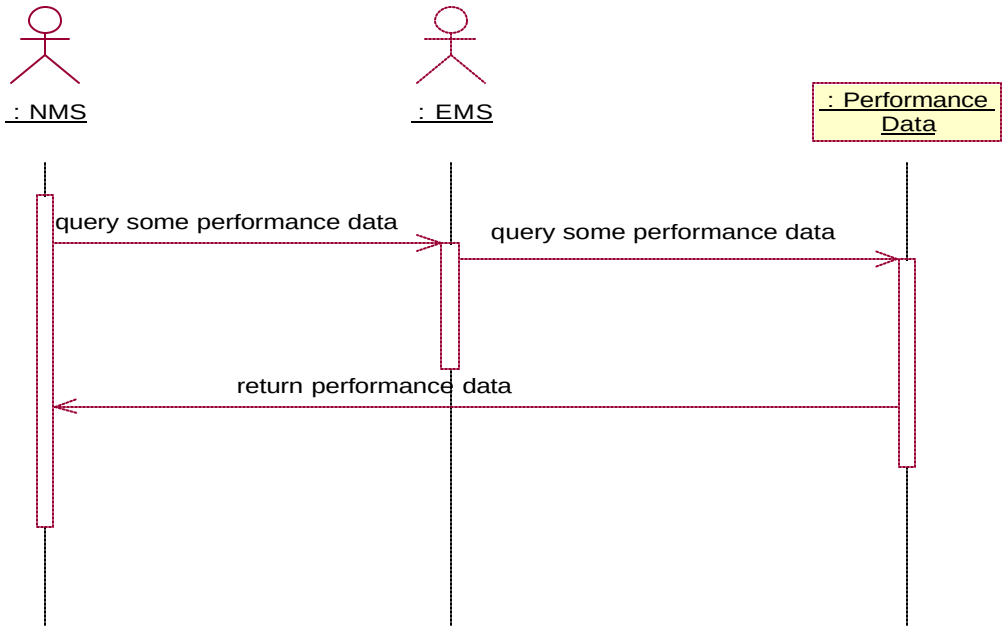


Figure 4-16: Performance Management Diagram

4.3.4 Service management

The following diagram show interactions between NMS and EMS about service information query and update.

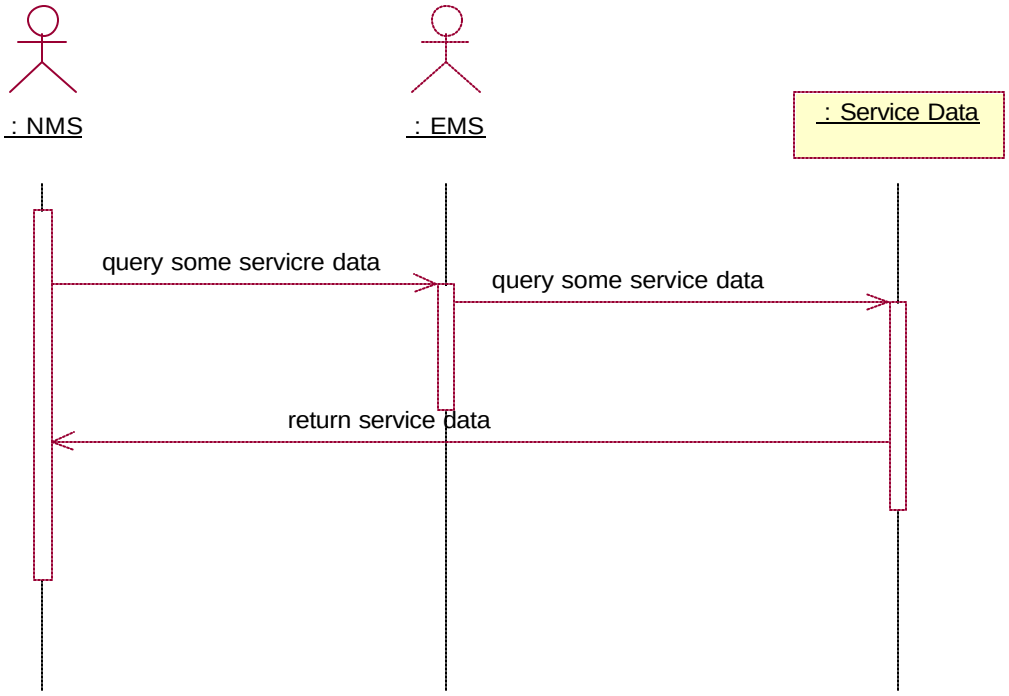


Figure 4-17: Service Management - Query Diagram

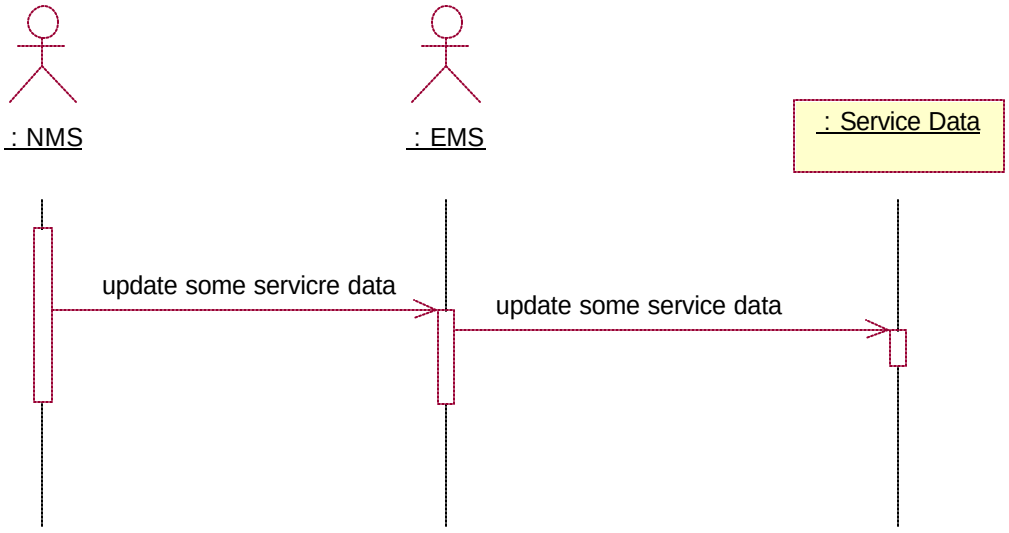


Figure 4-18: Service Management - Update Diagram