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SERIES Q: SWITCHING AND SIGNALLING
Q3 interface

Use case descriptions and analysis for SDH-DLC network level management interface

ITU-T Recommendation Q.837.2

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ITU-T Recommendation Q.837.2

Use case descriptions and analysis for SDH-DLC network level management interface

Summary

ITU-T Recommendation Q.837.2 provides a use case description and analysis for the management interface between an element management system and a network management system. This Recommendation defines part of the management aspects for network resources of SDH-DLC access network equipment. It should be noted that ITU-T Recommendation Q.837.1 contains information of management functionality requirement for both network and network element level as well as the appropriate managed entities to be used in SDH-DLC network. The management information found in ITU-T Recommendation Q.837.1 shall be referred to throughout this Recommendation. Common management functions that are applicable for fault, performance, configuration management functions at NMS-EMS interface are referred to in ITU-T Recommendation Q.827.1.

As a common understanding, the element management system is a vendor management system (VMS) and the network management system is an integrated network management system to manage the various EMSs of different vendors.

Source

ITU-T Recommendation Q.837.2 was approved on 14 October 2007 by ITU-T Study Group 4 (2005-2008) under the ITU-T Recommendation A.8 procedure.

Keywords

DLC, SDH, UML.

FOREWORD

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ITU-T Recommendation Q.837.2

Use case descriptions and analysis for SDH-DLC network level management interface

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 SDH-DLC network. This Recommendation follows the interface specification methodology described in [ITU-T M.3020].

This Recommendation addresses management interface behaviour required for managing SDH-DLC network resources. Behaviour for real-time and non-real-time interfacing is addressed. 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 SDH and DLC network management, and also explains the static and dynamic relationships between these managed entities using UML class diagrams and sequence diagrams.

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.

- [ITU-T G.774] ITU-T Recommendation G.774 (2001), *Synchronous digital hierarchy (SDH) – Management information model for the network element view*.
- [ITU-T G.783] ITU-T Recommendation G.783 (2006), *Characteristics of synchronous digital hierarchy (SDH) equipment functional blocks*.
- [ITU-T G.805] ITU-T Recommendation G.805 (2000), *Generic functional architecture of transport networks*.
- [ITU-T G.902] ITU-T Recommendation G.902 (1995), *Framework Recommendation on functional access networks (AN) – Architecture and functions, access types, management and service node aspects*.
- [ITU-T G.960] ITU-T Recommendation G.960 (1993), *Access digital section for ISDN basic rate access*.
- [ITU-T G.962] ITU-T Recommendation G.962 (1993), *Access digital section for ISDN primary rate at 2048 kbit/s*.
- [ITU-T M.3010] ITU-T Recommendation M.3010 (2000), *Principles for a telecommunications management network*.

- [ITU-T M.3020] ITU-T Recommendation M.3020 (2007), *Management interface specification methodology*.
- [ITU-T M.3100] ITU-T Recommendation M.3100 (2005), *Generic network information model*.
- [ITU-T Q.821] ITU-T Recommendation Q.821 (2000), *Stage 2 and Stage 3 description for the Q3 interface – Alarm surveillance*.
- [ITU-T Q.824.5] ITU-T Recommendation Q.824.5 (1997), *Stage 2 and Stage 3 description for the Q3 interface – Customer administration: Configuration management of V5 interface environments and associated customer profiles*.
- [ITU-T Q.827.1] ITU-T Recommendation Q.827.1 (2004), *Requirements and analysis for the common management functions of NMS-EMS interfaces*.
- [ITU-T Q.837.1] ITU-T Recommendation Q.837.1 (2004), *SDH-DLC functional requirements for the network and network element views*.
- [ITU-T X.721] ITU-T Recommendation X.721 (1992), *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information*.
- [ITU-T X.731] ITU-T Recommendation X.731 (1992), *Information technology – Open Systems Interconnection – Systems management: State management function*.
- [ITU-T X.732] ITU-T Recommendation X.732 (1992), *Information technology – Open Systems Interconnection – Systems management: Attributes for representing relationships*.
- [ITU-T X.733] ITU-T Recommendation X.733 (1992), *Information technology – Open Systems Interconnection – Systems management: Alarm reporting function*.

3 Definitions

3.1 Terms defined elsewhere

This Recommendation uses the following terms defined elsewhere:

3.1.1 synchronous digital hierarchy (SDH) [ITU-T G.783]: A hierarchical set of digital transport structures, standardized for the transport of suitably adapted payloads over physical transmission networks.

3.1.2 add drop multiplexer (ADM) [ITU-T G.783]: Network element that provides access to all, or some subset of the constituent signals contained within an STM-N signal. The constituent signals are added to (inserted), and/or dropped from (extracted) the STM-N signal as it passes through the ADM.

3.1.3 access network (AN) [ITU-T G.902]: Implementation comprising those entities (such as cable plant, transmission facilities, etc.) which provide the required transport bearer capabilities for the provision of telecommunications services between a service node interface (SNI) and each of the associated user-network interfaces (UNIs). An access network can be configured and managed through a Q3 interface. In principle, there is no restriction on the types and the number of UNIs and SNIs which an access network may implement. The access network does not interpret (user) signalling.

3.1.4 network termination (NT) [ITU-T G.960]: The element of the access network performing the connection between the infrastructure owned by the access network operator and the service-consumer system (ownership decoupling). The NT can be passive or active, transparent or not.

3.1.5 digital loop carrier (DLC) [ITU-T Q.837.1]: An integrated access system containing a number of point-to-point communication links between a network side and user side supported by optical access transmission systems.

3.1.6 optical access network (OAN) [ITU-T Q.837.1]: The set of access links sharing the same network-side interfaces and supported by optical access transmission systems. The OAN may include a number of ODNs connected to the same OLT.

3.1.7 remote terminal (RT) [ITU-T Q.837.1]: The termination of the optical access network element that provides the user-side interface and connected to the ODN.

3.1.8 central terminal (CT) [ITU-T Q.837.1]: A central terminal (CT) provides the network-side interface of the OAN; it is connected to one or more remote terminals. A central terminal may consist of a HOM or ADM providing the network-side interface of the DLC system either integrated or separately.

3.1.9 SDH-DLC resources [ITU-T Q.837.1]: Physical or logical entities requiring management using TMN management service.

3.1.10 layer network [ITU-T G.805]: A "topological component" that represents the complete set of access groups of the same type which may be associated for the purpose of transferring information.

3.1.11 layer network domain (LND) [ITU-T G.805]: Represents an administration's view of the layer network responsible for transporting a specific type of characteristic information or services.

3.2 Terms defined in this Recommendation

This Recommendation does not define any new terms.

4 Abbreviations and acronyms

This Recommendation uses the following abbreviations and acronyms:

AVC	Attribute Value Change
BER	Bit Error Ratio
Bid	Bidirectional
BRA	Basic Rate Access
CSS	Controlled Slip Second
CSSFE	Controlled Slip Second Far End
CT	Central Terminal
CTP	Connection Termination Point
CV	Code Violation
CVCRC	Code Violation, Cyclic Redundancy Check
CVFE	Code Violation Far End
DLC	Digital Loop Carrier

EMS	Element Management System
E-R	Entity-Relationship
ES	Errored Second
ESFE	Errored Second Far End
GTP	Group Termination Point
HOM	High Order Multiplexer
HDB3	High Density Bipolar 3 code
ISDN	Integrated Services Digital Network
LND	Layer Network Domain
LE	Local Exchange
ME	Managed Entity
MIB	Management Information Base
NE	Network Element
NEL	Network Element Level
NMS	Network Management System
NOC	Network Operation Centre
NRZ	Non Return to Zero
OMT	Operation and Maintenance Terminal
OAN	Optical Access Network
OLT	Optical Line Termination
PL	Permanent Line
PM	Performance Management
POTS	Plain Old Telephone Service
PRA	Primary Rate Access
QoS	Quality of Service
RT	Remote Terminal
SAS	SEF/AIS (Severely Errored Framing Alarm Indication Signal) Second
SDH	Synchronous Digital Hierarchy
SES	Severely Errored Second
SESFE	Severely Errored Second Far End
Si	Sink
SNI	Service Node Interface
So	Source
TDM	Time Division Multiplexing
TMN	Telecommunication Management Network

TP	Termination Point
TTP	Trail Termination Point
UAS	UnAvailable Second
UASFE	UnAvailable Second Far End
UML	Unified Modelling Language
UNI	User-Network Interface

5 Conventions

In clause 8, when specifying managed entities and their management operations, the following abbreviations are applied to indicate the qualifier of attributes, notifications or operation parameters.

- M: Mandatory.
- O: Optional.
- C: Conditional.
- R: Readable.
- W: Writable.

6 General overview

6.1 Overview of DLC

In order to propose SDH-DLC as an option for optical access network, an explanation about the technologies involved is presented first. While the following introduction mainly explains DLC technology, SDH technology and its network management are described in other ITU-T Recommendations, for instance, [ITU-T G.774] series.

The DLC has been proposed to provide a cost-effective fibre-based solution in the access part of the telecommunications network, compared with conventional copper-based network. DLC is possible to be connected to any telecommunications networks such as data networks and SDH networks, either directly connected (built-in) or through external equipments, and allows flexible configuration of various services. However, this Recommendation only describes DLC using SDH as optical access network.

Basically a DLC system can be associated with time division multiplexing (TDM) technology. It is divided into three functions: tributary, core and aggregate. Tributary unit provides interface to the network side. Core unit provides internal processing of information signals such as multiplexing and/or cross-connection. Aggregate unit provides interface to optical network of the system.

The DLC system shall be a delivery mechanism capable of providing subscriber with a range of telecommunication services over optical fibre communication, using both subscriber and street sited remote terminals (RT). Each system will deliver services to a number of subscribers. It should be flexible in operation, allowing subscribers to be added to or removed from the network as required, as well as allowing it to adapt to the changing requirements of individual subscribers both in terms of capacity and services.

6.2 General architecture of SDH-DLC network

The general architecture of a DLC system is shown in Figure 6-1.

The system consists of a DLC unit, a central terminal and one or more remote terminals. Each DLC unit may consist of a high order multiplexer (HOM) and OLT.

The DLC system provides services of POTS (voice), ISDN (PRA and BRA), leased lines 64 kbit/s, $n \times 64$ kbit/s and 2 Mbit/s. The basic voice (POTS) and ISDN BRA services can be delivered over V5 interface (communication interface between optical access network and local exchange), while leased lines and ISDN PRA are delivered over E1. The V5 interface is also supposed to carry 1 up to N E1 ($N = 16$ maximum). More explanation for the overview of V5 interface at access network can be found in [b-ETSI 347-1].

Internal switching capability at remote terminal (RT) could be provided. In such a case, the billing information shall be reported to the exchange.

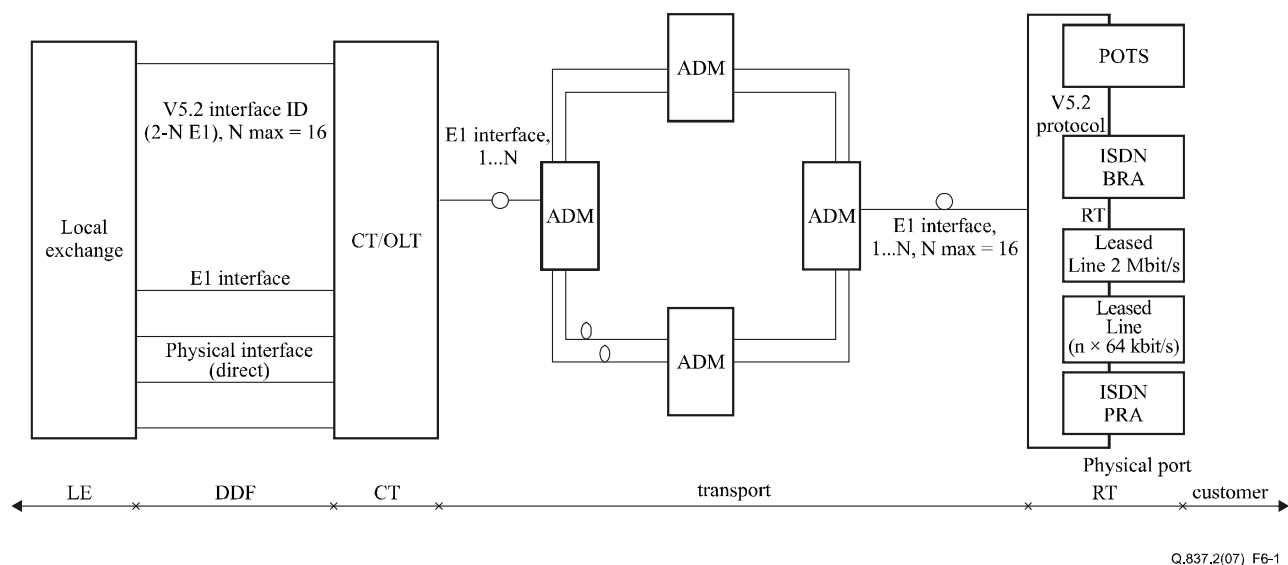


Figure 6-1 – The general configuration of DLC and SDH system

A DLC system includes the following external and internal interfaces.

a) *External interfaces:*

- 1) Interfaces to the services' or networks' side.
- 2) Interfaces to the subscribers' side.
- 3) The HOM interfaces to the networks' side.

b) *Internal interfaces:*

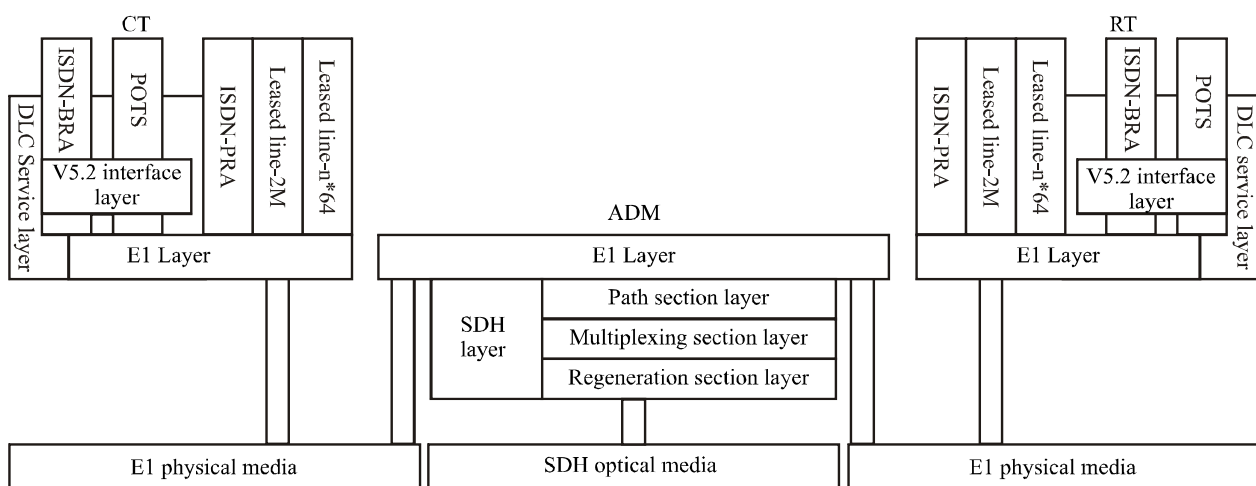
- 1) HOM – Optical network interfaces.
- 2) The OMT interface (or management interface for local craft terminal purpose).
- 3) The test port interface in both DLC units.

The transmission protocol used should allow any type of RTs to be located at any distance from the associated CT.

The RT is the termination of the optical network, which connects a number of different types of narrow-band services to subscribers via their specific electrical interfaces. Subscribers may be connected to the RT by copper cables.

6.3 Network layering

Layer networks provide the logical separation of network resources that support transport for different types of characteristic information as described in [ITU-T G.805]. A layer network domain (LND) represents an administration's view of the layer network responsible for transporting a specific type of characteristic information or services. 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. Figure 6-2 shows the layering concept of SDH-DLC network. The SDH physical optical network resources act as the server layer to transport DLC specific services as the client layer.



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Figure 6-2 – Network layering of SDH-DLC

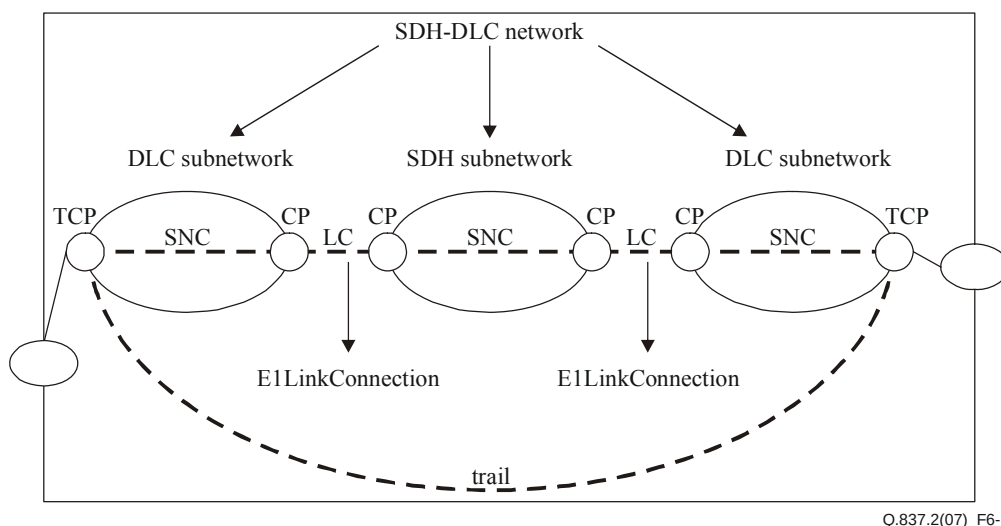
NOTE – SDH Optical Media (Synchronous Digital Hierarchy Transport Network Media).

Physical Layer: Physical Layer of SDH and DLC network

DLC Service Layer: Service layer of DLC, such as POTS, ISDN PRA, ISDN BRA, Leased line. For POTS and ISDN BRA, services can be delivered over V5 interface (communication interface between optical access network and local exchange), while services like ISDN PRA, Leased line ($N \times 64$ kbit/s and 2 Mbit/s) are delivered over E1.

6.4 Network partitioning

The partitioning of a network should represent the business requirements of a specific management interface. Therefore, SDH-DLC can be partitioned into several subnetworks: DLC CT-side subnetwork, SDH subnetwork, DLC RT-side subnetwork, and the links that connect them. However, partitioning for SDH-DLC network connections can also be divided into smaller subnetworks.



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Figure 6-3 – Partitioning SDH-DLC subnetwork

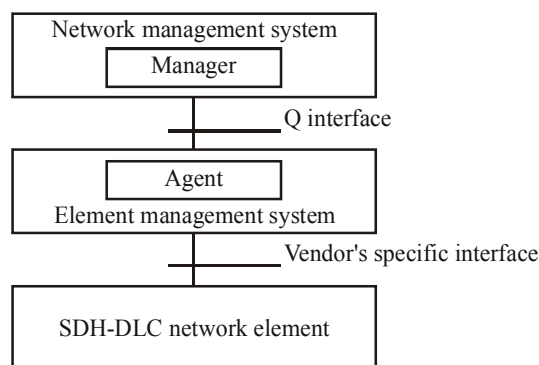
Partitioning is useful in describing the various management criteria under which a carrier's network can be divided. For example, the carrier's network might be partitioned along the lines of the network operation centre (NOC) responsible for each subnetwork. Within each subnetwork representing a NOC, subnetworks can be partitioned to describe the resources that are managed by a specific EMS.

7 Requirements

7.1 Business level requirements

This Recommendation only focuses on the management interface between NMS and EMS for SDH-DLC network, 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.

This Recommendation defines the requirements for the integrated management interface at the network level and in addition includes those at the element level required for the integrated management. These requirements shall be realized through standard protocols used for communication between NMS and EMS. These interface requirements support a multi-supplier/vendor environment in an operator's network. The NMS is acting as a Manager while EMS as an Agent.



Q.837.2(07)_F7-1

Figure 7-1 – Reference interface

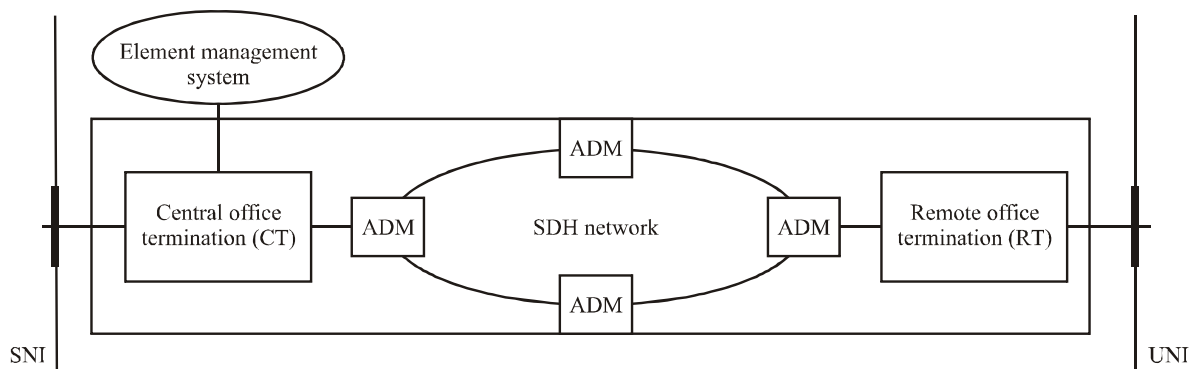
7.1.1 Actor roles

The actor in this Recommendation is the network management system (NMS). The NMS manages SDH-DLC network by interacting with element management systems (EMSs).

7.1.2 Telecommunications resources

EMS and the managed equipment supporting SDH-DLC system are viewed as relevant telecommunications resources in this Recommendation.

Figure 7-2 illustrates the SDH-DLC system architecture, which includes network elements like CT, RT and ADM. The EMS shown in the figure manages the network elements forming the SDH-DLC access network. The EMS manages the internal details of the network elements.



Q.837.2(07)_F7-2

Figure 7-2 – SDH-DLC system architecture

7.1.3 High-level use case diagrams

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

The first overview use case diagram (Figure 7-3) shows the main management function sets (FS) involved in the SDH-DLC management interface. The actor is the NMS which manages the SDH-DLC 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.

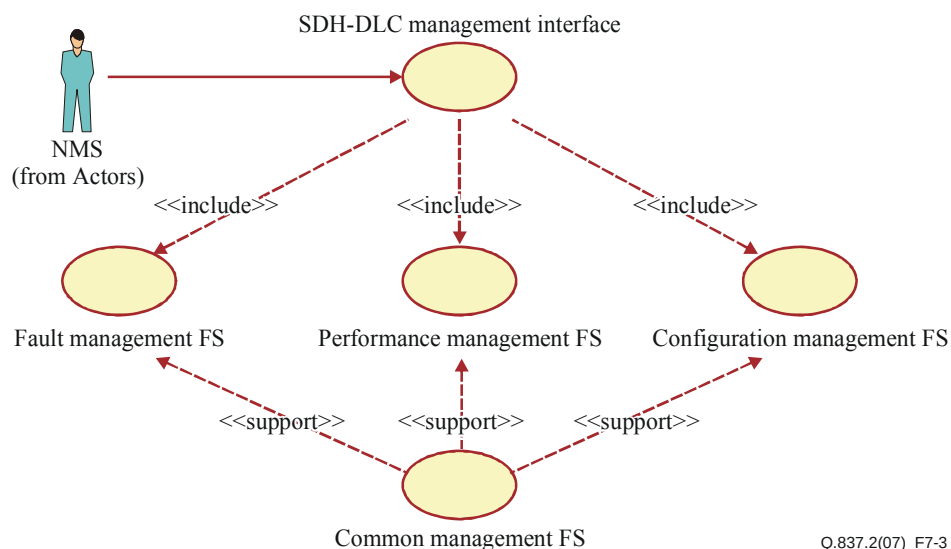


Figure 7-3 – Main use case diagram

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

Figure 7-4 shows the functions involved in the configuration management function set.

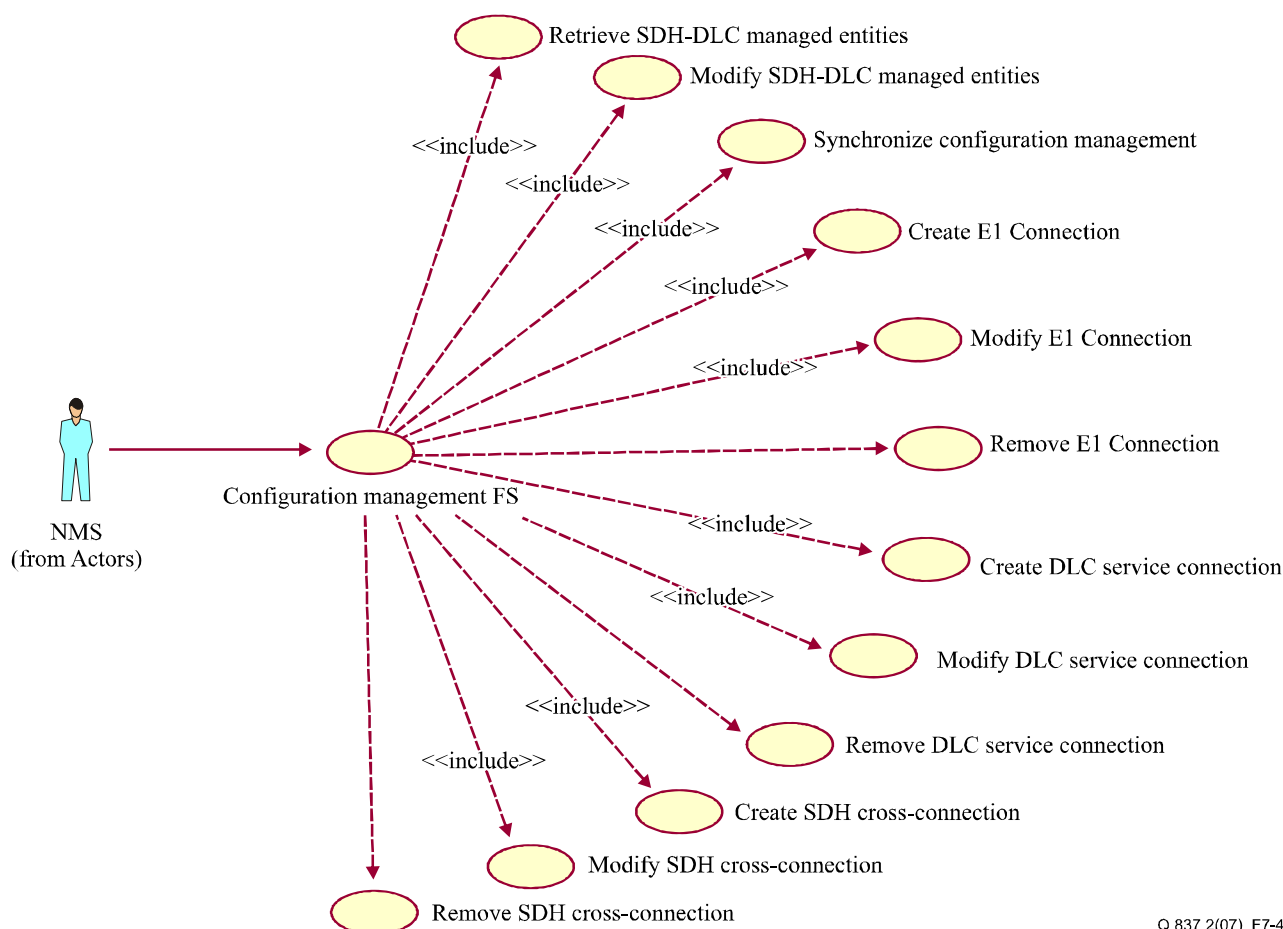


Figure 7-4 – Configuration management function set

The use case diagram for performance management function set according to [ITU-T Q.827.1] is shown in Figure 7-5.

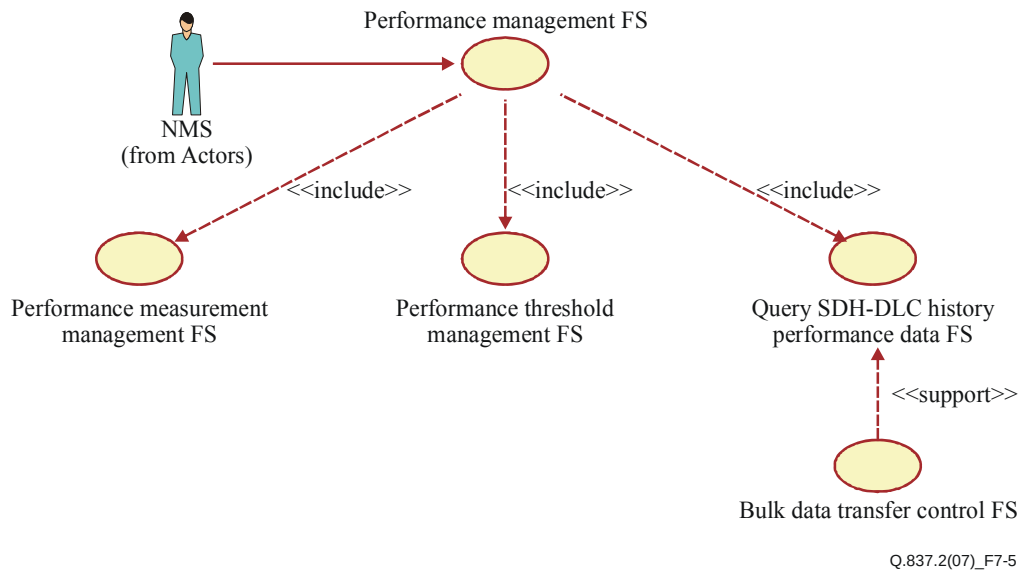


Figure 7-5 – Performance management function set

The use case diagram for fault management function set based on [ITU-T Q.827.1] is shown in Figure 7-6.

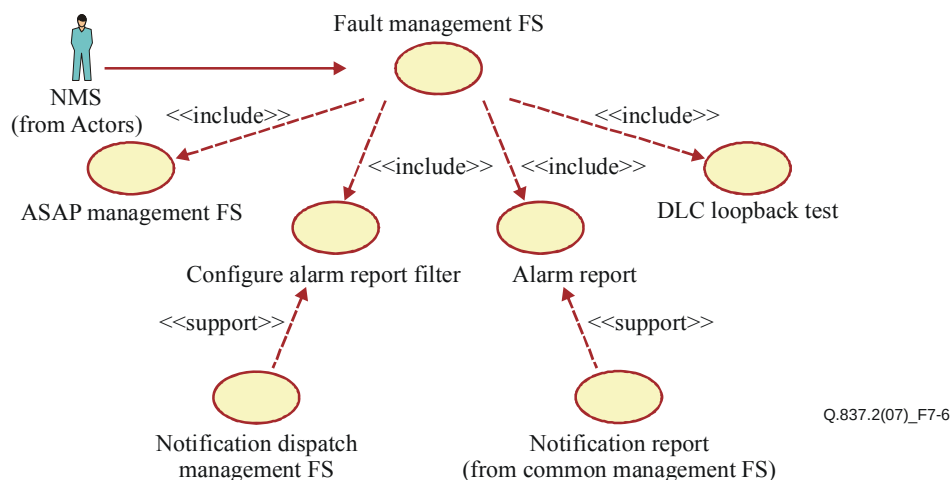


Figure 7-6 – Fault management function set

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

As an addition, loopback test function is also included in the use case descriptions for the SDH-DLC fault management function set.

7.2 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.

7.2.1 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.

7.2.2 Configuration management function set

7.2.2.1 Network inventory management

7.2.2.1.1 Retrieve SDH-DLC Managed Entities

Name	Retrieve SDH-DLC Managed Entities
Summary	NMS sends a request to EMS to retrieve the network inventory information about the SDH-DLC managed entities instances through management interface.
Actor(s)	NMS
Assumptions	1. EMS has the list of SDH-DLC network resources such as (Subnetwork, Network Element, etc.). 2. EMS supports the function of retrieving managed entities.
Pre-Conditions	NMS has established secured communication (including authentication) with EMS.
Begins When	NMS sends a request to EMS to query the attribute value information of a CM related managed entity instance(s).
Description	1. NMS sends a query inventory to EMS for SDH-DLC managed entities. 2. EMS receives the list of the managed entity instances as input parameters from the NMS query request. 3. EMS returns the attribute values for the specified managed entity instances to NMS.
Ends When	1. NMS receives the information of the specified managed entities. 2. EMS returns error information if the operation does not succeed.
Exceptions	1. Unknown Managed Entity. 2. Invalid Parameter. 3. EMS Processing Error.
Post-Conditions	NMS receives the inventory information when the query is successful.

7.2.2.1.2 Modify SDH-DLC Managed Entities

Name	Modify SDH-DLC Managed Entities
Summary	NMS is enabled to modify attribute values of SDH-DLC entities such as: Subnetwork, ManagedElement, EquipmentHolder, TerminationPoint. The common attributes that are allowed to be modified are, for example, administrative state, location name, vendor name and version. EMS is required to send attribute value change notifications upon modification of SDH-DLC related managed entities.
Actor(s)	NMS
Assumptions	The EMS supports the function of modifying the SDH-DLC managed entity.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has the list of attribute values of the SDH-DLC entities to be modified.
Begins When	The NMS sends a request to EMS to change some attribute values of a managed entity instance in the EMS.
Description	1. NMS sends a request to EMS to modify one or more attribute values of a SDH-DLC managed entity instance. 2. The input parameters in the request contain the class name of the managed entity instance(s), a list of entity IDs of the entity instances to be modified, a list of the attribute names and the corresponding new values for each entity instance. 3. EMS modifies the specified value of the managed entity instance(s). 4. EMS sends one or more attribute value change (AVC) notification as the success indication. 5. EMS returns error information if the operation does not succeed.
Ends When	1. NMS receives an attribute value change (AVC) notification regarding the modified SDH-DLC entities. 2. EMS returns error information if the operation does not succeed.
Exceptions	1. Unknown Managed Entity. 2. Attribute Not Modifiable. 3. Invalid Input Parameter. 4. EMS Processing Error.
Post-Conditions	The specified attribute(s) of the specified managed entity(ies) are modified by the EMS as requested by NMS.

7.2.2.1.3 Synchronize configuration management information

The purpose of this use case is to obtain the complete configuration management information from EMS to be restored in NMS. The specification level requirements for the synchronize configuration management information are described as in clause 6.2.1.4 of [ITU-T Q.827.1], Bulk data transfer function set, which will be reused in this Recommendation.

7.2.2.2 E1 connection management

7.2.2.2.1 Retrieve E1 Connection

Name	Retrieve E1 Connection
Summary	NMS sends a request to EMS to retrieve the E1 connections information.
Actor(s)	NMS
Assumptions	NMS has already retrieved the NE inventory information.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. E1 connections have already been configured in NEs.
Begins When	The NMS sends a request to query the E1 connection to the EMS.
Description	1. NMS sends a query of E1 connection in one or more specific NEs to EMS. 2. EMS returns E1 connection information with the following attributes to NMS: – E1 port Id type: This attribute contains the list of ports that are available for E1 connection. – User Label: A text string that may be used to describe the object or provide additional information. – Attribute. 3. NMS receives the response from EMS.
Ends When	NMS receives the response from EMS regarding E1 connection.
Exceptions	1. Unknown E1 connections. 2. EMS Processing Error. 3. Invalid parameters.
Post-Conditions	1. NMS receives inventory information when the query is successful. 2. The EMS returns the attribute values of the specified managed entity instances.

7.2.2.2.2 Create E1 Connection

Name	Create E1 Connection
Summary	The NMS requests EMS to assign connection between an E1 port on CT and an E1 port on RT based on operational requirement for provisioning.
Actor(s)	NMS
Assumptions	1. CT and RT have already been installed in the system. 2. E1 ports exist and are available for connection both in the CT and RT.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has the knowledge about E1 physical configuration. NMS needs to create a connection relationship between an E1 port on CT and an E1 port on RT equipment.
Begins When	The NMS requests EMS to create E1 connection.

Description	1. NMS requests EMS to create E1 connection. 2. NMS specifies ID of E1 ports for both CT and RT. 3. EMS validates request by checking if E1 ports of both CT and RT are available and if the bandwidth resource is sufficient. 4. When all resources required are available, EMS then creates a connection between two E1 ports. 5. EMS sends notification to NMS which indicates SDH-DLC managed entities and corresponding attribute value changes (e.g., operational state of E1 ports) upon the E1 connections that have been created.
Ends When	NMS receives notification from EMS on whether or not the E1 connection creation request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown E1 Ports. 3. Bandwidth Not Enough. 4. EMS Processing Error.
Post-Conditions	1. E1 connection has been set up. 2. EMS forwards/reports success notification of the creation of the user port at NE. 3. The related managed object instances are created or modified.

7.2.2.2.3 Modify E1 connection

Name	Modify E1 Connection
Summary	The NMS requests EMS to modify specified E1 connection that has been established.
Actor(s)	NMS
Assumptions	E1 ports already created in the CT and RT and connection or relationship between the ports on both CT and RT are in running operational condition.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has the knowledge about E1 physical configuration.
Begins When	The NMS requests EMS to modify E1 connection.
Description	1. NMS requests EMS to modify E1 connections. 2. EMS receives E1 Connection Id as input parameter. 3. EMS will then ask for confirmation from NMS if the modification of E1 connection can be executed. 4. NMS confirms or may abort upon EMS acknowledgment. 5. EMS validates request to modify E1 connection from NMS. 6. EMS executes the E1 connection modification between two E1 ports on both CT and RT. All related resources formerly assigned to the connection are now available for use by any subsequent connection request, modifying managed entities tracking these resource values. This operation also modifies logical managed entities associated with the connection. 7. EMS sends notification to NMS which indicates the specific E1 connections that have been modified.

Ends When	NMS receives notification from EMS on whether or not the E1 connection modification request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown E1 Connection Id. 3. EMS Processing Error.
Post-Conditions	1. E1 connection has been modified. 2. EMS forwards/reports success notification of the E1 modification at NE.

7.2.2.2.4 Remove E1 Connection

Name	Remove E1 Connection
Summary	The NMS requests EMS to remove specified E1 connection that has been established. Although operators, under operational considerations, may indicate that certain E1 connections are provisionally protected and cannot be removed.
Actor(s)	NMS
Assumptions	E1 ports already created in the CT and RT and connection or relationship between the ports on both CT and RT are in running operational condition.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has the knowledge about E1 physical configuration.
Begins When	The NMS requests EMS to remove/modify E1 connection.
Description	1. NMS requests EMS to remove E1 connections. 2. EMS receives E1 Connection Id as input parameter. 3. EMS will then ask for confirmation from NMS if the removal of E1 connection can be executed. 4. NMS confirms or may abort upon EMS acknowledgment. 5. EMS validates request to remove E1 connection from NMS. 6. EMS executes the E1 connection removal between two E1 ports on both CT and RT. All related resources formerly assigned to the connection are now available for use by any subsequent connection request, modifying managed entities tracking these resource values. This operation also removes or modifies logical managed entities associated with the connection. 7. EMS sends notification to NMS which indicates the specific E1 connections that have been removed.
Ends When	NMS receives notification from EMS on whether or not the E1 connection removal request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown E1 Connection Id. 3. E1 connection protected. 4. EMS Processing Error.
Post-Conditions	1. E1 connection has been removed. 2. EMS forwards/reports success notification of the E1 removal or modification at NE.

7.2.2.3 DLC service connection management

7.2.2.3.1 Retrieve DLC Service Connection

Name	Retrieve DLC Service Connection
Summary	NMS sends a request to EMS to retrieve the DLC Service connections information.
Actor(s)	NMS
Assumptions	NMS has already retrieved the NE inventory information.
Pre-Conditions	NMS has established secured communication (including authentication) with EMS.
Begins When	The NMS sends a request to query the DLC service connection to the EMS.
Description	1. NMS sends a query of DLC Service connection to EMS. 2. EMS returns DLC Service connection information with the following attributes to NMS: – Service ports ID: This attribute represents a unique value for DLC services such as POTS, leased line and ISDN. – Provisioning attribute values: This attribute represents the status of the current DLC services status. 3. NMS receives the response from EMS.
Ends When	NMS receives the response from EMS regarding DLC Service connections information.
Exceptions	1. Invalid input parameters. 2. Unknown DLC service connections. 3. EMS Processing Error.
Post-Conditions	1. NMS receives inventory information when the query is successful. 2. The EMS returns the attribute values of the specified managed entity instances.

7.2.2.3.2 Create DLC Service Connection

Name	Create DLC Service Connection
Summary	The NMS requests the EMS to create specified DLC service connection. This use case is for DLC service activation (POTS, ISDN, leased line). The EMS selects ports, facilities, and bandwidth from SDH-DLC resources determined to be available in order to complete the design, selection, and assignment process associated with a set of services for a particular customer.
Actor(s)	NMS
Assumptions	The user ports required to activate DLC services have been created in the NE from EMS. The CT and RT must have been installed.

Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. The provisioning NMS or operator have access to the valid/permissible service activation operation. 3. DLC network resources, such as user ports for POTS, leased lines and ISDN already exist and are created by EMS. 4. NMS has network resources information from EMS.
Begins When	NMS requests EMS to create DLC Service Connection.
Description	1. NMS requests the EMS to create a specific service connection. 2. NMS specifies input parameters which contain port ID of each service type to be created (POTS, leased line or ISDN), and provisioning attribute values, for example, administrative state and operational state in the SDH-DLC managed entities. The request parameter also includes a Service Instance Identifier, and characteristics for the endpoints, a Reservation Id (if relevant), and profile pointers that characterize the service connection desired. 3. EMS validates request by checking if the resources (NEs) and SDH-DLC managed entities required for this service connection are available. 4. EMS activates specified managed entities related to the service connection request. 5. EMS sends notification to NMS which indicates the service connection that is available. The EMS generates a subnetwork connection Id to describe the service connection and returns this value to the NMS. 6. EMS returns exception or error notification if the operation cannot be performed.
Ends When	NMS receives notification from EMS on whether or not the service connection request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown Ports. 3. Unknown NE. 4. Connection Already Exists. 5. EMS Processing Error.
Post-Conditions	1. Specified DLC service has been created. 2. EMS forwards/reports success notification of the creation of the service connection.

7.2.2.3.3 Modify DLC Service Connection

Name	Modify DLC Service Connection
Summary	The NMS requests the EMS to modify specified DLC service connection (POTS, ISDN and leased lines).
Actor(s)	NMS
Assumptions	The DLC services are already in operations
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has network resources information from EMS. 3. DLC network resources such as user ports for POTS, leased lines and ISDN already exist and are created by EMS.
Begins When	The NMS sends an action request to EMS to modify DLC Service connection.
Description	1. NMS requests EMS to modify specified services at NE. 2. EMS receives input parameters which contain Subnetwork Connection Id, ports Id and a listing of service profile names. 3. EMS validates request from NMS by checking if the related managed entities information contains Subnetwork Connection Id, ports Id and a listing of service profile names are available and allowed to be modified. 4. EMS will then ask for confirmation to NMS if the modification of specified DLC service connection can be executed. 5. NMS confirms or may abort upon the EMS acknowledgment. 6. EMS executes the modification of specified services. 7. EMS sends attribute value change notification to NMS which indicates the specified service that has been modified.
Ends When	NMS receives notification from EMS whether or not the DLC Service connection modification request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown Managed Entity. 3. EMS Processing Error.
Post-Conditions	1. Specified DLC service has been modified. 2. EMS forwards/reports success notification of the modification of the DLC service connection.

7.2.2.3.4 Remove DLC Service Connection

Name	Remove DLC Service Connection
Summary	The NMS requests the EMS to remove specified DLC service connection (POTS, ISDN and leased lines). This use case enables NMS to command EMS to deactivate specified services.
Actor(s)	NMS
Assumptions	The DLC services are already in operations.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has network resources information from EMS. 3. DLC network resources such as user ports for POTS, leased lines and ISDN already exist and are created by EMS.
Begins When	The NMS sends an action request to EMS to remove DLC Service connection.
Description	1. NMS requests EMS to remove specified services at NE. 2. EMS receives input parameters which contain Subnetwork Connection Id, ports Id and a listing of service profile names. 3. EMS validates request from NMS by checking if the related managed entities information contains Subnetwork Connection Id, ports Id and a listing of service profile names that are available and allowed to be removed. 4. EMS will then ask for confirmation to NMS if the removal of the specified DLC service connection can be executed. 5. NMS confirms or may abort upon EMS acknowledgment. 6. EMS executes the removal of the specified services. 7. EMS sends attribute value change notification to NMS which indicates the specified service that has been deactivated/removed.
Ends When	NMS receives notification from EMS on whether or not the DLC Service connection removal request operation is successful.
Exceptions	1. Unknown Service Instance. 2. Service Removal unsupported. 3. EMS Processing Error.
Post-Conditions	1. Specified DLC service has been removed. 2. EMS forwards/reports success notification of the removal of the service connection.

7.2.2.4 Cross-connection management

7.2.2.4.1 Retrieve SDH Cross-Connection

Name	Retrieve SDH Cross-Connection
Summary	The NMS sends a request to EMS to retrieve the cross-connections information within SDH-DLC network. A Cross-Connect represents a connection between two termination points, and or GTP, which should be modelled using a cross-connection object when the assignment is flexible and can be modified through the management interface. The common operation to perform cross-connect is within an SDH equipment (Add Drop Multiplexer and Digital Cross-Connect). For example, the granularity of cross-connection can be VC3, VC4, VC4-4C and VC12.
Actor(s)	NMS
Assumptions	NMS has already retrieved the NE inventory information.
Pre-Conditions	NMS has established secured communication (including authentication) with EMS.
Begins When	The NMS sends a request to query the SDH cross-connection to the EMS.
Description	1. NMS sends a query of SDH cross-connection to EMS. 2. EMS returns SDH cross-connection information with the following attributes to NMS: – Equipment ID as a unique identifier of the equipment to be cross-connected. – Signal Type describes the signal that is cross-connected. The termination points or GTPs that are cross-connected must have signal types that are compatible. – fromTermination specifies the source endpoint of cross-connections. – toTermination specifies destination endpoint of cross-connection. – Directionality (bidirectional or unidirectional). – An active indication: Indicates if the cross-connect is active in the ME. – Additional information: This allows the communication from the EMS to the NMS of additional information that is not explicitly modelled (according to vendor's specific implementation). 3. NMS receives the response from EMS.
Ends When	NMS receives the response from EMS regarding SDH cross-connections information.
Exceptions	1. Invalid input parameter. 2. Unknown SDH cross-connections. 3. EMS Processing Error.
Post-Conditions	1. NMS receives inventory information when the query is successful. 2. The EMS returns the attribute values of the specified managed entity instances.

7.2.2.4.2 Create SDH Cross-Connection

Name	Create SDH Cross-Connection
Summary	The NMS requests the EMS to create Cross-Connection within SDH-DLC network. A Cross-Connect is primarily used in the specification of routes.
Actor(s)	NMS
Assumptions	ADM as SDH managed element is already installed to perform the cross-connection function.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has network resources information from EMS (VC12, VC3, etc.).
Begins When	NMS requests EMS to create SDH cross-connection.
Description	1. NMS requests EMS to create cross-connection over VC12/VC3 level for specified interface (2 Mbit/s/STM-1/STM-4 interface) at ADM. 2. NMS specifies source endpoint of cross-connection (interface name, interface number). 3. NMS specifies destination endpoint of cross-connection (interface name and number). 4. NMS specifies transmission type (bidirectional or unidirectional) for the cross-connection. 5. EMS creates the cross-connection at ADM. 6. EMS sends notification to NMS which indicates the cross-connection that has been created. The EMS generates a subnetwork connection Id to describe the cross-connection and returns this value to the NMS. 7. EMS returns exception or error notification if the operation cannot be performed.
Ends When	NMS receives notification from EMS on whether or not the cross-connection request operation is successful.
Exceptions	1. Invalid input parameter. 2. Unknown managed entities. 3. EMS Processing Error.
Post-Conditions	EMS sends notifications of success of the creation of SDH cross-connection.

7.2.2.4.3 Modify SDH Cross-Connection

Name	Modify SDH Cross-Connection
Summary	NMS can request EMS to modify Cross-Connection for SDH network.
Actor(s)	NMS
Assumptions	NMS has network resources information from EMS.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. NMS has network resources information from EMS.
Begins When	The NMS requests EMS to modify SDH cross-connection.

Description	1. NMS requests EMS to modify SDH cross-connection. 2. EMS receives input parameters which contain Subnetwork connection Id, source end point, destination endpoint, and transmission type describing the actual cross-connection in operation. 3. EMS validates the request from NMS by checking the state of the specified cross-connection. 4. EMS will then ask for confirmation from NMS if the modification of the specified SDH cross-connection can be executed. 5. NMS confirms or may abort upon EMS acknowledgment. 6. EMS executes the operation: If cross-connection state is connected, EMS shall change state to be modified; if cross-connection state is disconnected, EMS executes to modify cross-connection. 7. EMS sends attribute value change notification to NMS which indicates the specified cross-connection that has been modified. 8. EMS sends notification to NMS which indicates the cross-connection objects that have been removed. 9. EMS returns exception or error notification if the operation cannot be performed.
Ends When	NMS receives notification from EMS on whether or not the cross-connection modification request operation is successful.
Exceptions	1. Unknown SDH cross-connection. 2. Invalid input parameter. 3. EMS Processing Error.
Post-Conditions	EMS sends notification to NMS which indicates the cross-connection that has been modified.

7.2.2.4.4 Remove SDH Cross-Connection

Name	Remove SDH Cross-Connection
Summary	NMS can request EMS to remove Cross-Connection for SDH network.
Actor(s)	NMS
Assumptions	The cross-connection has been established at NEs.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS 2. NMS has network resources information from EMS
Begins When	NMS requests EMS to remove SDH cross-connection.

Description	1. NMS requests EMS to remove SDH cross-connection. 2. EMS receives input parameters which contain Subnetwork connection Id, source end point, destination endpoint, and transmission type describing the actual cross-connection in operation. 3. EMS validates the request from NMS by checking the state of the specified cross-connection. 4. EMS will then ask for confirmation from NMS if the removal of the specified SDH cross-connection can be executed. 5. NMS confirms or may abort upon EMS acknowledgment. 6. EMS executes the operation: If cross-connection state is connected, EMS shall change state to be disconnected; if cross-connection state is disconnected, EMS executes to remove cross-connection. 7. EMS sends attribute value change notification to NMS which indicates the specified cross-connection that has been deactivated/removed. 8. EMS sends notification to NMS which indicates the cross-connection objects that have been removed. 9. EMS returns exception or error notification if the operation cannot be performed.
Ends When	NMS receives notification from EMS on whether or not the cross-connection removal request operation is successful.
Exceptions	1. Unknown SDH Cross-Connection. 2. Invalid input parameter. 3. EMS Processing Error.
Post-Conditions	EMS sends notification to NMS which indicates the cross-connection that has been removed.

7.2.3 Fault management function set

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

For SDH-DLC specific network management, the fault management function set also includes the information loopback test.

7.2.3.1 Alarm report function set

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

7.2.3.1.1 EMS Sending DLC Related Alarms

Name	EMS Sending DLC Related Alarms
Summary	A communications alarm notification is sent to the NMS whenever an alarmable event is detected by the EMS or NE.
Actor(s)	NMS
Assumptions	The NMS has the authority to receive DLC alarms
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. The EMS or NE has detected an alarmable event.
Begins When	An alarmable event is detected by the EMS or NE.
Description	1. After the detection of an alarmable event, the EMS generates and autonomously sends a communication alarm notification to the NMS. 2. The NMS receives the alarm report and associates it as part of the notification. The alarm report described in clause 6.2.4.3.2 of [ITU-T Q.827.1] will be reused in this Recommendation. 3. The communications alarm notification may include [ITU-T X.733]: – Event Time. – Alarm Source (the object instance emitting the notification). – Alarm Type. – Probable Cause. – Specific Problems (optional). – Perceived Severity (Allowable values are: indeterminate, critical, major, minor, warning or cleared). – Backed Up Status ("True" if backed up) (optional). – Back Up Object (Will be null if backedUpStatus is "false") (optional). – Proposed Repair Actions (Optional). – Alarm Effect On Service (True if alarm is service effecting). – Alarm Description.
Ends When	The NMS receives the alarm report and associates it as part of the notification from EMS.
Exceptions	EMS Processing Error.
Post-Conditions	The NMS receives new alarm information.

7.2.3.2 Configure alarm report filter function

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

The filter can include the following contents or their combination:

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

- Event Time.

7.2.3.3 ASAP management

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

7.2.3.4 Alarm synchronization

Alarm synchronization means NMS gets the current alarm summary of EMS according to filter. This action may be triggered manually or automatically. The retrieve current alarm summary service in [ITU-T Q.821] can be used for this function.

7.2.3.5 DLC Loopback Test

Name	DLC Loopback Test
Summary	NMS needs CT to make a loopback test in order to check the link status. NMS requests CT to make a loopback test on a port of the RT through the management interface. This function can be used to detect whether the physical line associated with the port or the internal path of the port is available or not.
Actor(s)	NMS
Assumptions	Managed elements CT and RT are already installed and available for loopback test.
Pre-Conditions	1. NMS has established secured communication (including authentication) with EMS. 2. The managed system supports loopback test function.
Begins When	The NMS requests EMS test at CT and RT.
Description	1. NMS sends request to EMS to perform loopback test at DLC network (CT and RT managed elements), and then returns the subsequent result of the loopback test. 2. EMS receives input parameters which contain port Id of CT and RT, data source type, the test type, the managed object, the start time of the test, the end time of the test, and the time interval of reporting and logging the test result. 3. EMS validates if all required SDH-DLC NEs for loopback test are available and ready for service or in running condition. 4. EMS then blocks other management activities involving the specified SDH-DLC NE (CT, RT and SDH link between those managed elements) while performing the loopback test. 5. Based on set parameters, EMS executes CT to start the test sequence on the specified port and the corresponding port at RT. 6. At the end of the test or each interval for reporting and logging, EMS will report the test results as well as record them in the log. The test results contain the E1 tributary bit error statistics, the upstream and downstream bit error ratio, packet loss ratio, the number of received octets, and the number of transmitted octets. 7. EMS sends notification to NMS which indicates the loopback tests that have been executed or removed. 8. EMS returns exception or error notification if the operation cannot be performed.

Ends When	NMS receives notification and associated results from EMS on whether or not the loopback test request operation is successful.
Exceptions	1. Invalid input parameters. 2. Unknown Managed Entity. 3. EMS Processing Error.
Post-Conditions	NMS receives the loopback test results.

7.2.4 Performance management function use cases

The specification level requirements and the use cases for the common parts of performance management are described in clause 6.2.3 of [ITU-T Q.827.1], which will be reused in this Recommendation. Performance monitoring is the systematic assessment of a particular entity's ability to carry out its assigned function through the continuous collection and analysis of appropriate performance data. This Recommendation will specify the managed entities to be used in the performance management for SDH-DLC only.

Measurement data is the main objective of all the other function sets in performance management. A short summary of the requirements for SDH-DLC performance measurement data may include the following: the measurement of DLC performance at CT ports, RT ports and E1 ports, ISDN performance parameter, and SDH transmission performance. The measurement data of E1 port focuses on the parameters about errored seconds, and unavailable seconds. The measurement data of DLC port includes the following parameters.

DLC performance parameters:

- upstream and downstream BERs of the port
- Code Violation
- Error Second
- Severely Errored Framing Alarm Indication Signal Second
- Severely Errored Second
- UnAvailable Second
- Controlled Slip Second
- Controlled Slip Second Far End
- Code Violation Far End
- Errored Second Far End
- Severely Errored Second Far End
- UnAvailable Second Far End

ISDN Performance parameter:

- Code Violation
- Code Violation Far End
- Errored Second
- Errored Second Far End
- Severely Errored Second
- Severely Errored Second Far End
- Code Violation, Cyclic Redundancy Check