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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 × 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.

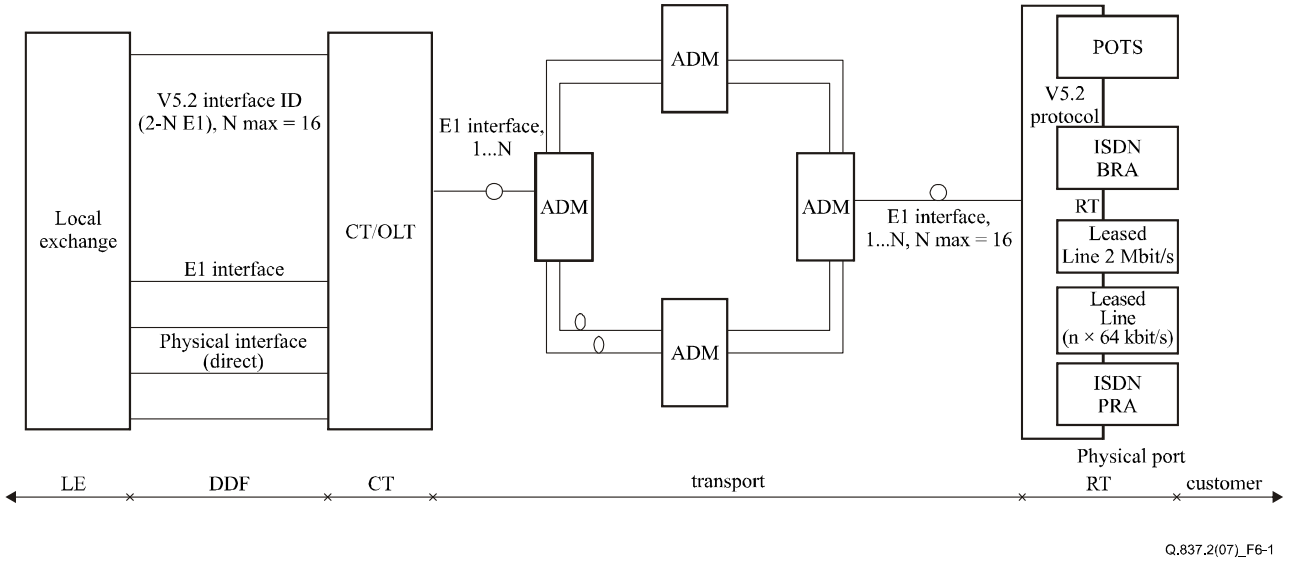

Figure 6-1 – The general configuration of DLC and SDH system

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.

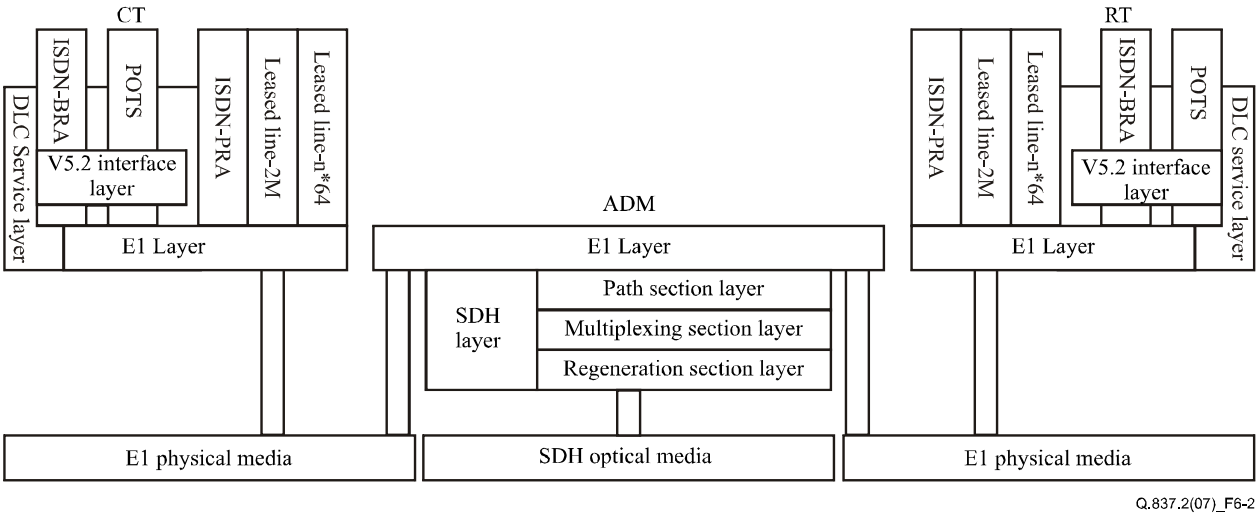

Figure 6-2 – Network layering of SDH-DLC

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 × 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.

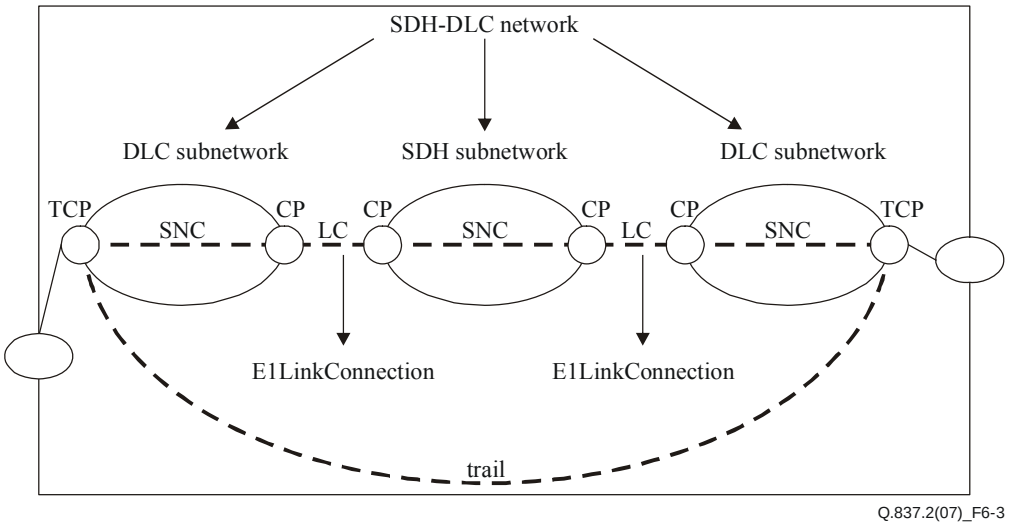

Figure 6-3 – Partitioning SDH-DLC subnetwork

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.

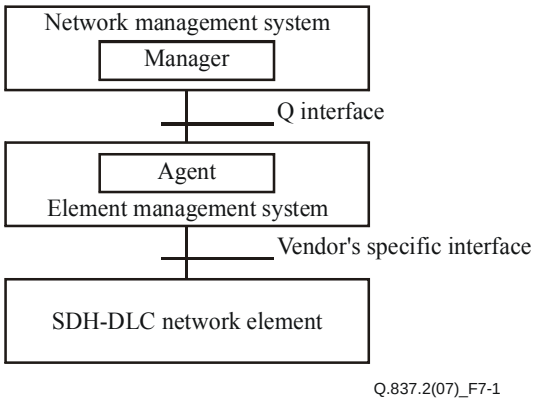

Figure 7-1 – Reference interface

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.

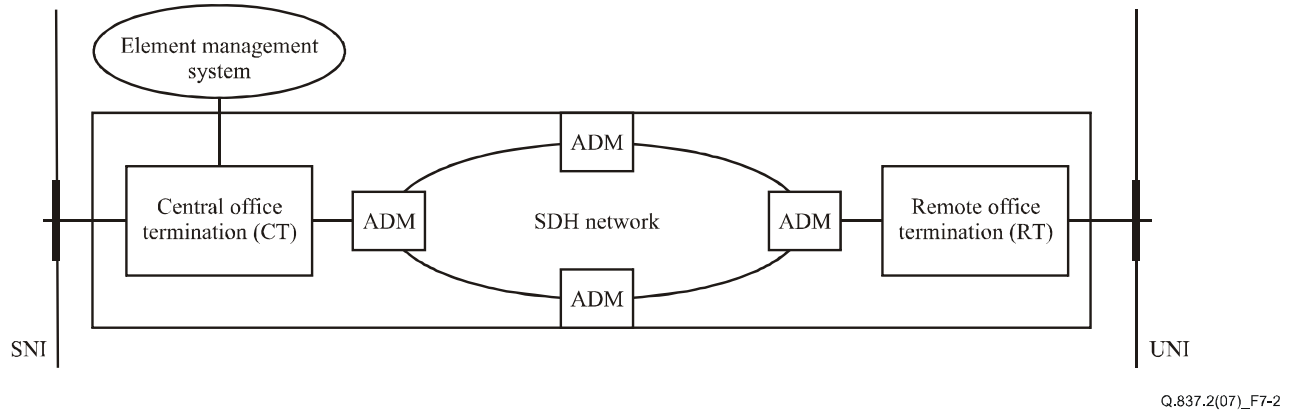

Figure 7-2 – SDH-DLC system architecture

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.

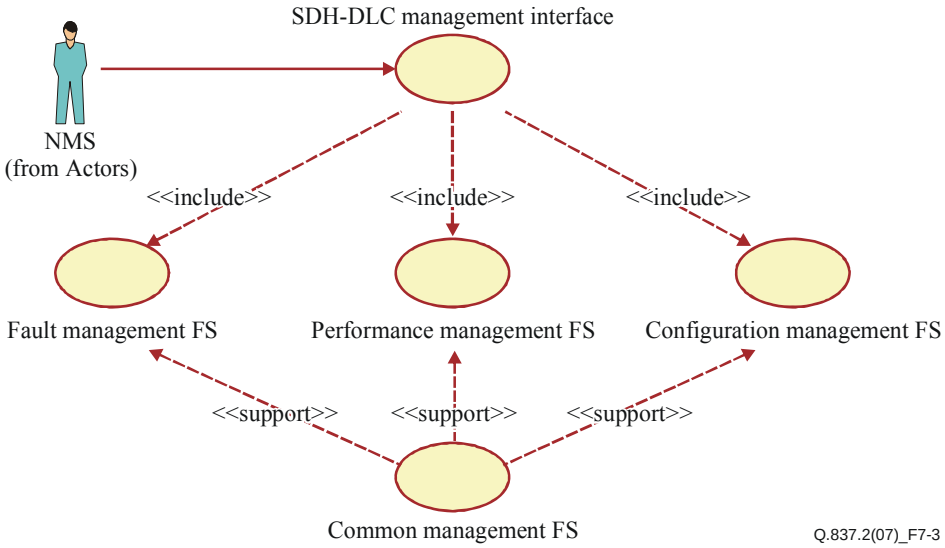

Figure 7-3 – Main use case diagram

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.

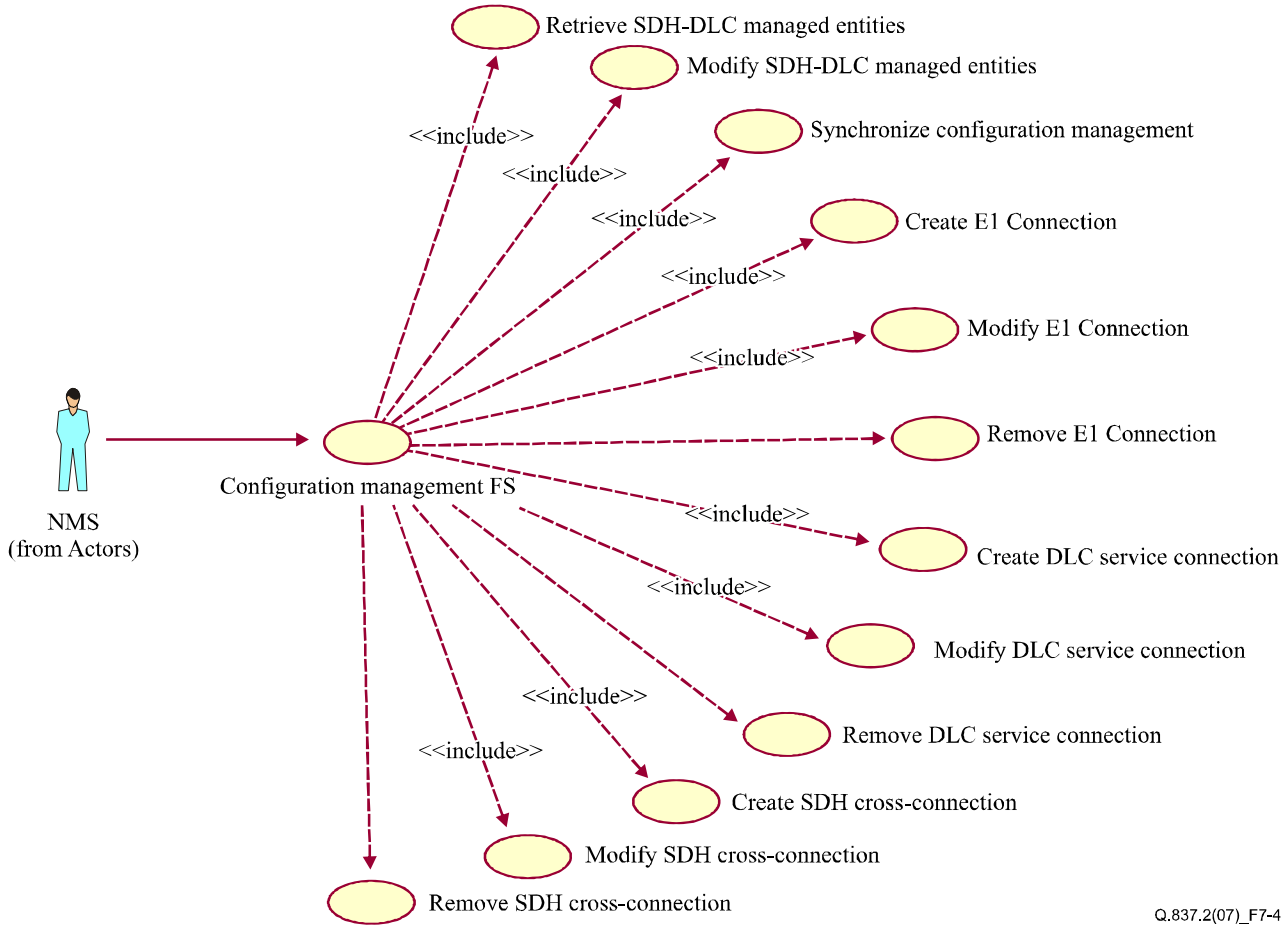

Figure 7-4 – Configuration management function set

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

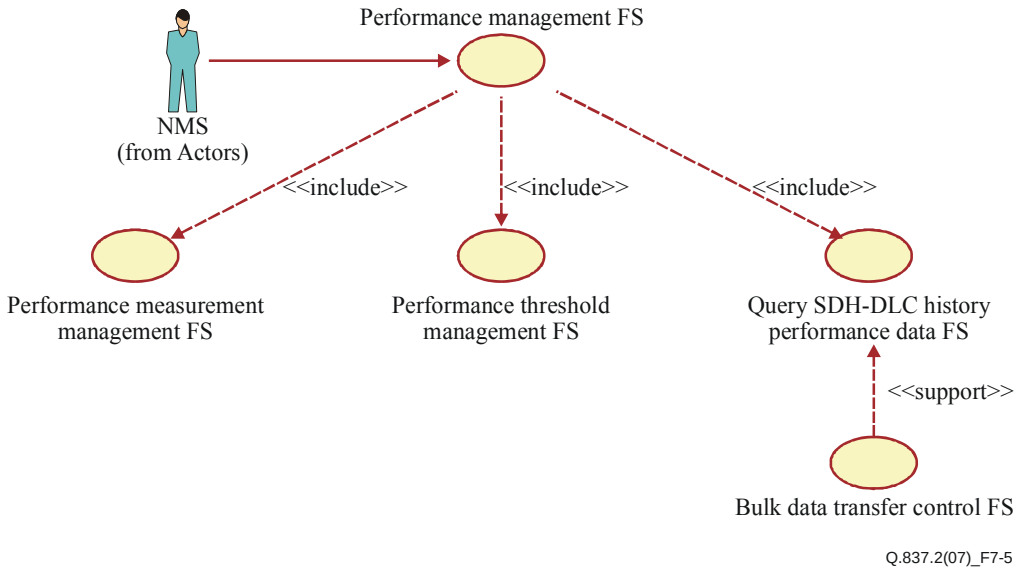

Figure 7-5 – Performance management function set

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

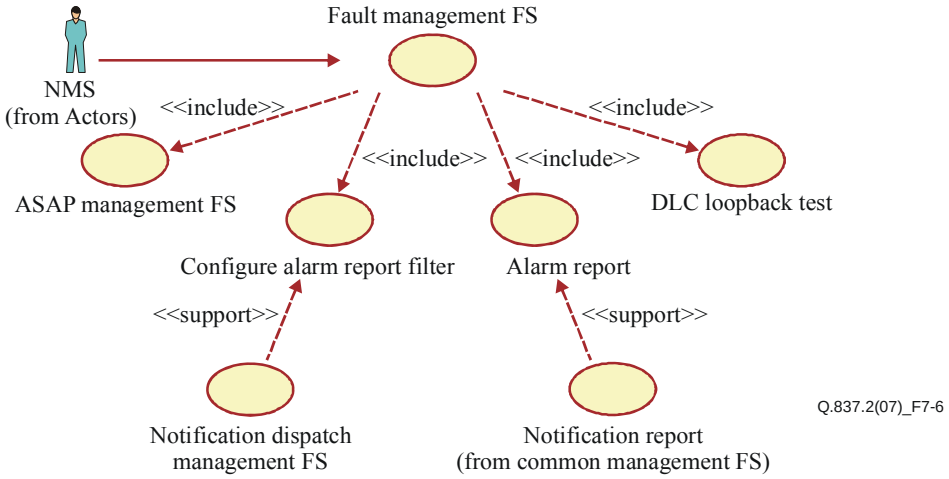

Figure 7-6 – Fault management function set

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

SDH Performance parameters measured on multiplex section, regenerator section, path termination section:

– Consecutive Severely Errored Second
– Far End Consecutive Severely Errored Second
– Far End Unavailable Second
– Near End Unavailable Second
– Unavailable Time Alarm

8 Analysis

8.1 Common management

8.1.1 Managed entities

The class diagrams of common management entities can be found in clause 7.2.1.1 of [ITU-T Q.827.1].

8.2 Configuration management

8.2.1 Class diagram of configuration management entities

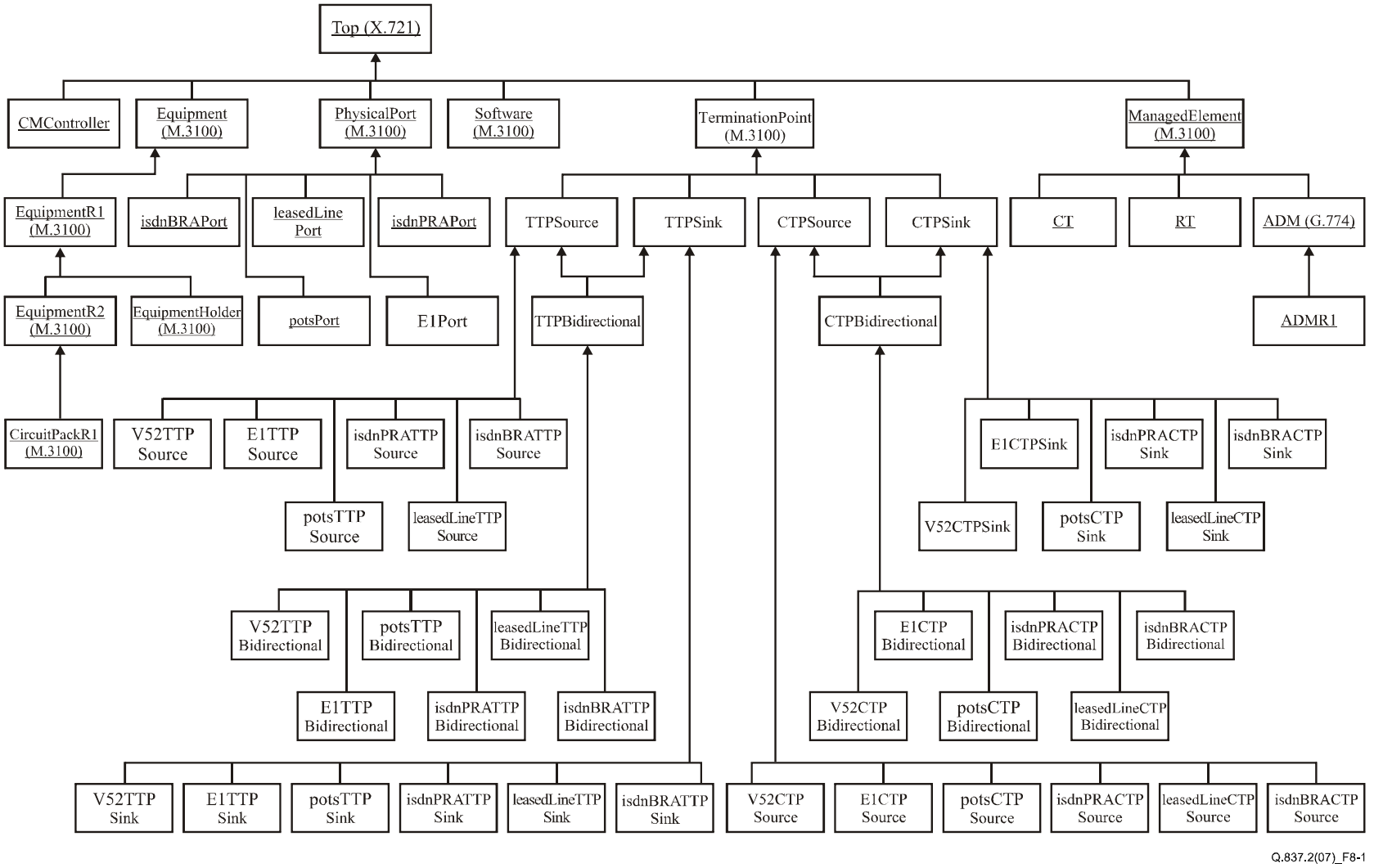

Figure 8-1 – Inheritance diagram for network element view

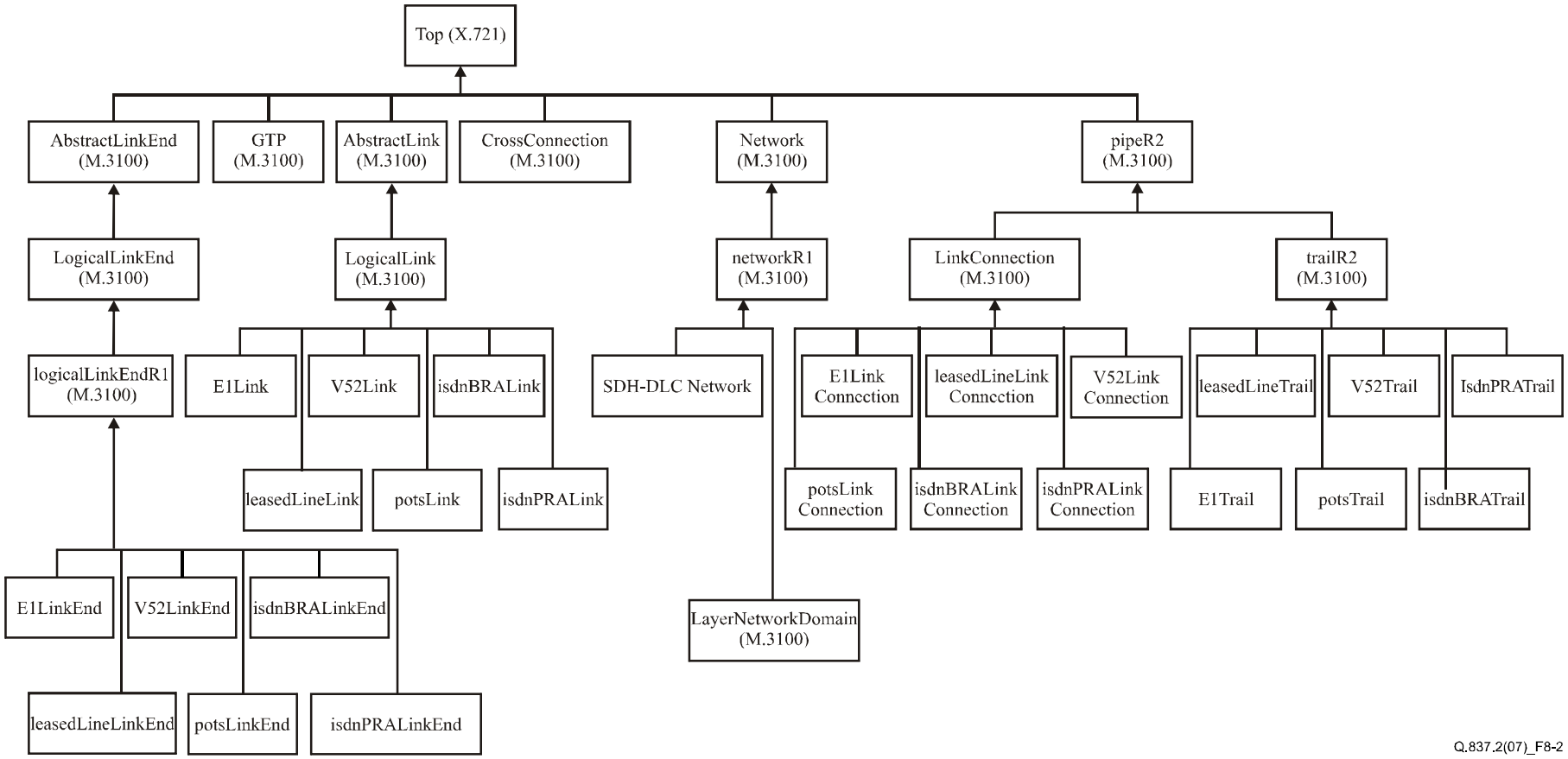

Figure 8-2 – Inheritance diagram for network view

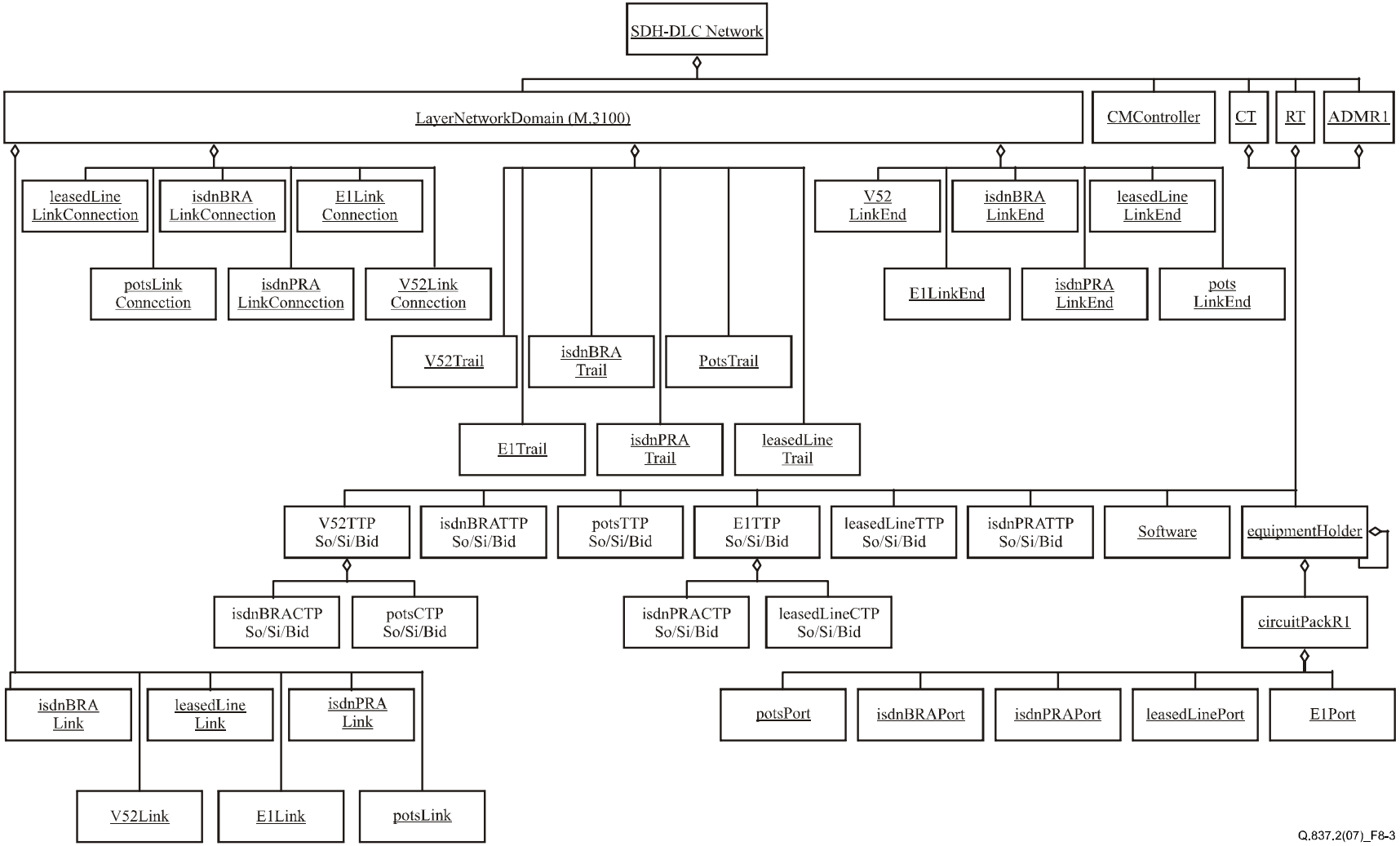

Figure 8-3 – Containment relationship of configuration managed entities

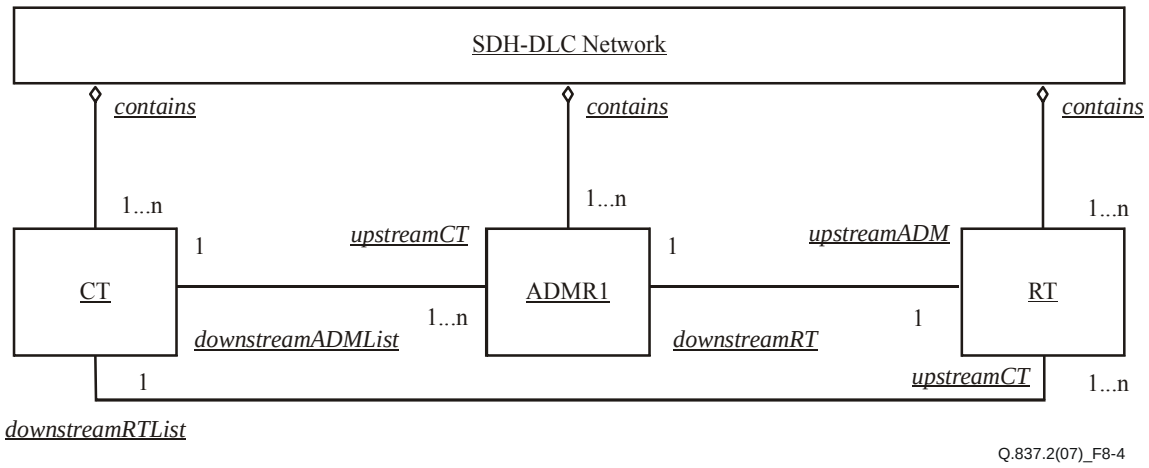

Figure 8-4 – E-R diagram for inventory management

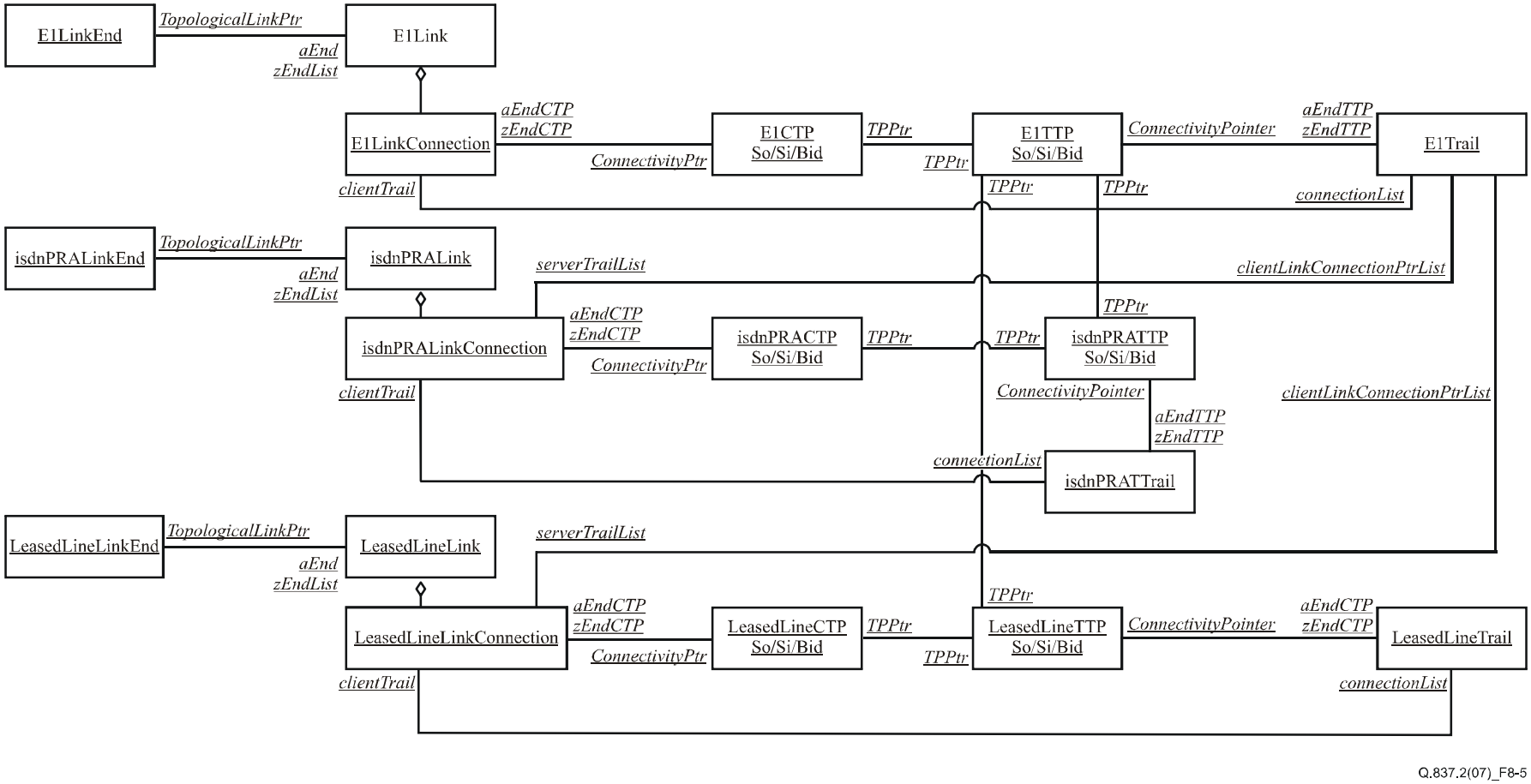

Figure 8-5 – E-R diagram of configuration management – E1 layer network managed entities

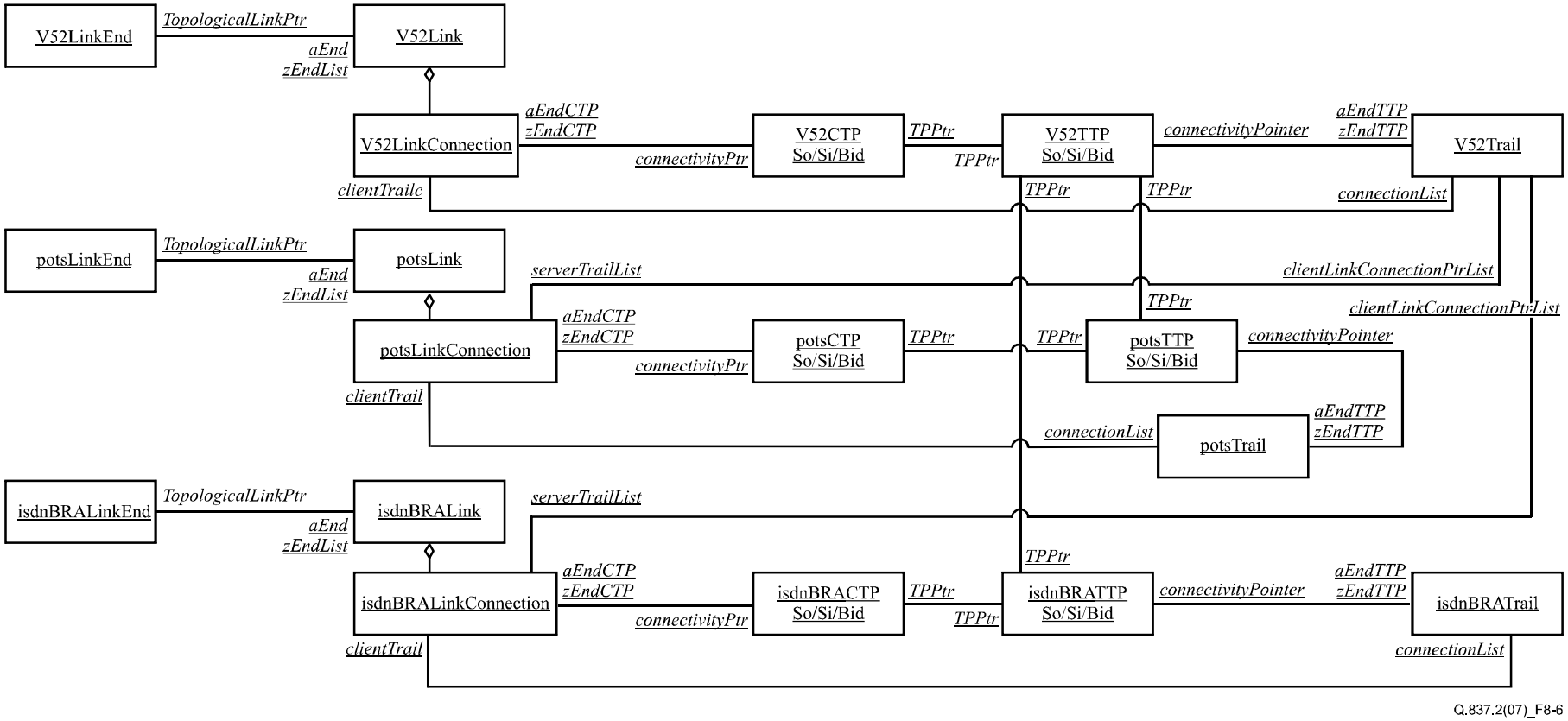

Figure 8-6 – E-R diagram of configuration management – V5.2 layer network managed entities

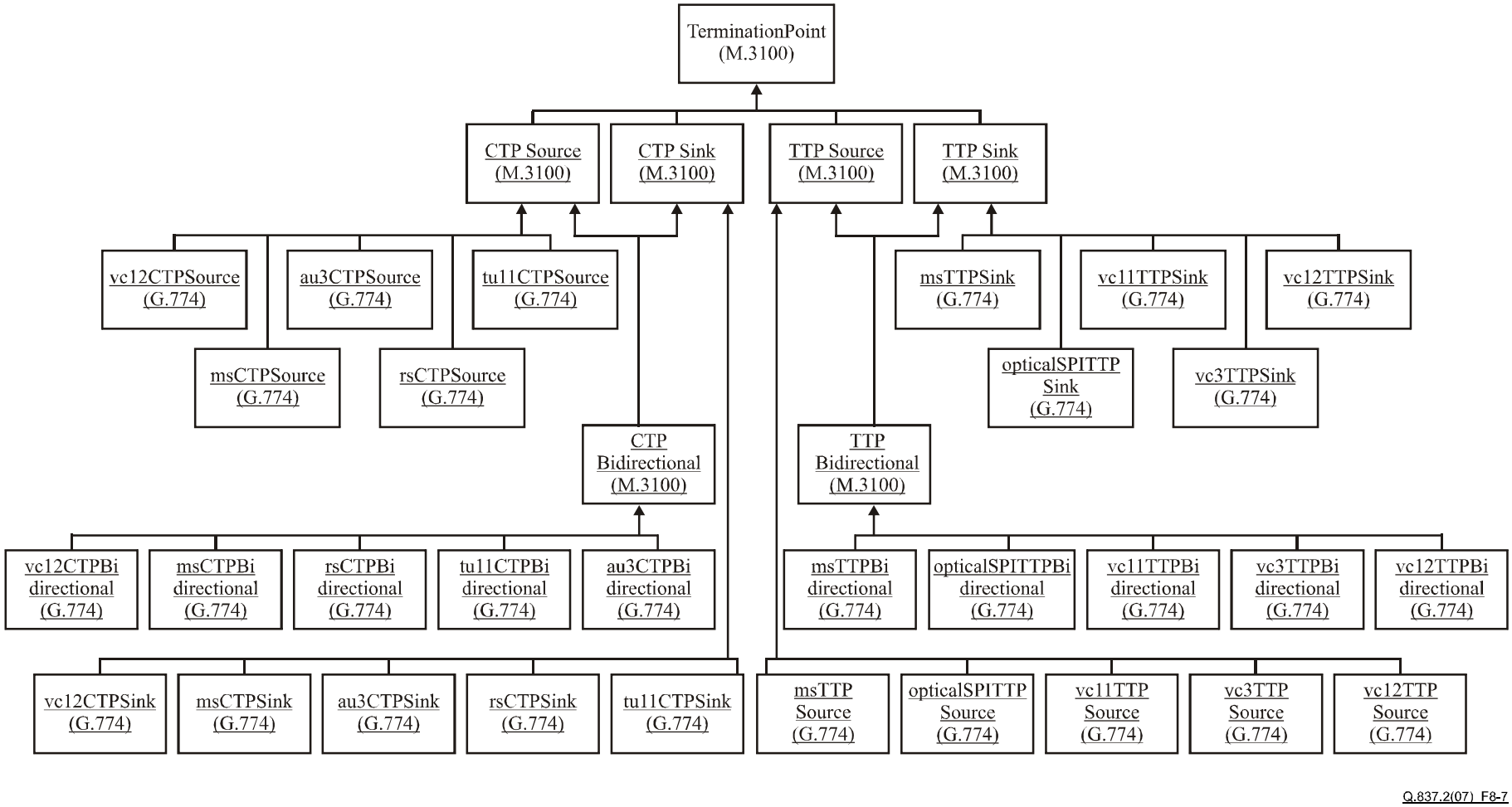

Figure 8-7 – Inheritance diagram SDH-related managed entities

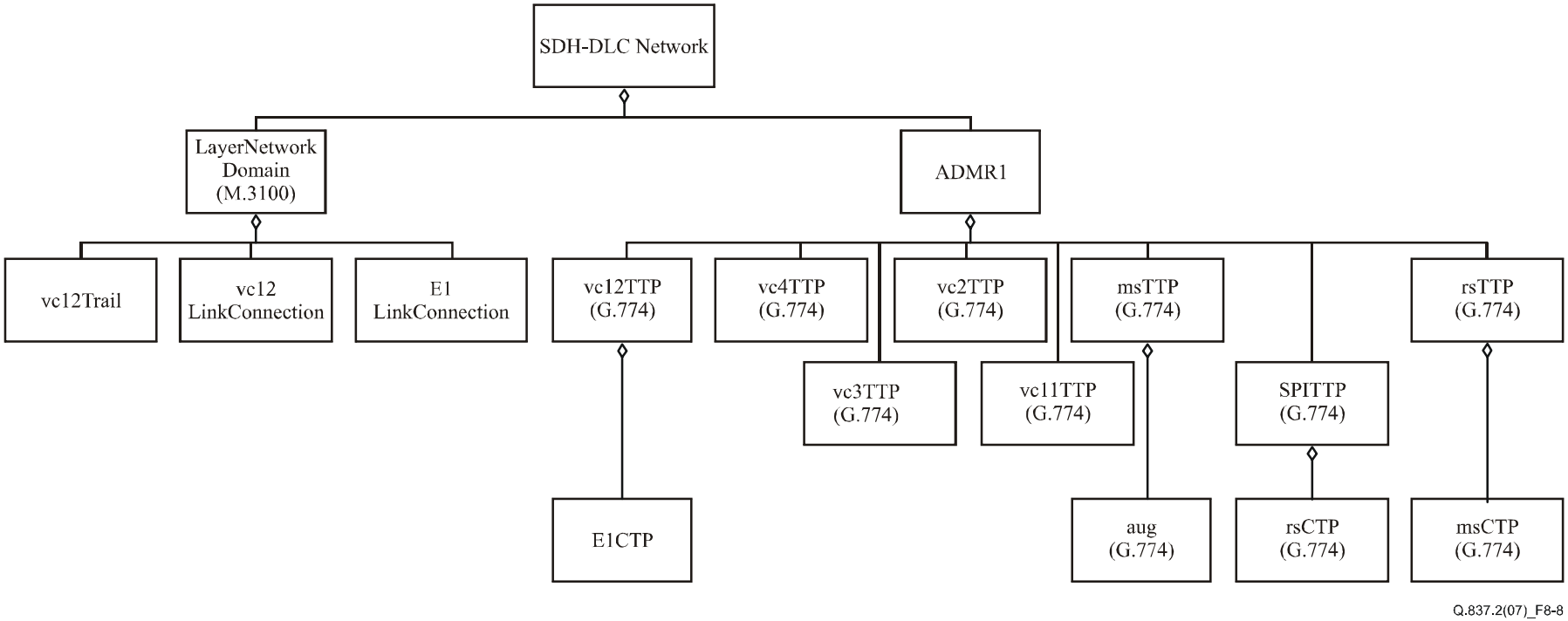

Figure 8-8 – Containment diagram SDH-related managed entities

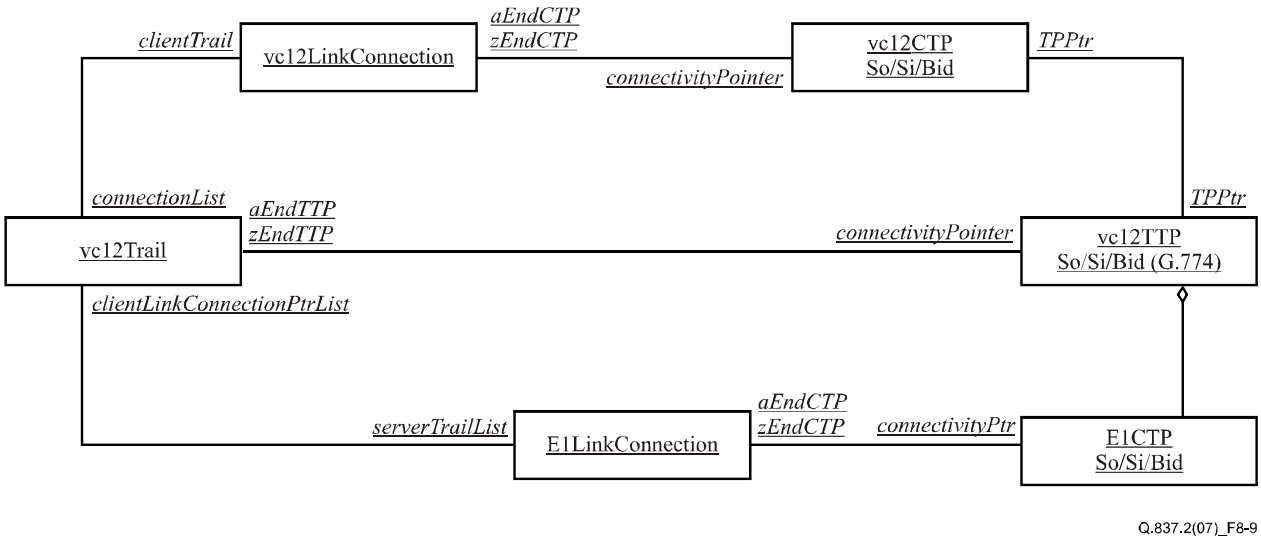

Figure 8-9 – E1-SDH relationship diagram

8.2.2 Managed entities

8.2.2.1 CMController

Behaviour: This managed entity is used by EMS to provide the configuration management control functions for NMS.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
cMControllerId	This is the unique identifier of the managed entity.	Integer	M, R

Operations	
Name	**Description**
modifyAttributeValue	This operation is used to modify the attribute values of one or more SDH-DLC configuration resource objects of the same type.
queryAttributeValue	This operation is used to query the attribute values of one or more SDH-DLC Configuration Management related managed entities.
createE1Connection	This operation is used to assign a connection relationship between an E1 port in CT and an E1 port in RT.
removeE1Connection	This operation is used to remove a designated connection relationship between an E1 port in CT and an E1 port in RT.
createDLCServiceConnection	This operation is used to create DLC Service resource objects for DLC service activation (POTS, ISDN, leased line).
removeDLCServiceConnection	This operation is used to remove DLC Service resource objects for DLC service activation (POTS, ISDN, leased line).
createSDHCrossConnection	This operation is used to create SDH Cross-Connection.
removeSDHCrossConnection	This operation is used to remove a designated SDH Cross-Connection.

Relationships:	
Zero or one instance of this managed entity may be contained in each ManagedElement instance.	
Reportable Notifications:	
objectCreation	O
objectDeletion	O

8.2.2.2 Equipment (M.3100)

Behaviour:

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

8.2.2.3 EquipmentR1 (M.3100)

Behaviour:

This object class is derived from Equipment and defined in [ITU-T M.3100].

8.2.2.4 EquipmentR2 (M.3100)

Behaviour:

This object class is derived from EquipmentR1 and defined in [ITU-T M.3100].

8.2.2.5 EquipmentHolder (M.3100)

Behaviour:

The Equipment Holder object class is a class of managed objects that represents physical resources of a network element that are capable of holding other physical resources. Examples of resources represented by instances of this object class are equipment bay, shelf and slot. This object class is derived from EquipmentR1 and defined in [ITU-T M.3100].

8.2.2.6 Software (M.3100)

Behaviour:

The software object class is a class of managed objects that represents logical information stored in equipment, including programs and data tables. Software may be nested within other software, thereby creating a containment relationship.

Relationships:

Zero or more instances of this managed entity can be contained in one instance of ManagedElement or CircuitPackR1.

8.2.2.7 pipeR2 (M.3100)

Behaviour:

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

8.2.2.8 CircuitPackR1 (M.3100)

Behaviour:
This object class is derived from Equipment and defined in [ITU-T M.3100].
Relationships:
Zero or one instance of this managed entity can be contained in a slot-typed EquipmentHolder instance. And Each CircuitPack instance may contain zero or more PhysicalPort sub-class instances.

8.2.2.9 PhysicalPort (M.3100)

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

8.2.2.10 ManagedElement (M.3100)

Behaviour:
The Managed Element object class is a class of managed objects representing telecommunications equipment or TMN entities (either groups or parts) within the telecommunications network that performs managed element functions, i.e., provides support and/or service to the subscriber. Managed elements may or may not additionally perform mediation/OS functions. A managed element communicates with the manager (directly or indirectly) over one or more standard Q-interfaces for the purpose of being monitored and/or controlled. A managed element contains equipment that may or may not be geographically distributed.

8.2.2.11 TerminationPoint (M.3100)

Behaviour:
This managed object represents the termination of a transport entity, such as an instance representing a Trail (or Connectionless trail) or a Link Connection (or Link flow). The managed entity supports the operational state and administrative state functions as defined in [ITU-T X.731]. The operational state reflects the perceived ability to generate and/or receive a valid signal. Changes in state are reported automatically or as requested by a managing system. This managed entity is defined for the purposes of grouping together all common attributes of termination point both in NE view and in network view.

8.2.2.12 CrossConnection (M.3100)

Behaviour:
A managed object of this class represents an assignment relationship between the termination point or GTP object listed in the fromTermination attribute and the termination point or GTP objects listed in the toTermination attribute of this managed object. This object class is derived from top and is defined in [ITU-T M.3100].

8.2.2.13 CT

This managed entity represents Central Terminal in the DLC system for describing DLC CT managed element. This managed entity is derived from ManagedElement and inherits all the attributes and notifications of its super class.

Attributes

Name	Description	Type	Qualifier
cTId	This is the unique identifier of this CT managed entity.	Name	M, R
assocV5Interface	This attribute gives the relation to the V5.2 interface, that the virtual access port or that the user port is assigned to. It is a group relationship attribute according to [ITU-T X.732].	Set of String (Each string is used to identify a specific V5 interface.)	M, R
clientUserPorts	The clientUserPorts attribute points to the instances of the userPort sub-classes in an Access Network. clientUserPorts are located in the RT, used for client providing DLC services. The userPorts are related to those DLC services (POTS ISDN BRA, ISDN PRA, and leased lines)	List of Name	M, R/W
cTassocTimeSlot	This attribute represents the associated time slot of this CT. The value is an integer which indicates the time slot number assigned for this CT.	Integer	M, R
cTIP	This attribute identifies the IP address of this CT instance.	String (in IP address format)	M, R
downstreamADMList	This attribute indicates the ADMs connected to this designated CT.	List of Name	M, R/W
downstreamRTList	This attribute indicates the RTs connected to this designated CT.	List of Name	M, R/W

Relationships:

One or more instances of this managed entity are contained in the SDH-DLC Network. Each CT is associated with one or more ADMs, and one or more RTs, which are represented by the association attributes downstreamADMList and downstreamRTList.

Reportable Notifications:

The same as ManagedElement.

8.2.2.14 RT

Behaviour:

This managed entity represents Remote Terminal in the DLC system for describing DLC RT managed element. This managed entity is derived from ManagedElement and inherits all the attributes and notifications of its super class.

Attributes

Name	Description	Type	Qualifier
rTId	This is the unique identifier of this RT managed entity.	Name	M, R
rTassocTimeSlot	This attribute points to an object representing the associated time slot.	Integer	M, R

rTequipmentNumber	This attribute is the userPort identification at the LE part.	Integer	M, R
rTIP	This attribute identifies the IP address of this RT instance.	String	M, R
upstreamCT	This attribute indicates the upstream CT that this RT is connected to.	Name	M, R/W
upstreamADM	This attribute indicates the upstream ADM that this RT is connected to.	Name	M, R/W

Relationships:

One or more instances of this managed entity are contained in the SDH-DLC Network. Each RT is associated with one CT, and one ADM, which are represented by the association attributes upstreamCT and upstreamADM.

Reportable Notifications:

The same as ManagedElement.

8.2.2.15 ADMR1

Behaviour:

This managed entity represents the functionality of add and drop multiplexer network element in the SDH system, and it is derived from ManagedElement for describing ADM managed element. An ADM is a 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 they pass through the ADM. This managed entity inherits ADM [ITU-T G.774].

Attributes

Name	Description	Type	Qualifier
downstreamRT	This attribute indicates the downstream RT that this ADM is connected to.	Name	M, R/W
upstreamCT	This attribute indicates the upstream CT that this ADM is connected to.	Name	M, R/W

Relationships:

One or more instances of this managed entity are contained in the SDH-DLC Network. Each ADM is associated with one RT, represented by the downstream RT attribute. One or more ADMs are associated with one CT, represented by the upstream CT attribute.

Reportable Notifications:

The same as ManagedElement

8.2.2.16 E1Port

Behaviour:

This managed object describes an E1 port within an ADM, CT and RT. This managed entity is derived from PhysicalPort [ITU-T M.3100] and inherits all the attributes and notifications of its super class.

Attributes

Name	Description	Type	Qualifier
codingType	This attribute indicates the encoding type of this E1 port. The value is a integer which has the following interpretation: 1: HDB3, 2: NRZ.	Integer (1, 2)	M, R

frameStructureIndicator	This attribute indicates the detected framing properties of the characteristic information at the corresponding path layer. If the detection process is not activated or pending, the value is 0 (noIndication), otherwise the value is 1.	Integer (0, 1)	M, R
impedance	This attribute indicates the matching impedance of this E1 port. The value is an integer with the following interpretation: 1: non-balance mode, 75 Ω; 2: balance mode, 120 Ω.	Integer (1, 2)	M, R
loopEnable	This attribute is controlled by NMS, indicating whether this E1 port is enabled or disabled for loopback purpose. The value true indicates it is enabled.	Boolean	M, R/W
Relationships: Zero or more instances of this managed object are contained in one CircuitPackR1 managed object.			
Reportable Notifications: The same as PhysicalPort.			

8.2.2.17 leasedLinePort

Behaviour:			
This managed object describes port within an RT. This managed entity is derived from PhysicalPort and inherits all the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
bitRate	This attribute indicates the bit rate integer N of N × 64 kbit/s	Integer	M, R
bitsPerCharacter	This attribute indicates the number of bits transmitted per character for an asynchronous transmission mode.	Integer	M, R
dataEquipmentMode	This attribute indicates whether the interface is working as a terminal (dte) or there is a modem connected to it (dce).	ENUM {dte, dce}	M, R
dataInterfaceMode	This attribute indicates an N × 64 kbit/s working either as X.24 or V.24 electrically terminated. 1: X.24 2: V.24	Integer (1, 2)	M, R
directionality	The directionality attribute specifies whether this leased line port is unidirectional or bidirectional.	ENUM {unidirectional, bidirectional}	M, R
frameStructureIndicator	This attribute indicates whether the tributary stream is structured or not. Value "true" means the stream is structured.	Boolean	M, R

Relationships: Zero or more instances of this managed object are contained in one CircuitPackR1 managed object.
Reportable Notifications: The same as PhysicalPort.

8.2.2.18 potsPort

Behaviour: This managed object describes port within an RT. This managed entity is derived from PhysicalPort and inherits all the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
subscriberNumber	This attribute gives the current subscriber directory number.	Integer	M, R
specialFeatures	This attribute indicates whether or not there are special features and if so what they are. The default value, an empty string, indicates that there are no special features.	String	M, R
Relationships: Zero or more instances of this managed object are contained in one CircuitPackR1 managed object.			
Reportable Notifications: The same as PhysicalPort.			

8.2.2.19 isdnBRAPort

Behaviour: This managed object describes port within an RT. This managed entity is derived from PhysicalPort and inherits all the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
accessDigitalSectionInd	This attribute indicates whether or not there is an access digital section at this ISDN port.	Boolean	M, R
assocFrameCommPath	It points to the associated ISDN communication path carrying the D-channel frame mode data of the assigned ISDN access if the customer has subscribed to this service. It is a group relationship according to [ITU-T X.732].	Set of String (Each string is used to identify a specific communication path.)	M, R/W
assocTimeSlot	This attribute points to an object representing the associated time slot.	Integer	M, R
bearerChannelType	This attribute indicates whether or not the bearer channel is used for PL access.	Boolean	M, R
dataType	This attribute indicates the type of data which is assigned to this ISDN communication path [ITU-T G.960].	Enum {B-Channel, D-Channel}	M, R
subscriberNumber	This attribute gives the current subscriber directory number.	Integer	M, R

Relationships: Zero or more instances of this managed object are contained in one CircuitPackR1 managed object.
Reportable Notifications: The same as PhysicalPort.

8.2.2.20 isdnPRAPort

Behaviour: This managed object describes port within an RT. This managed entity is derived from PhysicalPort and inherits the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
accessDigitalSection Ind	This attribute indicates whether or not there is an access digital section at this ISDN port.	Boolean	M, R
assocFrameComm Path	It points to the associated ISDN communication path carrying the D-channel frame mode data of the assigned ISDN access if the customer has subscribed to this service. It is a group relationship according to [ITU-T X.732].	Set of String (Each string is used to identify a specific communication path.)	M, R/W
assocTimeSlot	This attribute points to an object representing the associated time slot.	Integer	M, R
bearerChannelType	This attribute indicates whether or not the bearer channel is used for PL access.	Boolean	M, R
dataType	This attribute indicates the type of data which is assigned to this ISDN communication path.	Enum {B-Channel, D-Channel}	M, R
subscriberNumber	This attribute gives the current subscriber directory number.	Integer	M, R
Relationships: Zero or more instances of this managed object are contained in one CircuitPackR1 managed object.			
Reportable Notifications: The same as PhysicalPort.			

8.2.2.21 TrailR2 (M.3100)

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

8.2.2.22 Network (M.3100)

Behaviour:

The network object class is a class of managed objects that are collections of interconnected telecommunications and management objects (logical or physical) capable of exchanging information. These objects have one or more common characteristics, for example, they may be owned by a single customer or provider, or associated with a specific service network. A network may be nested within another (larger) network, thereby forming a containment relationship. An example of a network that is contained in another network is a transmission sub-network. It is owned by a single administration and can only perform transmission functions.

8.2.2.23 Group Termination Point (M.3100)

Behaviour:

This managed entity is defined in [ITU-T M.3100]. Instances of this managed entity may be created and deleted by request of the managing system.

8.2.2.24 ConnectionTerminationPointSource (M.3100)

Behaviour:

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

8.2.2.25 ConnectionTerminationPointSink (M.3100)

Behaviour:

This managed object terminates a link connection. This managed entity is derived from NetworkTerminationPoint and inherits the attributes and notifications of its super class.

8.2.2.26 ConnectionTerminationPointBidirectional (M.3100)

Behaviour:

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

8.2.2.27 trailTerminationPointSource (M.3100)

Behaviour:

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

8.2.2.28 trailTerminationPointSink (M.3100)

Behaviour:

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

8.2.2.29 trailTerminationPointBidirectional (M.3100)

Behaviour:

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

8.2.2.30 layerNetworkDomain (M.3100)

Behaviour:

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

8.2.2.31 linkConnection (M.3100)

Behaviour:

The Link Connection object class is a class of managed objects responsible for the transparent transfer of information between (Network) Connection Termination Points. This managed entity is derived from pipeR2 [ITU-T M.3100] and inherits the attributes and notifications of its super class.

8.2.2.32 E1LinkConnection

Behaviour:

This managed entity is used to describe the transport entity transferring information between two E1CTPBidirectional instances at SDH-DLC Service layer. Instances of this managed entity can also be created and deleted as requested by a managing system. The managed entity supports availability status and administrative state functions as defined in [ITU-T X.731]. Changes in state are reported automatically or on demand to a managing system. This managed entity is derived from linkConnection [ITU-T M.3100] and inherits all the attributes and notifications of its super class.

Relationships:

This managed entity is established between two E1CTPBidirectional instances. Zero or more E1LinkConnection instances may be contained in one layer network domain instance, and one or more E1LinkConnections aggregate an E1Link instance. Each E1LinkConnection instance is associated with two E1CTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one vc12Trail represented by the serverTrailList attribute.

8.2.2.33 potsLinkConnection

Behaviour:

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

Relationships:

This managed entity is established between two potsCTPBidirectional instances. Zero or more potsLinkConnection instances may be contained in one layer network domain instance, and one or more potsLinkConnection aggregate a potsLink instance. Each potsLinkConnection instance is associated with two potsCTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one V52Trail represented by the serverTrailList attribute.

8.2.2.34 isdnPRALinkConnection

Behaviour:

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

Relationships:

This managed entity is established between two isdnPRACTPBidirectional instances. Zero or more isdnPRALinkConnection instances may be contained in one layer network domain instance, one or more isdnPRALinkConnection aggregate an isdnPRALink instance. Each isdnPRALinkConnection instance is associated with two isdnPRACTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one E1Trail represented by the serverTrailList attribute.

8.2.2.35 isdnBRALinkConnection

Behaviour:

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

Relationships:

This managed entity is established between two isdnBRACTPBidirectional instances. Zero or more isdnBRALinkConnection instances may be contained in one layer network domain instance, one or more isdnBRALinkConnection aggregate an isdnBRALink instance. Each isdnBRALinkConnection instance is associated with two isdnBRACTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one V52Trail represented by the serverTrailList attribute.

8.2.2.36 leasedLineLinkConnection

Behaviour:

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

Relationships:

This managed entity is established between two leasedLineCTPBidirectional instances. Zero or more leasedLineLinkConnection instances may be contained in one layer network domain instance, and one or more leasedLineLinkConnection aggregate a leasedLineLink instance. Each leasedLineLinkConnection instance is associated with two leasedLineCTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one E1Trail represented by the serverTrailList attribute.

8.2.2.37 V52LinkConnection

Behaviour:

This managed entity is used to describe the transport entity transferring information between two V52CTPBidirectional instances at SDH-DLC Service layer. Instances of this managed entity can also be created and deleted as requested by a managing system. The managed entity supports availability status and administrative state functions as defined in [ITU-T X.731]. Changes in state are reported automatically or on demand to a managing system. This managed entity is derived from linkConnection and inherits all the attributes and notifications of its super class.

Relationships:

This managed entity is established between two V52CTPBidirectional instances. Zero or more V52LinkConnection instances may be contained in one layer network domain instance, and one or more V52LinkConnection aggregate a V52Link instance. Each V52LinkConnection instance is associated with two V52CTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes.

8.2.2.38 E1Trail

Behaviour:

This managed entity is used to describe the transport entity transferring information between two E1TTP instances at SDH-DLC Network. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from TrailR2 and inherits all the attributes and notifications of its super class.

Relationships:

Zero or more E1Trail may be contained in one layerNetworkDomain instance, and each E1Trail is associated with two E1TTP instances, and associated as clientLinkConnectionPointerList of isdnPRALinkConnection and leasedLineLinkConnection.

8.2.2.39 V52Trail

Behaviour:

This managed entity is used to describe the transport entity transferring information between two V52TTP instances at SDH-DLC Network. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from TrailR2 and inherits all the attributes and notifications of its super class.

Relationships:

Zero or more V52Trails may be contained in one layerNetworkDomain instance, and each V52Trail is associated as connectivityPointer of V52TTP instances, and associated as clientLinkConnectionPointerList of potsLinkConnection and isdnBRALinkConnection.

8.2.2.40 potsTrail

Behaviour:
This managed entity is used to describe the transport entity transferring information between two potsTTP instances at DLC Service Layer. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from Trail and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsTrails may be contained in one layerNetworkDomain instance. Each potsTrail is associated as connectivityPointer of potsTTP instances.

8.2.2.41 isdnBRATrail

Behaviour:
This managed entity is used to describe the transport entity transferring information between two isdnBRATTP instances at DLC Service Layer. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from Trail and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRATrails may be contained in one layerNetworkDomain instance. Each isdnBRATrail is associated as connectivityPointer of isdnBRATTP instances.

8.2.2.42 leasedLineTrail

Behaviour:
This managed entity is used to describe the transport entity transferring information between two leasedLineTTP instances at DLC Service Layer. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from Trail and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineTrails may be contained in one layerNetworkDomain instance. Each leasedLineTrail is associated as connectivityPointer of leasedLineTTP instances.

8.2.2.43 isdnPRATrail

Behaviour:
This managed entity is used to describe the transport entity transferring information between two isdnPRATTP instances at DLC Service Layer. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from Trail and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnPRATrails may be contained in one layerNetworkDomain instance. Each isdnPRATrail is associated as connectivityPointer of isdnPRATTP instances.

8.2.2.44 E1TTPBidirectional

Behaviour:
This managed entity represents Trail Termination Point Bidirectional that originates and terminates E1 trail. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more E1TTPBidirectional may be contained in SDH-DLC NE instance. Each E1TTPBidirectional is associated as TPPointer of E1CTPBidirectional, leasedLineTTPBidirectional, and isdnPRATTPBidirectional instances, and associated as connectivityPointer of E1Trail.

8.2.2.45 E1TTPSink

Behaviour:
This managed entity represents Trail Termination Point Sink that terminates E1 trail. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more E1TTPSink may be contained in SDH-DLC NE instance. Each E1TTPSink is associated as TPPointer of E1CTPSink, leasedLineTTPSink, and isdnPRATTPSink instances, and associated as connectivityPointer of E1Trail.

8.2.2.46 E1TTPSource

Behaviour:
This managed entity represents Trail Termination Point Source that originates E1 trail. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more E1TTPSource may be contained in SDH-DLC NE instance. Each E1TTPSource is associated as TPPointer of E1CTPSource, leasedLineTTPSource, and isdnPRATTPSource instances, and associated as connectivityPointer of E1Trail.

8.2.2.47 E1CTPBidirectional

Behaviour:			
This managed entity originates and terminates an E1 link connection. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
E1CTPId	ID for this CTP	integer	M, R
Relationships:			
Zero or more E1CTPBidirectional may be contained in one vc12TTPBidirectional instance. Each E1CTPBidirectional is associated as TPPointer of E1TTPBidirectional, associated as connectivityPointer of E1LinkConnection.			

8.2.2.48 E1CTPSource

Behaviour:

This managed entity represents Connection Termination Point Source for E1 link connection. This CTP is created if the E1 link connection provides transmitting capabilities only. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.

Attributes

Name	Description	Type	Qualifier
crossConnectionPointer	The cross-connection pointer attribute points to the cross-connection managed object that has link connection with this CTP.	Name	M, R/W
downstreamConnectivity Pointer	The downstream connectivity pointer attribute points to the termination point managed object, within the same managed element, that receives information (traffic) from this termination point at the same layer, or is null.	Name	M, R/W

Relationships:

Zero or more E1CTPSource may be contained in one vc12TTPSource instance. Each E1CTPSource is associated as TPPointer of E1TTPSource, and associated as connectivityPointer of E1LinkConnection.

8.2.2.49 E1CTPSink

Behaviour:

This managed entity represents Connection Termination Point Sink for E1 link connection. This CTP is created if the E1 link connection provides receiving capabilities only. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.

Attributes

Name	Description	Type	Qualifier
crossConnectionObject Pointer	The cross-connection pointer attribute points to the cross-connection managed object that has link connection with this CTP.	Name	M, R/W
upstreamConnectivity Pointer	The upstream connectivity pointer attribute points to the termination point managed object, within the same managed element, that sends information (traffic) from this termination point at the same layer, or is null.	Name	M, R/W

Relationships:

Zero or more E1CTPSink may be contained in one vc12TTPSink instance. Each E1CTPSink is associated as TPPointer of E1TTPSink, and associated as connectivityPointer of E1LinkConnection.

8.2.2.50 V52TTPBidirectional

Behaviour: This managed entity represents Trail Termination Point Bidirectional that originates and terminates V52 trail. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.			
assocE1Link	This attribute gives the E1 link entity which is assigned to the V52TTP	Name	M, R
Relationships: Zero or more V52TTPBidirectional may be contained in SDH-DLC NE instance. Each V52TTPBidirectional is associated as TPPointer of V52CTPBidirectional, potsTTPBidirectional, and isdnBRATTPBidirectional instances, and associated as connectivityPointer of V52Trail.			

8.2.2.51 V52TTPSink

Behaviour: This managed entity represents Trail Termination Point Sink that terminates V52 trail. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.			
assocE1Link	This attribute gives the E1 link entity which is assigned to the V52TTP	Name	M, R
Relationships: Zero or more V52TTPSink may be contained in SDH-DLC NE instance. Each V52TTPSink is associated as TPPointer of V52CTPSink, potsTTPSink, and isdnBRATTPSink instances, and associated as connectivityPointer of V52Trail.			

8.2.2.52 V52TTPSource

Behaviour: This managed entity represents Trail Termination Point Source that originates V52 trail. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.			
assocE1Link	This attribute gives the E1 link entity which is assigned to the V52TTP	Name	M, R
Relationships: Zero or more V52TTPSource may be contained in SDH-DLC NE instance. Each V52TTPSource is associated as TPPointer of V52CTPSource, potsTTPSource, and isdnBRATTPSource instances, and associated as connectivityPointer of V52Trail.			

8.2.2.53 V52CTPBidirectional

Behaviour: This managed entity originates and terminates a V52 link connection. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.
Relationships: Each V52CTPBidirectional is associated as TPPointer of V52TTPBidirectional, and associated as connectivityPointer of V52LinkConnection.

8.2.2.54 V52CTPSink

Behaviour:
This managed entity terminates a V52 link connection. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.
Relationships:
Each V52CTPSink is associated as TPPointer of V52TTPSink, and associated as connectivityPointer of V52LinkConnection.

8.2.2.55 V52CTPSource

Behaviour:
This managed entity originates a V52 link connection. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.
Relationships:
Each V52CTPSource is associated as TPPointer of V52TTPSource, and associated as connectivityPointer of V52LinkConnection.

8.2.2.56 potsTTPBidirectional

Behaviour:
This managed entity originates and terminates POTS trail. It represents the access point in a layer network of SDH-DLC which is a focus for both the trail relationship and the client/server relationship. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsTTPBidirectional may be contained in SDH-DLC NE instance. Each potsTTPBidirectional is associated as TPPointer of potsCTPBidirectional and V52TTPBidirectional instances, and associated as connectivityPointer of potsTrail.

8.2.2.57 potsTTPSink

Behaviour:
This managed entity terminates POTS trail. It represents the access point in a layer network of SDH-DLC which is a focus for both the trail relationship and the client/server relationship. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsTTPSink may be contained in SDH-DLC NE instance. Each potsTTPSink is associated as TPPointer of potsCTPSink and V52TTPSink instances, and associated as connectivityPointer of potsTrail.

8.2.2.58 potsTTPSource

Behaviour:
This managed entity originates POTS trail. It represents the access point in a layer network of SDH-DLC which is a focus for both the trail relationship and the client/server relationship. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsTTPSource may be contained in SDH-DLC NE instance. Each potsTTPSource is associated as TPPointer of potsCTPSource and V52TTPSource instances, and associated as connectivityPointer of potsTrail.

8.2.2.59 potsCTPBidirectional

Behaviour:
This managed entity terminates and originates a POTS link connection. The upstream and downstream connectivity pointer attributes point to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsCTPBidirectional may be contained in one V52TTPBidirectional instance. Each potsCTPBidirectional is associated as TPPointer of potsTTPBidirectional, and associated as connectivityPointer of potsLinkConnection.

8.2.2.60 potsCTPSink

Behaviour:
This managed entity terminates a POTS link connection. The downstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsCTPSink may be contained in one V52TTPSink instance. Each potsCTPSink is associated as TPPointer of potsTTPSink, and associated as connectivityPointer of potsLinkConnection.

8.2.2.61 potsCTPSource

Behaviour:
This managed entity originates a POTS link connection. The upstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more potsCTPSource may be contained in one V52TTPSource instance. Each potsCTPSource is associated as TPPointer of potsTTPSource, and associated as connectivityPointer of potsLinkConnection.

8.2.2.62 isdnBRATTPBidirectional

Behaviour:
This managed entity originates and terminates an ISDN BRA trail. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRATTPBidirectional may be contained in SDH-DLC NE instance. Each isdnBRATTPBidirectional is associated as TPPointer of isdnBRACTPBidirectional and V52TTPBidirectional, and associated as connectivityPointer of isdnBRATrail.

8.2.2.63 isdnBRATTPSink

Behaviour:
This managed entity terminates an ISDN BRA trail. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRATTPSink may be contained in SDH-DLC NE instance. Each isdnBRATTPSink is associated as TPPointer of isdnBRACTPSink and V52TTPSink, and associated as connectivityPointer of isdnBRATrail.

8.2.2.64 isdnBRATTPSource

Behaviour:
This managed entity originates an ISDN BRA trail. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRATTPSource may be contained in SDH-DLC NE instance. Each isdnBRATTPSource is associated as TPPointer of isdnBRACTPSource and V52TTPSource, and associated as connectivityPointer of isdnBRATrail.

8.2.2.65 isdnBRACTPBidirectional

Behaviour:
This managed entity terminates and originates an ISDN BRA link connection. The upstream and downstream connectivity pointer attributes point to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRACTPBidirectional may be contained in one V52TTPBidirectional instance. Each isdnBRACTPBidirectional is associated as TPPointer of isdnBRATTPBidirectional, and associated as connectivityPointer of isdnBRALinkConnection.

8.2.2.66 isdnBRACTPSink

Behaviour:
This managed entity terminates an ISDN BRA link connection. The downstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRACTPSink may be contained in one V52TTPSink instance. Each isdnBRACTPSink is associated as TPPointer of isdnBRATTPSink, and associated as connectivityPointer of isdnBRALinkConnection.

8.2.2.67 isdnBRACTPSource

Behaviour:
This managed entity originates an ISDN BRA link connection. The upstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnBRACTPSource may be contained in one V52TTPSource instance. Each isdnBRACTPSource is associated as TPPointer of isdnBRATTPSource, and associated as connectivityPointer of isdnBRALinkConnection.

8.2.2.68 leasedLineTTPBidirectional

Behaviour:
This managed entity originates and terminates Leased Line trail. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineTTPBidirectional may be contained in SDH-DLC NE instance. Each leasedLineTTPBidirectional is associated as TPPointer of E1TTPBidirectional and leasedLineCTPBidirectional, and associated as connectivityPointer of leasedLineTrail.

8.2.2.69 leasedLineTTPSink

Behaviour:
This managed entity terminates Leased Line trail. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineTTPSink may be contained in SDH-DLC NE instance. Each leasedLineTTPSink is associated as TPPointer of E1TTPSink and leasedLineCTPSink, and associated as connectivityPointer of leasedLineTrail.

8.2.2.70 leasedLineTTPSource

Behaviour:
This managed entity originates Leased Line trail. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineTTPSource may be contained in SDH-DLC NE instance. Each leasedLineTTPSource is associated as TPPointer of E1TTPSource and leasedLineCTPSource, and associated as connectivityPointer of leasedLineTrail.

8.2.2.71 leasedLineCTPBidirectional

Behaviour:
This managed entity terminates and originates a Leased Line link connection. The upstream and downstream connectivity pointer attributes point to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineCTPBidirectional may be contained in one E1TTPBidirectional instance. Each leasedLineCTPBidirectional is associated as TPPointer of leasedLineTTPBidirectional, and associated as connectivityPointer of leasedLineLinkConnection.

8.2.2.72 leasedLineCTPSink

Behaviour:
This managed entity terminates a Leased Line link connection. The downstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineCTPSink may be contained in one E1TTPSink instance. Each leasedLineCTPSink is associated as TPPointer of leasedLineTTPSink, and associated as connectivityPointer of leasedLineLinkConnection.

8.2.2.73 leasedLineCTPSource

Behaviour:
This managed entity originates a Leased Line link connection. The upstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more leasedLineCTPSource may be contained in one E1TTPSource instance. Each leasedLineCTPSource is associated as TPPointer of leasedLineTTPSource, and associated as connectivityPointer of leasedLineLinkConnection.

8.2.2.74 isdnPRATTPBidirectional

Behaviour:
This managed entity originates and terminates ISDN PRA trail. This managed entity is derived from TTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnPRATTPBidirectional may be contained in SDH-DLC NE instance. Each isdnPRATTPBidirectional is associated as TPPointer of isdnPRACTPBidirectional and E1TTPBidirectional, and associated as connectivityPointer of isdnPRATrail.

8.2.2.75 isdnPRATTPSink

Behaviour:
This managed entity terminates ISDN PRA trail. This managed entity is derived from TTPSink and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnPRATTPSink may be contained in one SDH-DLC NE instance. Each isdnPRATTPSink is associated as TPPointer of isdnPRACTPSink and E1TTPSink, and associated as connectivityPointer of isdnPRATrail.

8.2.2.76 isdnPRATTPSource

Behaviour:
This managed entity originates ISDN PRA trail. This managed entity is derived from TTPSource and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnPRATTPSource may be contained in SDH-DLC NE instance. Each isdnPRATTPSource is associated as TPPointer of isdnPRACTPSource and E1TTPSource, and associated as connectivityPointer of isdnPRATrail.

8.2.2.77 isdnPRACTPBidirectional

Behaviour:
This managed entity terminates and originates an ISDN PRA link connection. The upstream and downstream connectivity pointer attributes point to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPBidirectional and inherits the attributes and notifications of its super class.
Relationships:
Zero or more isdnPRACTPBidirectional may be contained in one E1TTPBidirectional instance. Each isdnPRACTPBidirectional is associated as TPPointer of isdnPRATTPBidirectional, and associated as connectivityPointer of isdnPRALinkConnection.

8.2.2.78 isdnPRACTPSink

Behaviour:

This managed entity terminates an ISDN PRA link connection. The downstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSink and inherits the attributes and notifications of its super class.

Relationships:

Zero or more isdnPRACTPSink may be contained in one E1TTPSink instance. Each isdnPRACTPSink is associated as TPPointer of isdnPRATTPSink, and associated as connectivityPointer of isdnPRALinkConnection.

8.2.2.79 isdnPRACTPSource

Behaviour:

This managed entity originates an ISDN PRA link connection. The upstream connectivity pointer attribute points to the termination point managed object, within the same managed element of SDH-DLC, that receives information (traffic) from this termination point at the same layer, or is null. Instances of this managed entity can also be created and deleted as requested by a managing system. This managed entity is derived from CTPSource and inherits the attributes and notifications of its super class.

Relationships:

Zero or more isdnPRACTPSource may be contained in one E1TTPSource instance. Each isdnPRACTPSource is associated as TPPointer of isdnPRATTPSource, and associated as connectivityPointer of isdnPRALinkConnection.

8.2.2.80 abstractLink (M.3100)

Behaviour:

This managed entity gives a topological description of the capacity between two adjacent subnetworks, or two link ends; or a subnetwork and an access group when network trail termination points lie outside the boundary of the largest subnetwork. This managed entity is defined in [ITU-T M.3100].

8.2.2.81 abstractLinkEnd (M.3100)

Behaviour:

This managed entity is a managed entity which contains Network Connection Termination Points for the purpose of representing topology. This managed entity is defined in [ITU-T M.3100].

8.2.2.82 logicalLink (M.3100)

Behaviour:

This managed entity is used to represent a link that may be administratively composed of link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is defined in [ITU-T M.3100].

8.2.2.83 logicalLinkEnd (M.3100)

Behaviour:

This managed entity is used to represent the end of a logical link. When present, the Network CTPs in the Link End List Package identify the network CTPs that are present in the Logical Link End. There is no name binding between a Logical Link End and the network CTPs that are associated with the Logical Link. This managed entity is defined in [ITU-T M.3100].

8.2.2.84 logicalLinkEndR1 (M.3100)

Behaviour:

This managed entity is derived from logicalLinkEnd and defined in [ITU-T M.3100].

8.2.2.85 Link

Behaviour:

This managed entity is used to represent a link that may be administratively composed of E1 link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from logicalLink [ITU-T M.3100] and defined in this Recommendation.

Relationships:

Zero or more E1Link instances may be contained in one layer network domain instance. Each E1Link instance is associated with two E1LinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.86 isdnBRALink

Behaviour:

This managed entity is used to represent a link that may be administratively composed of ISDN BRA link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from logicalLink [ITU-T M.3100] and defined in this Recommendation.

Relationships:

Zero or more isdnBRALink instances may be contained in one layer network domain instance. Each isdnBRALink instance is associated with two isdnBRALinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.87 isdnPRALink

Behaviour:

This managed entity is used to represent a link that may be administratively composed of ISDN PRA link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from logicalLink [ITU-T M.3100] and defined in this Recommendation.

Relationships:

Zero or more isdnPRALink instances may be contained in one layer network domain instance. Each isdnPRALink instance is associated with two isdnPRALinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.88 leasedLineLink

Behaviour:
This managed entity is used to represent a link that may be administratively composed of Leased Line link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from logicalLink [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more leasedLineLink instances may be contained in one layer network domain instance. Each leasedLineLink instance is associated with two leasedLineLinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.89 potsLink

Behaviour:
This managed entity is used to represent a link that may be administratively composed of POTS link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from LogicalLink [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more potsLink instances may be contained in one layer network domain instance. Each potsLink instance is associated with two potsLinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.90 V52Link

Behaviour:
This managed entity is used to represent a link that may be administratively composed of V52 link connections or bandwidth that may be provided by one or more topological links or other logical links. This managed entity is derived from logicalLink [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more V52Link instances may be contained in one layer network domain instance. Each V52Link instance is associated with two V52LinkEnd instances represented by the aEnd and zEndList attributes.

8.2.2.91 E1LinkEnd

Behaviour:
This managed entity is used to represent the end of a E1 link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more E1LinkEnd instances may be contained in one layer network domain instance. Each E1LinkEnd instance is associated with E1Link instances represented by topologicalLinkPtr attributes.

8.2.2.92 isdnBRALinkEnd

Behaviour:
This managed entity is used to represent the end of an ISDN BRA link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more isdnBRALinkEnd instances may be contained in one layer network domain instance. Each isdnBRALinkEnd instance is associated with isdnBRALink instances represented by topologicalLinkPtr attributes.

8.2.2.93 isdnPRALinkEnd

Behaviour:
This managed entity is used to represent the end of an ISDN PRA link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more E1LinkEnd instances may be contained in one layer network domain instance. Each isdnPRALinkEnd instance is associated with isdnPRALink instances represented by topologicalLinkPtr attributes.

8.2.2.94 leasedLineLinkEnd

Behaviour:
This managed entity is used to represent the end of a Leased Line link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more leasedLineLinkEnd instances may be contained in one layer network domain instance. Each leasedLineLinkEnd instance is associated with leasedLineLink instances represented by topologicalLinkPtr attributes.

8.2.2.95 potsLinkEnd

Behaviour:
This managed entity is used to represent the end of a POTS link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more potsLinkEnd instances may be contained in one layer network domain instance. Each potsLinkEnd instance is associated with potsLink instances represented by topologicalLinkPtr attributes.

8.2.2.96 V52LinkEnd

Behaviour:
This managed entity is used to represent the end of a V52 link. This managed entity is derived from logicalLinkEndR1 [ITU-T M.3100] and defined in this Recommendation.
Relationships:
Zero or more V52LinkEnd instances may be contained in one layer network domain instance. Each V52LinkEnd instance is associated with V52Link instances represented by topologicalLinkPtr attributes.

8.2.2.97 au3CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, au3CTPSink, au3CTPSource. This object class represents a termination point where an AU-3 Connection is terminated as well as originated. The AU-3 consists of a VC-3 plus an AU pointer which indicates the phase alignment of the VC-3 with respect to the STM-N frame.

8.2.2.98 au3CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class represents a termination point where an AU-3 Connection is terminated. The AU-3 consists of a VC-3 plus an AU pointer which indicates the phase alignment of the VC-3 with respect to the STM-N frame.

8.2.2.99 au3CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class represents a termination point where an AU-3 Connection is originated. The AU-3 consists of a VC-3 plus an AU pointer which indicates the phase alignment of the VC-3 with respect to the STM-N frame.

8.2.2.100 au4CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, au4CTPSinkR1, au4CTPSource. This object class represents a termination point where an AU-4 Connection is terminated as well as originated. The AU-4 consists of a VC-4 plus an AU pointer which indicates the phase alignment of the VC-4 with respect to the STM-N frame.

8.2.2.101 au4CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class represents a termination point where an AU-4 Connection is terminated. The AU-4 consists of a VC-4 plus an AU pointer which indicates the phase alignment of the VC-4 with respect to the STM-N frame.

8.2.2.102 au4CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class represents a termination point where an AU-4 Connection is originated. The AU-4 consists of a VC-4 plus an AU pointer which indicates the phase alignment of the VC-4 with respect to the STM-N frame.

8.2.2.103 augBidirectional (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorBidirectional, augSink, augSource. This object class is instantiated if AU-n Connection(s) are being terminated or originated. This object class represents the point at which the AU-3/4 pointer is derived, based on the phase of the VC-3/4 POH relative to the STM-N SOH. Also, the STM-N payload is byte-demultiplexed into its component AU Groups (AUGs).

8.2.2.104 augSink (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSink. This object class is instantiated if AU-n Connection(s) are being terminated. This object class represents the point at which the AU-3/4 pointer is derived, based on the phase of the VC-3/4 POH relative to the STM-N SOH. Also, the STM-N payload is byte-demultiplexed into its component AU Groups (AUGs).

8.2.2.105 augSource (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSource. This object class is instantiated if AU-n Connection(s) are being originated. This object class represents the point at which the AU-3/4 pointer is derived, based on the phase of the VC-3/4 POH relative to the STM-N SOH. Also, the STM-N payload is byte-demultiplexed into its component AU Groups (AUGs).

8.2.2.106 msCTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, msCTPSource, msCTPSink. This object class terminates and originates a multiplex section connection.

8.2.2.107 msCTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a multiplex section connection.

8.2.2.108 msCTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a multiplex section connection.

8.2.2.109 msTTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, msTTPSource, msTTPSink. This object class terminates and originates a multiplex section trail, i.e., the processing and removal of the multiplex section overhead from the incoming/outgoing signal.

8.2.2.110 msTTPSink (G.774)

Behaviour:

This managed entity is derived from tTPSink. This object class terminates a multiplex section trail, i.e., the processing and removal of the multiplex section overhead from the incoming signal.

8.2.2.111 msTTPSource (G.774)

Behaviour:

This managed entity is derived from tTPSource. This object class originates a multiplex section trail, i.e., the processing and removal of the multiplex section overhead from the outgoing signal.

8.2.2.112 opticalSPITTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, opticalSPITTPSource, opticalSPITTPSink. This object class represents the point where the incoming or outgoing optical interface signal is converted into an internal logic level and the timing is recovered from the line signal.

8.2.2.113 opticalSPITTPSink (G.774)

Behaviour:

This managed entity is derived from tTPSink. This object class represents the point where the incoming or outgoing optical interface signal is converted into an internal logic level and the timing is recovered from the line signal.

8.2.2.114 opticalSPITTPSource (G.774)

Behaviour:

This managed entity is derived from tTPSource. This object class represents the point where the outgoing optical interface signal is converted into an internal logic level and the timing is recovered from the line signal.

8.2.2.115 rsCTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, rsCTPSink, rsCTPSource. This object class terminates and originates a regenerator section connection.

8.2.2.116 rsCTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a regenerator section connection.

8.2.2.117 rsCTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a regenerator section connection.

8.2.2.118 tu11CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, tu11CTPSink, tu11CTPSource. This object class terminates and originates a tu-11 connection.

8.2.2.119 tu11CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a tu-11 connection.

8.2.2.120 tu11CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a tu-11 connection.

8.2.2.121 tu12CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, tu12CTPSink, tu12CTPSource. This object class terminates and originates a tu-12 connection.

8.2.2.122 tu12CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a tu-12 connection.

8.2.2.123 tu12CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a tu-12 connection.

8.2.2.124 tu2CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, tu2CTPSink, tu2CTPSource. This object class terminates and originates a tu-2 connection.

8.2.2.125 tu2CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a tu-2 connection.

8.2.2.126 tu2CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a tu-2 connection.

8.2.2.127 tu3CTPBidirectional (G.774)

Behaviour:

This managed entity is derived from cTPBidirectional, tu3CTPSink, tu3CTPSource. This object class terminates and originates a tu-3 connection.

8.2.2.128 tu3CTPSource (G.774)

Behaviour:

This managed entity is derived from cTPSource. This object class originates a tu-3 connection.

8.2.2.129 tu3CTPSink (G.774)

Behaviour:

This managed entity is derived from cTPSink. This object class terminates a tu-3 connection.

8.2.2.130 tug2Bidirectional (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorBidirectional, tug2Sink, tug2Source. This object class is instantiated if TU-11, TU-12, TU-2 connection(s) are being terminated or originated. A TUG-2 consists of a homogeneous or heterogeneous assembly of four TU-11s, three TU-12s or one TU-2.

8.2.2.131 tug2Source (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSource. This object class is instantiated if TU-11, TU-12, TU-2 connection(s) are being originated.

8.2.2.132 tug2Sink (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSink. This object class is instantiated if TU-11, TU-12, TU-2 connection(s) are being terminated.

8.2.2.133 tug3Bidirectional (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorBidirectional, tug3Sink, tug3Source. This object class is instantiated if TU-3 connection(s) are being terminated or originated; or if TU-11s, TU-12s, or TU-2s are being terminated or originated from a VC-4. A TUG-3 consists of a homogeneous assembly of seven TUG-2s or one TU-3.

8.2.2.134 tug3Source (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSource. This object class is instantiated if TU-3 connection(s) are being originated; or if TU-11s, TU-12s, or TU-2s are being originated from a VC-4. A TUG-3 consists of a homogeneous assembly of seven TUG-2s or one TU-3.

8.2.2.135 tug3Sink (G.774)

Behaviour:

This managed entity is derived from indirectAdaptorSink. This object class is instantiated if TU-3 connection(s) are being terminated; or if TU-11s, TU-12s, or TU-2s are being terminated from a VC-4. A TUG-3 consists of a homogeneous assembly of seven TUG-2s or one TU-3.

8.2.2.136 vc11TTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, vc11TTPSink, vc11TTPSource. This object class terminates and originates a vc11 trail, i.e., the point at which the VC11-POH is extracted from the STM-N frame.

8.2.2.137 vc11TTPSink (G.774)

Behaviour:

This managed entity is derived from tTPSink. This object class terminates a vc11 trail, i.e., the point at which the VC11-POH is extracted from the STM-N frame.

8.2.2.138 vc11TTPSource (G.774)

Behaviour:

This managed entity is derived from tTPSource. This object class originates a vc11 trail, i.e., the point at which the VC11-POH is extracted from the STM-N frame.

8.2.2.139 vc12TTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, vc12TTPSink, vc12TTPSource. This object class originates and terminates a vc12 trail, i.e., the point at which the VC12-POH is extracted from the STM-N frame.

Relationship:

vc12TTPBidirectional contains zero or more E1CTPBidirectional instance. Each of vc12TTPBidirectional is associated as TPPointer of vc12CTPBidirectional.

8.2.2.140 vc12TTPSink (G.774)

Behaviour:
This managed entity is derived from tTPSink. This object class terminates a vc12 trail, i.e., the point at which the VC12-POH is extracted from the STM-N frame.
Relationship:
vc12TTPSink contains zero or more E1CTPSink instance. Each of vc12TTPSink is associated as TPPointer of vc12CTPSink.

8.2.2.141 vc12TTPSource (G.774)

Behaviour:
This managed entity is derived from tTPSource. This object class originates a vc12 trail, i.e., the point at which the VC12-POH is extracted from the STM-N frame.
Relationship:
vc12TTPSource contains zero or more E1CTPSource instance. Each of vc12TTPSource is associated as TPPointer of vc12CTPSource.

8.2.2.142 vc12CTPBidirectional

Behaviour:
This managed entity is derived from cTPBidirectional, vc12TTPSink, vc12TTPSource. This object class originates and terminates a vc12 connection.
Relationship:
Each vc12CTPBidirectional is associated as TPPointer of vc12TTPBidirectional, and associated as connectivityPointer of vc12LinkConnection.

8.2.2.143 vc12CTPSink

Behaviour:
This managed entity is derived from cTPSink. This object class terminates a vc12 connection.
Relationship:
Each vc12CTPSink is associated as TPPointer of vc12TTPSink, and associated as connectivityPointer of vc12LinkConnection.

8.2.2.144 vc12CTPSource

Behaviour:
This managed entity is derived from cTPSource. This object class originates a vc12 connection.
Relationship:
Each vc12CTPSource is associated as TPPointer of vc12TTPSource, and associated as connectivityPointer of vc12LinkConnection.

8.2.2.145 vc12Trail

Behaviour:

This managed entity is derived from Trail and inherits the attributes and notifications of its super class. This managed entity is used to describe the transport entity transferring information between two vc12TTP instances at SDH Network.

Relationship:

Each vc12Trail is associated as clientLinkConnectionPointerList of E1LinkConnection, and associated as connectivityPointer of vc12TTP instances.

8.2.2.146 vc12LinkConnecion

Behaviour:

This managed entity is used to describe the transport entity transferring information between two vc12CTPBidirectional instances at SDH-DLC service layer. Instances of this managed entity can also be created and deleted as requested by a managing system. The managed entity supports availability status and administrative state functions as defined in [ITU-T X.731]. Changes in state are reported automatically or on demand to a managing system. This managed entity is derived from LinkConnection [ITU-T M.3100] and inherits all the attributes and notifications of its super class.

Relationship:

This managed entity is established between two vc12CTPBidirectional instances. Zero or more vc12LinkConnection instances may be contained in one layer network domain instance. Each vc12LinkConnection instance is associated with two vc12CTP instances represented by the aEndNetworkTPList and zEndNetworkTPList attributes, and associated with one vc12Trail represented by the clientTrail attribute.

8.2.2.147 vc2TTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, vc2TTPSink, vc2TTPSource. This object class terminates and originates a vc2 trail, i.e., the point at which the SDH VC-2 is terminated/originated.

8.2.2.148 vc2TTPSink (G.774)

Behaviour:

This managed entity is derived from tTPSink. This object class terminates a vc2 trail, i.e., the point at which the SDH VC-2 is terminated.

8.2.2.149 vc2TTPSource (G.774)

Behaviour:

This managed entity is derived from tTPSource. This object class originates a vc2 trail, i.e., the point at which the SDH VC-2 is originated.

8.2.2.150 vc3TTPBidirectional (G.774)

Behaviour:

This managed entity is derived from tTPBidirectional, vc3TTPSink, vc3TTPSource. This object class terminates and originates a vc3 trail, i.e., the point at which the SDH VC-3 is terminated/originated.

8.2.2.151 vc3TTPSink (G.774)

Behaviour:
This managed entity is derived from tTPSink. This object class terminates a vc3 trail, i.e., the point at which the SDH VC-3 is terminated.

8.2.2.152 vc3TTPSource (G.774)

Behaviour:
This managed entity is derived from tTPSource. This object class originates a vc3 trail, i.e., the point at which the SDH VC-3 is originated.

8.2.2.153 vc4TTPBidirectional (G.774)

Behaviour:
This managed entity is derived from tTPBidirectional, vc4TTPSink, vc4TTPSource. This object class terminates and originates a vc4 trail, i.e., the point at which the SDH VC-4 is terminated/originated.

8.2.2.154 vc4TTPSink (G.774)

Behaviour:
This managed entity is derived from tTPSink. This object class terminates a vc4 trail, i.e., the point at which the SDH VC-4 is terminated.

8.2.2.155 vc4TTPSource (G.774)

Behaviour:
This managed entity is derived from tTPSource. This object class originates a vc4 trail, i.e., the point at which the SDH VC-4 is originated.

8.2.3 Management operations

8.2.3.1 Retrieve SDH-DLC managed entities

This configuration management will use "queryAttributeValue" management operation to retrieve SDH-DLC managed entities.

1) "queryAttributeValue" operation

Owner entity	CMController		
Description	This operation is used to query the attribute values of one or more SDH-DLC configuration management related managed entities. The input parameters of the request contain the list of object ID. If the operation succeeds, the attribute values of the requested managed objects as well as success indication will be returned. If any exception occurs, EMS will return to NMS error information and the operation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moInstanceList	This parameter specifies the managed entities on which the attribute values are to be queried.	LIST of Name
	attributeNameList	This parameter contains the list of	LIST of

		attribute names to be queried. An empty list indicates all the possible attributes for the specified managed entities.	AttributeName
Output parameters	queryResult	This parameter is the list of the object instance as well as the attribute names and values related to each of the managed entity instance.	LIST of STRUCT{ moInstance : Name, attributeInfoList : LIST of Name/Value pairs}
Return value	–	Success indication	Boolean
Exceptions raised	UnknownManaged Entity	The specified managed entity instance does not exist in EMS.	
	InvalidInput Parameter	The attribute(s) specified in the request is not valid.	
	EMSProcessing Error	Error occurs during the operation processing.	

8.2.3.2 Modify SDH-DLC managed entities

This configuration management will use "modifyAttributeValue" management operation to modify SDH-DLC managed entities.

1) "modifyAttributeValue" operation

Owner entity	CMController		
Description	This operation is used to modify the attribute values of one or more SDH-DLC configuration resource objects of the same type. The input parameters of the request contain the object ID, the input modification list that specifies the attribute names to be modified, the attribute names to be modified and the corresponding values. The operation finishes when NMS receives success indication associated with the output modification list which includes the modified instance ID, the modified attribute names and values. If any exception occurs, EMS will return to NMS error information and the operation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moClass	This parameter specifies the class name of the managed entity(ies) to be modified.	String
	moInstanceList	This parameter specifies managed entities whose attribute values are to be modified.	LIST of Name

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

Return value	–	Success indication	Boolean
Exceptions raised	AttributeNotModifiable	The specified attribute(s) is not modifiable for the managed object class.	
	UnknownManagedEntity	The specified managed entity instance(s) does not exist in EMS.	
	InvalidParameter	The item of the "modificationList" parameter is invalid.	
	EMSProcessingError	Error occurs during the operation processing.	

8.2.3.3 E1 connection management

This configuration management function set consists of "Retrieve E1 connection", "Create E1 connection", "Modify E1 connection" and "Remove E1 connection". NMS is able to invoke the configuration management function to retrieve E1 connection attribute values, and to modify E1 connection attribute values by using management operations of "queryAttributeValue" (as defined in clause 8.2.3.1) and "modifyAttributeValue" (as defined in clause 8.2.3.2) respectively. NMS will use "createE1Connection" and "removeE1Connection" management operations to invoke "Create E1 connection" and "Remove E1 connection" functions respectively.

1) "createE1Connection" operation

Owner entity	CMController		
Description	This operation is used to assign a connection between an E1 port in CT and an E1 port in RT. E1 connection has a fixed bandwidth of 2 Mbit/s. The input parameters of the request contain the E1 Port Id of CT, and the E1 port Id of RT equipment. Operators, under operational considerations, may indicate that, for certain E1, connections are provisionally protected and cannot be removed. This operation finishes when NMS receives report from EMS that all necessary resources are available and E1 connection has been created as requested. Otherwise, in case the resources are not available, or any other exception occurs, this operation request fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	cTE1PortId	This parameter specifies the E1 Port in the CT equipment on which the E1 connection is to be created.	Name
	rTE1PortId	This parameter specifies the E1 Port in the RT equipment on which the E1 connection is to be created.	Name
	protectionInd	This parameter specifies if the E1 connection that will be created is be "unprotected" or "protected".	ENUM {unprotected, protected}
Output parameters	E1ConnectionId	This parameter points out the unique identifier of the E1 connection that has been successfully created.	Name
Return value	–	Success indication	Boolean
Exceptions raised	UnknownManaged Entity	The specified E1 port instance(s) does not exist in EMS.	
	BandwidthNot Enough	Available bandwidth is not sufficient to perform the creation of the specified E1 connection.	
	EMSProcessingError	Error occurs during the operation processing.	

2) "removeE1Connection" operation

Owner entity	CMController		
Description	This operation is used to remove a connection between an E1 port in CT and an E1 port in RT. The input parameters of the request contain the E1 Connection Id. Note that only E1 connection in "unprotected" state can be removed. This operation finishes when NMS receives report from EMS that all necessary resources are released and the specified E1 connection has been removed as requested. Otherwise, if any other exception occurs, this operation request fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	E1ConnectionId	This parameter points out the unique identifier of the E1 connection to be removed.	Name
Return value	–	Success indication	Boolean
Exceptions raised	UnknownManaged Entity	The specified E1 connection instance does not exist in EMS.	
	E1Connection Protected	The specified E1 connection instance has been marked previously in "protected" state.	
	EMSProcessing Error	Error occurs during the operation processing.	

8.2.3.4 DLC service connection Management

This configuration management function set consists of "Retrieve DLC Service Connection", "Create DLC Service Connection", "Modify DLC Service Connection" and "Remove DLC Service Connection". NMS is able to invoke the configuration management function to retrieve DLC service connection attribute values, and to modify DLC connection attribute values by using management operations of "queryAttributeValue" (as defined in clause 8.2.3.1) and "modifyAttributeValue" (as defined in clause 8.2.3.2) respectively. NMS will use "createDLCServiceConnection" and "removeDLCServiceConnection" management operations to invoke "Create DLC Service connection" and "Remove DLC Service connection" functions respectively.

1) "createDLCServiceConnection" operation

Owner entity	CMController		
Description	This operation is used to create a DLC service connection (POTS, ISDN, leased lines). The input parameters include the class name of the resource object for DLC services, and the attribute values of the object. If the creation and service activation succeeds, EMS will return the identifier of the created object instance as well as the success information, and NMS receives an object creation notification. If any exception occurs, EMS will return to NMS error information and the operation regarding DLC service connection creation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	CTportId	This parameter specifies DLC port ID at CT side for each service type to be created.	Name
	RTportId	This parameter specifies DLC port ID at RT side for each service type to be created.	Name
	serviceType	This parameter specifies which kind of service connection to be created (POTS, ISDN BRA, ISDN PRA or leased line) at the DLC network.	String

	servicesAttribute Values	This parameter specifies the list of service provisioning attribute names and attribute values to be used for the creation of the DLC services object instance (serviceId, portId, networkElementId, userLabel, administrativeState, operationalState).	LIST of STRUCT {
			serviceId: Name;
			portId: Name;
			networkId: Name;
			userLabel: String;
			administrativeState: ENUM;
			operationalState: ENUM;
			}

Output parameters	DLCServicesId	This parameter identifies the DLC services that have just been created.	Name
Return value	–	Success indication	Boolean
Exceptions raised	InvalidInputParameter	At least one attribute name or attribute value in the "attributeValues" parameter is invalid.	
	UnknownManaged Entity	The specified port instance(s) does not exist in EMS.	
	ConnectionAlready Exists	The specified DLC service connection has already been created, since each port can only have one service connection created on it.	
	EMSProcessing Error	Error occurs during EMS processing.	

2) "removeDLCServiceConnection" operation

Owner entity	CMController		
Description	This operation is used to remove DLC Service connections (POTS, ISDN, leased lines). The input parameters include the instances of DLC services connection to be removed. If the removal succeeds, EMS will return the identifier of the removed object instance as well as the success indication, and NMS receives an object deletion notification. If any exception occurs, EMS will return to NMS error information and this operation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	DLCServicesIdList	This parameter specifies a list of DLC service connections to be removed.	LIST of Name
Output parameters	succRemovalInfo List	This parameter specifies the DLC service connection that have just been removed successfully.	LIST of Name

	failedRemovalInfo List	This parameter specifies the removal failure information of this operation. It is a list of structure, for each unremoved managed object, the ID and the reason are specified.
		The possible reasons for removal failure are:
		– not allowed;
		– association not removed;
		– containing other managed entities;
		– other reasons.
			LIST of STRUCT {
			moInstance : Name;
			reason : RemovalFailureReason(ENUM);
			}
			The possible values for type "RemovalFailureReason" can be found in the left column.

Return value	–	Success indication	ENUM {success, partialSuccess, failed}
Exceptions raised	UnknownService Instance	The service connection instance specified in the request is unknown to EMS.	
	RemovalUnsupported	It is not supported to remove the specified DLC service instance(s) through the management interface.	
	EMSProcessingError	Error occurs during EMS processing.	

8.2.3.5 Cross-connection management

This configuration management function set consists of "Retrieve SDH Cross Connection", "Create SDH Cross Connection", "Modify SDH Cross Connection" and "Remove SDH Cross Connection". NMS is able to invoke the configuration management function to retrieve SDH cross-connection attribute values, and to modify SDH cross-connection attribute values by using management operations of "queryAttributeValue" (as defined in clause 8.2.3.1) and "modifyAttributeValue" (clause 8.2.3.2) respectively. The "queryAttributeValue" and "modifyAttributeValue" management

operations are defined in clause 7.2.2. NMS will use "createSDHCrossConnection" and "removeSDHCrossConnection" management operations to invoke "Create SDH Cross Connection" and "Remove SDH Cross Connection" functions respectively.

1) "createSDHCrossConnection" operation

Owner entity	CMController		
Description	This operation is used to create a Cross-Connection instance in the SDH network equipment (ADM). The input parameters of the request contain the equipment ID, and the corresponding cross-connection attribute values. This operation finishes when NMS receives report from EMS that all necessary resources are available and SDH cross-connection has been created as requested. Otherwise, in case the resources are not available, or any other exception occurs, NMS will have its operation request fail.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	equipmentId	This parameter specifies the equipment on which SDH cross-connection is to be created.	Name

	signalType	This parameter identifies the signal type to be used for a cross-connection, TP pool or GTP. The signal type can either be simple, bundle, or complex.
		If the signal type is bundle, it is made up of a number of signal types all of the same characteristic information. If the signal type is complex, it consists of a sequence of bundle signal types. The order in the complex signal type represents the actual composition of the signal.
			SignalType ::= Choice {
			simple: CharacteristicInformation;
			bundle: BundleType;
			complex: List of BundleType;
			}
			
			CharacteristicInformation ::= String
			
			BundleType ::= Struct {
			
			characteristicInfoType:
			
			CharacteristicInformation;
			bundlingFactor: INTEGER;
			}

	fromTermination	This parameter identifies a TTP (source or bidirectional), a CTP (sink or bidirectional) or a GTP composed of members of one of these categories.	Name
	toTermination	This parameter identifies a CTP (source or bidirectional), a TTP (sink or bidirectional) or a GTP composed of members of one of these categories.	Name

	directionality	This parameter specifies whether transmission use in the cross-connection is unidirectional or bidirectional.	ENUM {
			unidirectional,
			bidirectional
			}

	administrativeState	This parameter specifies if the cross-connection that will be created will be "unlocked" (traffic is allowed to pass through the connection) or "locked" state (no traffic is allowed to pass through the cross-connection).	ENUM { unlocked, locked }
	additionalInformation	This parameter specifies any other input or information to complement the cross-connection that will be created.	String
Output parameters	crossConnectionId	This parameter points out the unique identifier of the SDH cross-connection that has been successfully created.	Name
Return value	–	Success indication	Boolean
Exceptions raised	UnknownManaged Entity	The specified equipment instance does not exist in EMS.	
	EMSProcessingError	Error occurs during the operation processing.	

2) "removeSDHCrossConnection" operation

Owner entity	CMController		
Description	This operation is used to remove a designated SDH Cross-Connection in the SDH network equipment (ADM). The input parameters of the request contain the cross-connection ID. This operation finishes when NMS receives a report from EMS that the SDH cross-connection has been removed as requested. Otherwise, if any other exception occurs, this operation request fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	crossConnectionId	This parameter points out the unique identifier of the SDH cross-connection that will be removed.	Name
Output parameters	–	–	–
Return value	–	Success indication	Boolean
Exceptions raised	UnknownSDHCross Connection	The cross-connection object does not exist.	
	EMSProcessingError	Error occurs during the operation processing.	

8.2.4 Sequence diagram

8.2.4.1 Network inventory management

This sequence diagram covers configuration management function sets of "Retrieve inventory" and "Modify SDH-DLC Managed Entities".

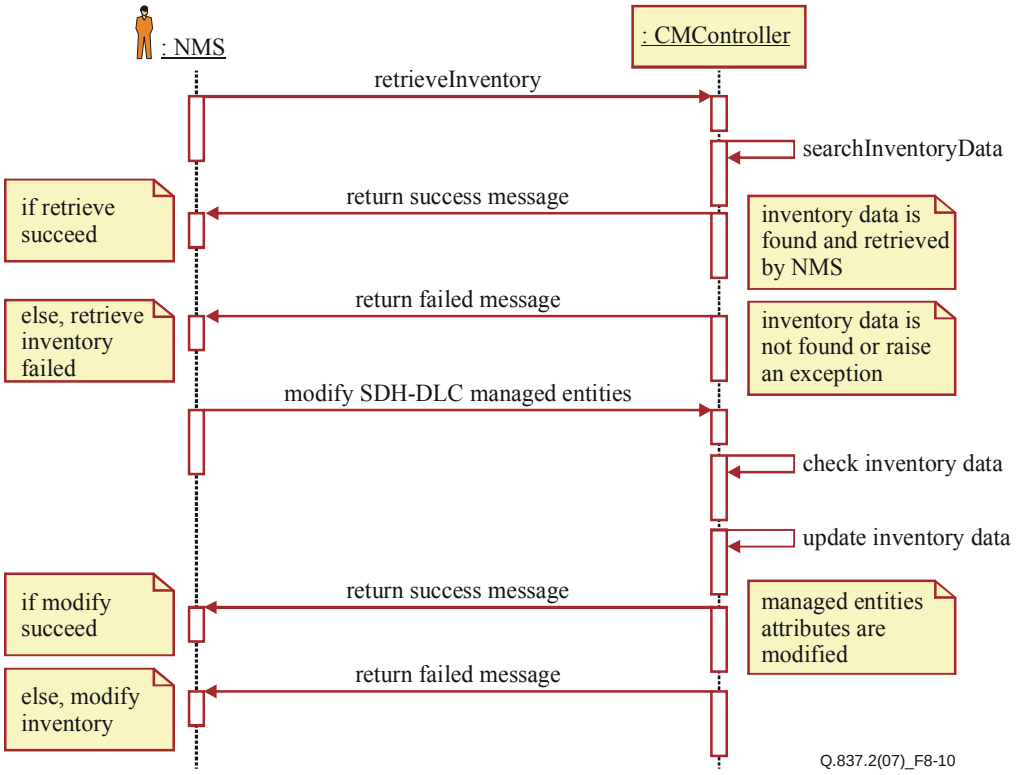

Figure 8-10 – Network inventory management sequence diagram

8.2.4.2 Create E1 connection

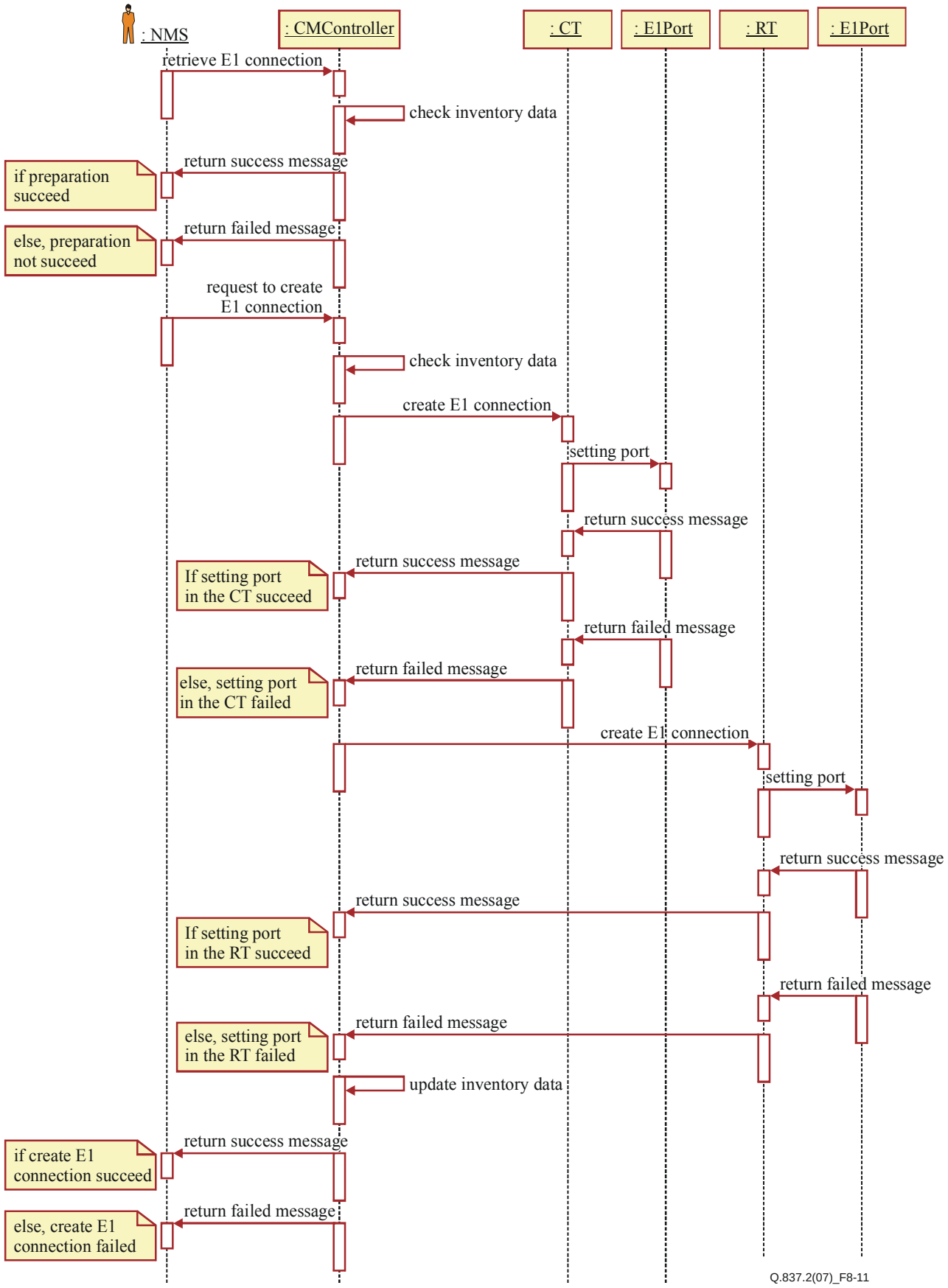

Figure 8-11 – Create E1 connection sequence diagram

8.2.4.3 Modify and remove E1 connection

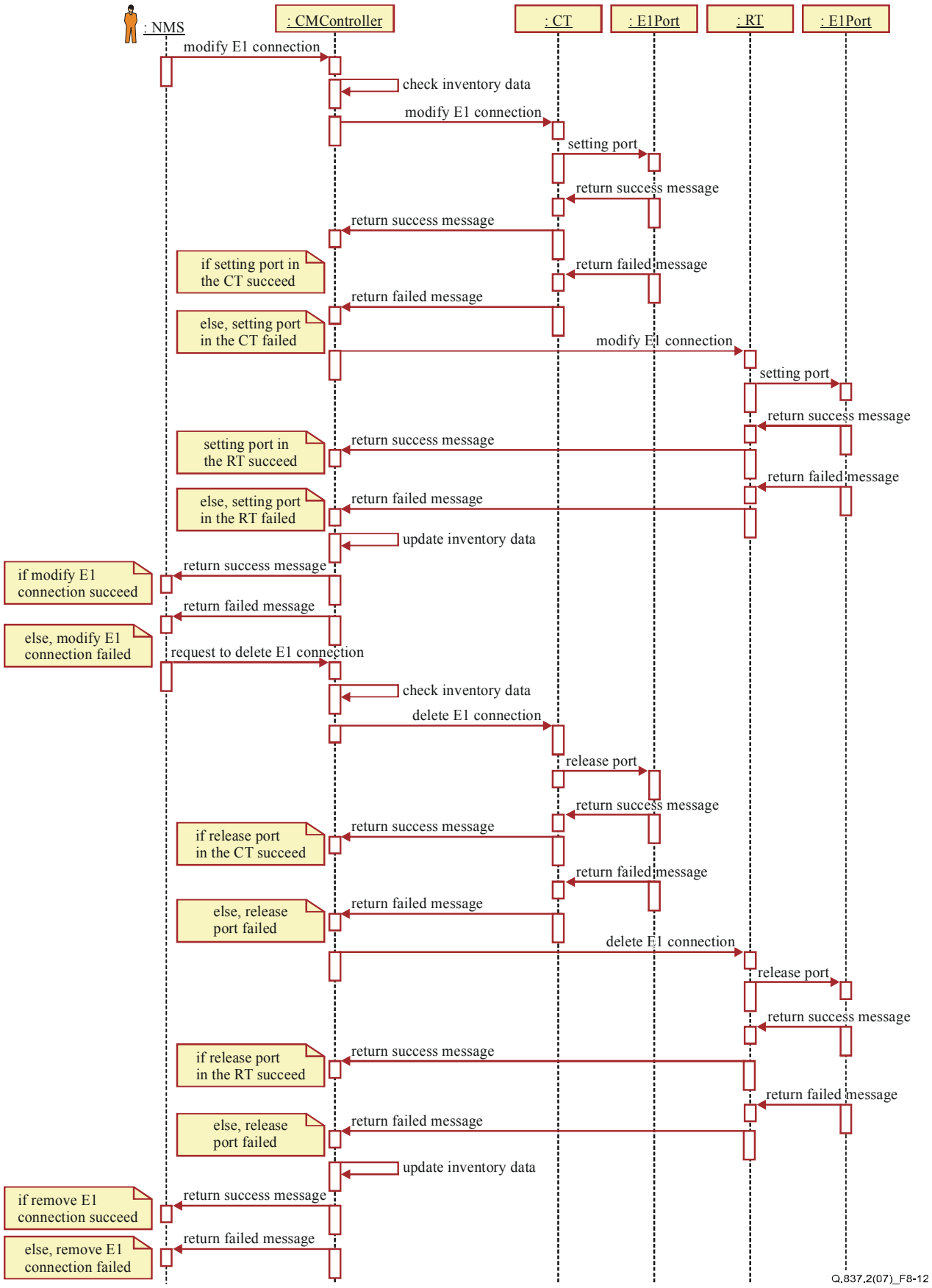

Figure 8-12 – Remove E1 connection sequence diagram

8.2.4.4 Create DLC service connection

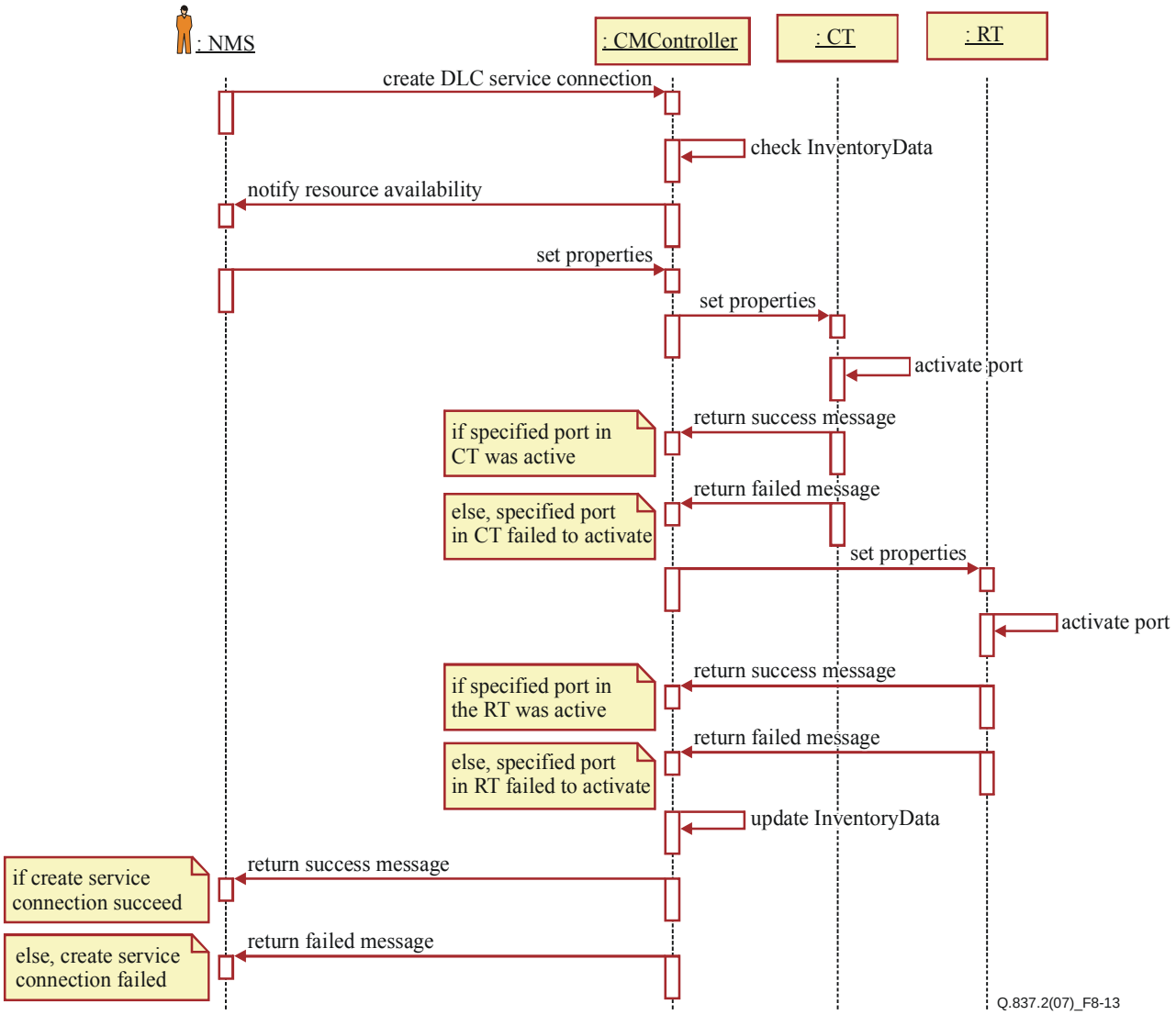

Figure 8-13 – Create DLC service connection sequence diagram

8.2.4.5 Remove DLC service connection

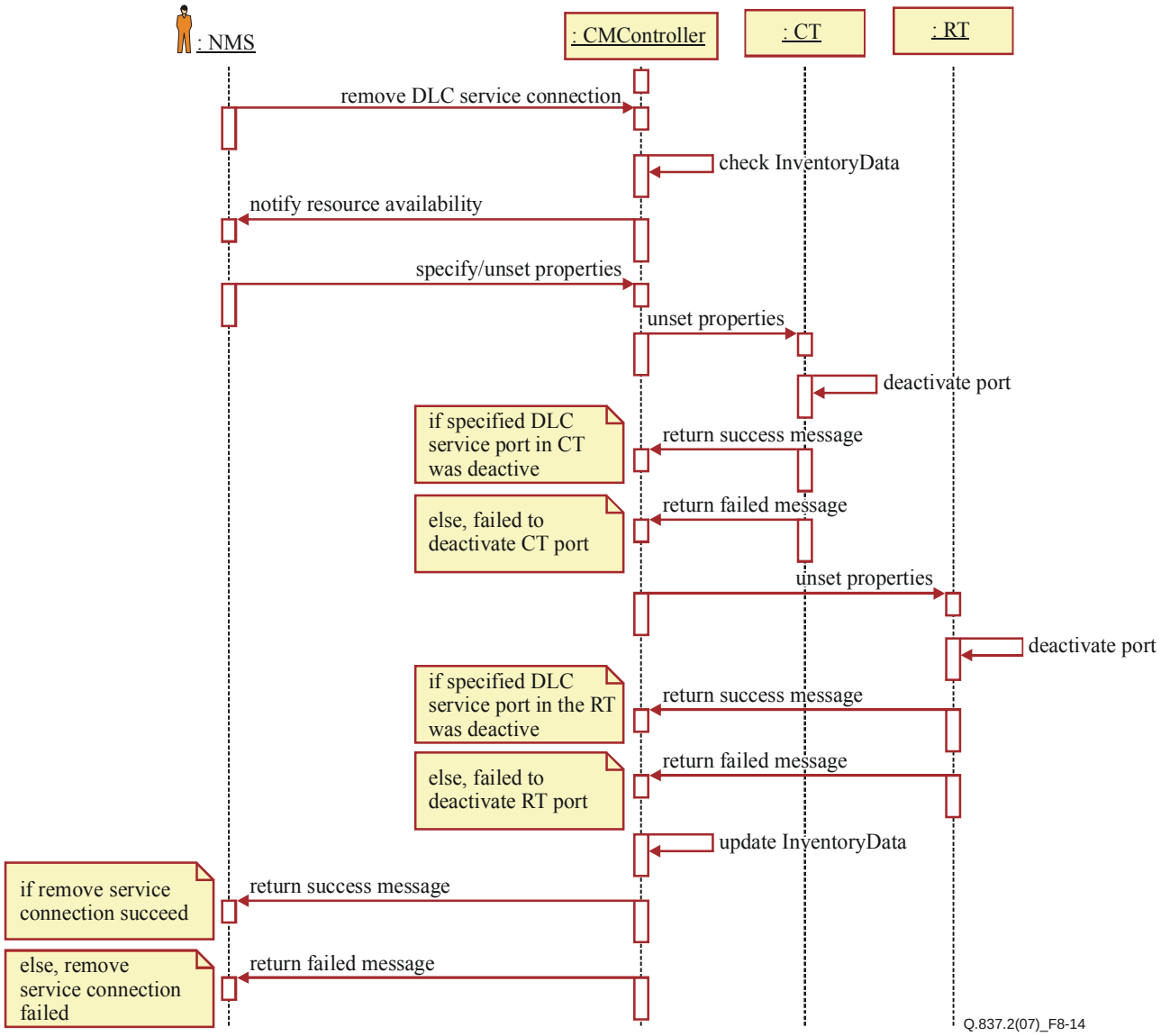

Figure 8-14 – Remove DLC service connection sequence diagram

8.2.4.6 Create SDH cross-connection

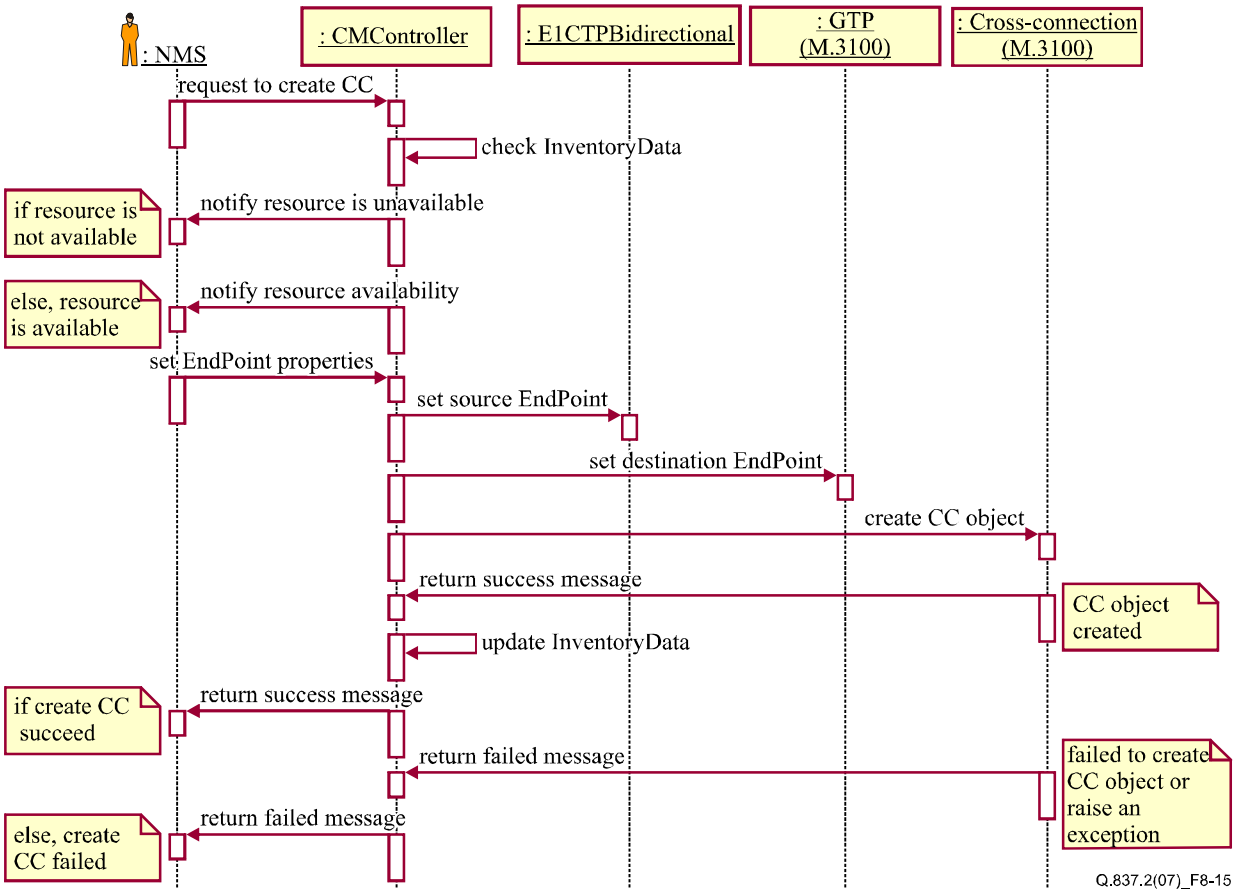

Figure 8-15 – Create SDH cross-connection sequence diagram

8.2.4.7 Remove SDH cross-connection

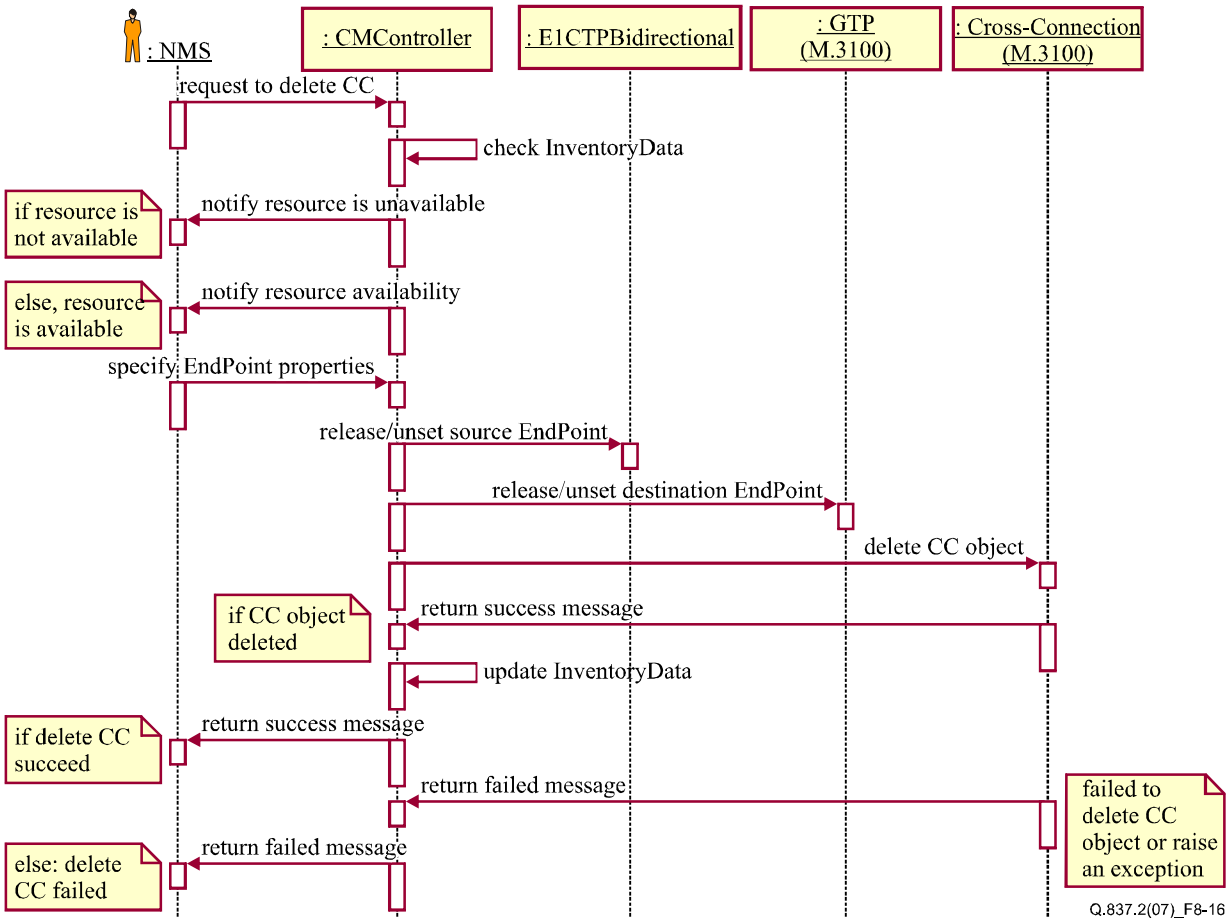

Figure 8-16 – Remove SDH cross-connection sequence diagram

8.3 Fault management

The common part for analysis of fault management function set can be found in clause 7.4 of [ITU-T Q.827.1].

8.3.1 Managed entities

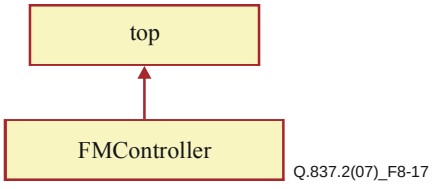

Figure 8-17 – Inheritance diagram of the fault management

8.3.1.1 FMController

Behaviour: This managed entity controls the fault management between NMS and EMS.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
fMControllerId	This is the unique identifier of the managed entity.	Integer	M, R
Operations			
Name	**Description**		
startLoopbackTest	This function is used to request CT to start a loopback test operation on a RT port.		
stopLoopbackTest	This function is used to stop a loopback test operation.		
queryLoopbackResult	This function is used to query a loopback test operation result.		
Relationships: Zero or one instance of this managed entity exists for each ManagedElement instance.			
Reportable Notifications:			
objectCreation			O
objectDeletion			O

8.3.2 Management operations

8.3.2.1 DLC loopback test

1) "startLoopbackTest" operation

Owner entity	FMController		
Description	This function is used to enable a loopback test operation on CT and RT. The input parameters include the class name of the object, and the attribute values of the object to be loopback tested. If the start operation succeeds, EMS will return the identifier of the created object instance regarding the execution of the test operation as well as the success information. If any exception occurs, EMS will return to NMS error information and the operation regarding start loopback test operation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	moInstanceList	This parameter specifies the CT and RT managed entities to be tested.	LIST of Name
	loopbackType	This parameter specifies the type of loopback, whether by payload (partial information bit pattern) or by frame (full bit pattern).	ENUM { payload, frame}

	loopbackDirection	This parameter specifies the direction in which the loopback test is to be performed. The direction can be set either from CT to RT or the other way around. The options are: - AZ -- From CT to RT - ZA -- From RT to CT.	ENUM { az, za}
	startTime	This parameter identifies the start time of the loopback test operation. The default value (when empty) is the current time.	Generalized Time
	endTime	This parameter identifies the end time of the loopback test operation. The default value (when empty) means the test will continue until interruption.	Generalized Time
	timeInterval	This parameter identifies the time interval for EMS to report and log the loopback test results.	Integer (Units: minutes)
Output parameters	loopbackTestId	This parameter is the identifier of the loopback test started by this operation.	Integer
Return value	–	Success indication	Boolean
Exceptions raised	InvalidInputParameter	The attribute(s) specified in the request is not valid.	
	UnknownManagedEntity	The managed entity(ies) specified in the test request is unknown to EMS.	
	EMSProcessingError	Error occurs during the operation processing.	

2) "stopLoopbackTest" operation

Owner entity	FMController		
Description	This function is used to stop a running loopback test operation. The input parameter is loopbackTest ID. If the operation succeeds, EMS will stop the loopback test on the specified NE. If any exception occurs, EMS will return to NMS error information and the operation fails or the associated loopback test cannot be stopped.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	loopbackTestId	This parameter is the identifier of the test job.	Integer
Output parameters	–	–	–
Return value	–	Success indication	Boolean
Exceptions raised	UnknownLoopbackTest	The loopback test Id specified in the request is unknown to EMS.	
	EMSProcessingError	Error occurs during the operation processing.	

3) "queryLoopbackResult" operation

Owner entity	FMController		
Description	This function is used to query the information and the diagnostic loopback test result of one or multiple loopback tests that have been performed. The input parameter is loopbackTest ID list. If the operation succeeds, EMS will send the loopback test diagnostic result from the specified NEs. If any exception occurs, EMS will return to NMS error information and the operation fails.		
Operation fields	**Name**	**Description**	**Type**
Input parameters	loopbackTestId	This parameter is the identifier of the loopback test whose diagnostic result is to be queried.	Integer (The identifier of the lookback test.)
Output parameters	loopbackTestInfo	This parameter provides the information of the requested loopback test job. The loopback test information contains the following: LoopbackTestInfo ::= STRUCT {loopbackTestId: Integer moInstanceList: List of Name loopbackType: ENUM {payload, frame} loopbackDirection: ENUM {az, za} startTime: GeneralizedTime endTime: GeneralizedTime timeInterval: Integer (Units: minutes) }	LoopbackTestInfo (See left column for more details)
	loopbackDiagnosticResult	This parameter returns the complete result upon request from DLC loopback test operation above.	String
Return value	–	Success indication	Boolean
Exceptions raised	UnknownLoopbackTest	The job ID(s) specified in the request is unknown to EMS.	
	EMSProcessingError	Error occurs during the operation processing.	

8.3.3 Sequence diagram

8.3.3.1 DLC loopback test

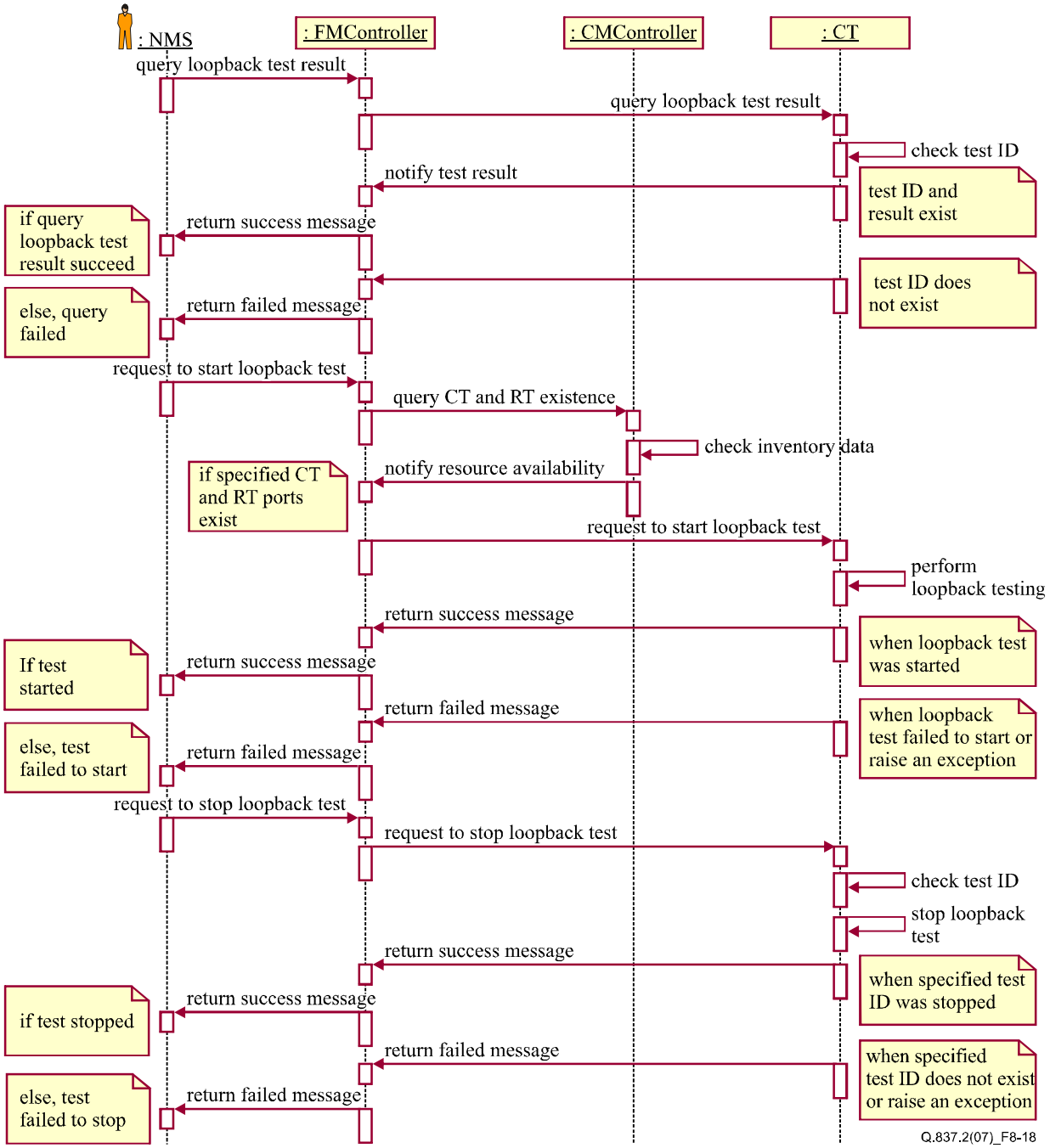

Figure 8-18 – DLC loopback test sequence diagram

8.3.4 Alarm probable causes

The following are the probable causes that are specific for SDH-DLC management systems. The probable cause values will be assigned numbers at the design phase. In addition, all the common probable causes defined in [ITU-T M.3100], [ITU-T X.721] and [ITU-T X.733] are also applicable in SDH-DLC network management.

ProbableCause	Description	Type
powerSupplyFailure CTAlarm	Power supply alarm occurs on CT side.	environmentalAlarm
powerSupplyFailure RTAlarm	Power supply alarm occurs on RT side.	environmentalAlarm
losAlarm	Loss of the incoming signal detected at CT side, because of fibre failure or laser source failure.	communicationAlarm
aisAlarm	Alarm Indication Signal indicates trouble condition exists in the E1 link between CT and RT side.	communicationAlarm
lofAlarm	Loss of Frame alarm will be sent when frame structure or alignment cannot be extracted from the received signal, at either CT or RT.	communicationAlarm
v5CommProtocol Errors	These alarms will be generated when V5 interface meets fault conditions such as: Persistent port control protocol syntax errors, Restart timer error and Persistent PSTN data link failures.	equipmentAlarm
v5ConfigErrors	These alarms will be generated when V5 interface meets fault conditions such as: Interface identification failure and V5 Interface provisioning mismatch failure.	equipmentAlarm
syncLosOltAlarm	Synchronization loss occurs on a PON port of OLT side.	equipmentAlarm
syncLosOnuAlarm	Synchronization loss occurs on a PON port of ONU or ONT side.	equipmentAlarm
berOltAlarm	BER performance alarm occurs on a PON port of OLT side.	qualityOfServiceAlarm
berOnuAlarm	BER performance alarm occurs on a PON port of ONU or ONT side.	qualityOfServiceAlarm
rcvEAlarm	No optical signal has been received on an Ethernet port of OLT, ONU or ONT.	equipmentAlarm
sndEAlarm	No optical signal has been sent on an Ethernet port of OLT, ONU or ONT.	equipmentAlarm
losE1Alarm	Signal loss occurs on an E1 port of OLT, ONU or ONT.	equipmentAlarm
aisE1Alarm	AIS alarm occurs on an E1 port of OLT, ONU or ONT.	equipmentAlarm
syncE1Alarm	Frame synchronization loss occurs on an E1 port of OLT, ONU or ONT.	equipmentAlarm
checkE1Alarm	Check alarm occurs on an E1 port of OLT, ONU or ONT.	equipmentAlarm
regFail	ONU or ONT P2MP discovery (registration) fails.	communicationAlarm

8.4 Performance management

The common part of analysis for performance management can be found in clause 7.3 of [ITU-T Q.827.1].

8.4.1 Performance measurement parameters

8.4.1.1 DLC performance measurement parameters

Behaviour: This set of measurement parameters is collected at CT and RT.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
CV	This attribute identifies a count of one-second intervals containing one or more code violations.	integer	M, R
ES	This attribute identifies a count of one-second intervals containing one or more digital transmission errors.	integer	M, R
SAS	This attribute identifies a count of one-second intervals containing one or more severely errored frame (SEF) events.	integer	M, R
SES	This attribute identifies a count of one-second intervals containing more than X digital transmission errors or a severely errored frame (SEF) event.	integer	M, R
UAS	This attribute identifies a count of one-second intervals during which resource service was unavailable.	integer	M, R
CSS	This attribute identifies a count of one-second intervals containing one of more controlled slips.	integer	M, R
CSSFE	This attribute identifies a count of one-second intervals containing one or more controlled slips which were received by the far-end terminal.	integer	M, R
CVFE	This attribute identifies a count of one-second intervals containing one or more code violations which were received by the far-end terminal.	integer	M, R
CSFE	This attribute identifies a count of one-second intervals containing one or more digital transmission errors which were received by the far-end terminal.	integer	M, R
EESFE	This attribute identifies a count of one-second intervals containing more than X digital transmission errors or a severely errored frame (SEF) event received by the far-end terminal.	integer	M, R
UASFE	This attribute identifies a count of one-second intervals during which resource service was unavailable to the far-end terminal.	integer	M, R

8.4.1.2 ISDN performance measurement parameters

Behaviour: This set of measurement parameters is collected at ISDN ports.			
Attributes			
Name	**Description**	**Type**	**Qualifier**
CV	This attribute identifies a count of one-second intervals containing one or more code violations.	integer	M, R
CVFE	This attribute identifies a count of one-second intervals containing one or more code violations which were received by the far-end terminal.	integer	M, R
ES	This attribute identifies a count of one-second intervals containing one or more digital transmission errors.	integer	M, R
ESFE	This attribute identifies a count of one-second intervals containing one or more digital transmission errors which were received by the far-end terminal.	integer	M, R
SES	This attribute identifies a count of one-second intervals containing more than one digital transmission errors or a severely errored frame (SEF) event.	integer	M, R
SESFE	This attribute identifies a count of one-second intervals containing more than one digital transmission errors or a severely errored frame (SEF) event received by the far-end terminal.	integer	M, R
CVCRC	This attribute is counted when a CRC-9 violation is detected over 3 consecutive M-frames.	integer	M, R

Appendix I

Table of managed entities

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

Table I.1 – Table of managed entities

Managed entity name in this Recommendation	Statement
CMController	Defined in this recommendation
FMController	Defined in this Recommendation
Equipment	Externally defined in [ITU-T M.3100]
EquipmentR1	Externally defined in [ITU-T M.3100]
EquipmentR2	Externally defined in [ITU-T M.3100]
EquipmentHolder	Externally defined in [ITU-T M.3100]
CircuitPackR1	Externally defined in [ITU-T M.3100]
Software	Externally defined in [ITU-T M.3100]
LayerNetworkDomain	Externally defined in [ITU-T M.3100]
AlarmSeverityAssignmentProfile	Externally defined in [ITU-T M.3100]
PhysicalPort	Externally defined in [ITU-T M.3100]
ManagedElement	Externally defined in [ITU-T M.3100]
TerminationPoint	Externally defined in [ITU-T M.3100]
CrossConnection	Externally defined in [ITU-T M.3100]
TrailR2	Externally defined in [ITU-T M.3100]
groupTerminationPoint	Externally defined in [ITU-T M.3100]
LinkConnection	Externally defined in [ITU-T M.3100]
pipeR2	Externally defined in [ITU-T M.3100]
Network	Externally defined in [ITU-T M.3100]
networkR1	Externally defined in [ITU-T M.3100]
ConnectionTerminationPointSource	Externally defined in [ITU-T M.3100]
ConnectionTerminationPointSink	Externally defined in [ITU-T M.3100]
ConnectionTerminationPointBidirectional	Externally defined in [ITU-T M.3100]
trailTerminationPointSource	Externally defined in [ITU-T M.3100]
TrailTerminationPointSink	Externally defined in [ITU-T M.3100]
trailTerminationPointBidirectional	Externally defined in [ITU-T M.3100]
AbstractLink	Externally defined in [ITU-T M.3100]
AbstractLinkEnd	Externally defined in [ITU-T M.3100]
LogicalLink	Externally defined in [ITU-T M.3100]
LogicalLinkEnd	Externally defined in [ITU-T M.3100]
logicalLinkEndR1	Externally defined in [ITU-T M.3100]
CT	Defined in this Recommendation
RT	Defined in this Recommendation
ADMR1	Defined in this Recommendation

Table I.1 – Table of managed entities

Managed entity name in this Recommendation	Statement
E1Port	Defined in this Recommendation
leasedLinePort	Defined in this Recommendation
potsPort	Defined in this Recommendation
isdnBRAPort	Defined in this Recommendation
isdnPRAPort	Defined in this Recommendation
E1LinkConnection	Defined in this Recommendation
potsLinkConnection	Defined in this Recommendation
isdnPRALinkConnection	Defined in this Recommendation
isdnBRALinkConnection	Defined in this Recommendation
leasedLineLinkConnection	Defined in this Recommendation
V52LinkConnection	Defined in this Recommendation
E1Trail	Defined in this Recommendation
V52Trail	Defined in this Recommendation
potsTrail	Defined in this Recommendation
isdnBRATrail	Defined in this Recommendation
leasedLineTrail	Defined in this Recommendation
isdnPRATrail	Defined in this Recommendation
E1TTPBidirectional	Defined in this Recommendation
E1TTPSink	Defined in this Recommendation
E1TTPSource	Defined in this Recommendation
E1CTPSource	Defined in this Recommendation
E1CTPSink	Defined in this Recommendation
E1CTPBidirectional	Defined in this Recommendation
V52TTPBidirectional	Defined in this Recommendation
V52TTPSink	Defined in this Recommendation
V52TTPSource	Defined in this Recommendation
V52CTPBidirectional	Defined in this Recommendation
V52CTPSink	Defined in this Recommendation
V52CTPSource	Defined in this Recommendation
potsTTPBidirectional	Defined in this Recommendation
potsTTPSink	Defined in this Recommendation
potsTTPSource	Defined in this Recommendation
potsCTPBidirectional	Defined in this Recommendation
potsCTPSink	Defined in this Recommendation
potsCTPSource	Defined in this Recommendation
isdnBRATTPBidirectional	Defined in this Recommendation
isdnBRATTPSink	Defined in this Recommendation
isdnBRATTPSource	Defined in this Recommendation
isdnBRACTPBidirectional	Defined in this Recommendation

Table I.1 – Table of managed entities

Managed entity name in this Recommendation	Statement
isdnBRACTPSink	Defined in this Recommendation
isdnBRACTPSource	Defined in this Recommendation
leasedLineTTPBidirectional	Defined in this Recommendation
leasedLineTTPSink	Defined in this Recommendation
leasedLineTTPSource	Defined in this Recommendation
leasedLineCTPBidirectional	Defined in this Recommendation
leasedLineCTPSink	Defined in this Recommendation
leasedLineCTPSource	Defined in this Recommendation
isdnPRATTPBidirectional	Defined in this Recommendation
isdnPRATTPSink	Defined in this Recommendation
isdnPRATTPSource	Defined in this Recommendation
isdnPRACTPBidirectional	Defined in this Recommendation
isdnPRACTPSink	Defined in this Recommendation
isdnPRACTPSource	Defined in this Recommendation
E1Link	Defined in this Recommendation
E1LinkEnd	Defined in this Recommendation
isdnBRALink	Defined in this Recommendation
isdnBRALinkEnd	Defined in this Recommendation
isdnPRALink	Defined in this Recommendation
isdnPRALinkEnd	Defined in this Recommendation
leasedLineLink	Defined in this Recommendation
leasedLineLinkEnd	Defined in this Recommendation
potsLink	Defined in this Recommendation
potsLinkEnd	Defined in this Recommendation
V52Link	Defined in this Recommendation
V52LinkEnd	Defined in this Recommendation
au3CTPBidirectional	Externally defined in [ITU-T G.774]
au3CTPSink	Externally defined in [ITU-T G.774]
au3CTPSource	Externally defined in [ITU-T G.774]
au4CTPBidirectional	Externally defined in [ITU-T G.774]
au4CTPSink	Externally defined in [ITU-T G.774]
au4CTPSource	Externally defined in [ITU-T G.774]
augBidirectional	Externally defined in [ITU-T G.774]
augSink	Externally defined in [ITU-T G.774]
augSource	Externally defined in [ITU-T G.774]
msCTPBidirectional	Externally defined in [ITU-T G.774]
msCTPSink	Externally defined in [ITU-T G.774]
msCTPSource	Externally defined in [ITU-T G.774]
msTTPBidirectional	Externally defined in [ITU-T G.774]

Table I.1 – Table of managed entities

Managed entity name in this Recommendation	Statement
msTTPSink	Externally defined in [ITU-T G.774]
msTTPSource	Externally defined in [ITU-T G.774]
opticalSPITTPBidirectional	Externally defined in [ITU-T G.774]
opticalSPITTPSink	Externally defined in [ITU-T G.774]
opticalSPITTPSource	Externally defined in [ITU-T G.774]
rsCTPBidirectional	Externally defined in [ITU-T G.774]
rsCTPSource	Externally defined in [ITU-T G.774]
rsCTPSink	Externally defined in [ITU-T G.774]
tu11CTPBidirectional	Externally defined in [ITU-T G.774]
tu11CTPSource	Externally defined in [ITU-T G.774]
tu11CTPSink	Externally defined in [ITU-T G.774]
tu12CTPBidirectional	Externally defined in [ITU-T G.774]
tu12CTPSource	Externally defined in [ITU-T G.774]
tu12CTPSink	Externally defined in [ITU-T G.774]
tu2CTPBidirectional	Externally defined in [ITU-T G.774]
tu2CTPSource	Externally defined in [ITU-T G.774]
tu2CTPSink	Externally defined in [ITU-T G.774]
tu3CTPBidirectional	Externally defined in [ITU-T G.774]
tu3CTPSource	Externally defined in [ITU-T G.774]
tu3CTPSink	Externally defined in [ITU-T G.774]
tug2Bidirectional	Externally defined in [ITU-T G.774]
tug2Source	Externally defined in [ITU-T G.774]
tug2Sink	Externally defined in [ITU-T G.774]
tug3Bidirectional	Externally defined in [ITU-T G.774]
tug3Source	Externally defined in [ITU-T G.774]
tug3Sink	Externally defined in [ITU-T G.774]
vc11TTPBidirectional	Externally defined in [ITU-T G.774]
vc11TTPSink	Externally defined in [ITU-T G.774]
vc11TTPSource	Externally defined in [ITU-T G.774]
vc12TTPBidirectional	Externally defined in [ITU-T G.774]
vc12TTPSink	Externally defined in [ITU-T G.774]
vc12TTPSource	Externally defined in [ITU-T G.774]
vc12CTPBidirectional	Defined in this Recommendation
vc12CTPSink	Defined in this Recommendation
vc12CTPSource	Defined in this Recommendation
vc12Trail	Defined in this Recommendation
vc2TTPBidirectional	Externally defined in [ITU-T G.774]
vc2TTPSink	Externally defined in [ITU-T G.774]
vc2TTPSource	Externally defined in [ITU-T G.774]

Table I.1 – Table of managed entities

Managed entity name in this Recommendation	Statement
vc3TTPBidirectional	Externally defined in [ITU-T G.774]
vc3TTPSink	Externally defined in [ITU-T G.774]
vc3TTPSource	Externally defined in [ITU-T G.774]
vc4TTPBidirectional	Externally defined in [ITU-T G.774]
vc4TTPSink	Externally defined in [ITU-T G.774]
vc4TTPSource	Externally defined in [ITU-T G.774]

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