
**Information technology — Elements of
management information related to the OSI
Network Layer**

*Technologies de l'information — Éléments d'information de gestion relatifs à
la couche OSI réseau*

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Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 10733 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.283.

This second edition cancels and replaces the first edition (ISO/IEC 10733:1993), which has been technically revised. It also incorporates Amendment 1:1996, Technical Corrigendum 1:1994, Technical Corrigendum 2:1996 and Technical Corrigendum 3:1997.

Annexes A to G form an integral part of this International Standard.

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Introduction

This Recommendation | International Standard is one of a set of Recommendations and International Standards produced to facilitate the interconnection of open systems. The set of Recommendations and International Standards covers the services, protocols and management information required to achieve such interconnection.

This Recommendation | International Standard is positioned with respect to other related Recommendations and International Standards by the layers defined in the *Reference Model for Open System Interconnection* (see ITU-T Rec. X.200 | ISO/IEC 7498-1). In particular, it is concerned with the definition of Network Layer management information.

This Recommendation | International Standard is an update of ITU-T Rec. X.283 (1993) and ISO/IEC 10733:1993 to incorporate all Amendments and Technical corrigenda.

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INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – ELEMENTS OF MANAGEMENT INFORMATION RELATED TO THE OSI NETWORK LAYER

1 Scope

This Recommendation | International Standard provides the specification of management information within an Open System related to those operations of the OSI Network Layer. Specifics on how Network layer management is accomplished is beyond the scope of this Recommendation | International Standard. Network Layer management information is defined by specifying:

- the managed object class definition of Network Layer Managed Objects following guidelines put forth by the *Structure of Management Information* (see Recommendations X.720-X.724 and ISO/IEC 10165);
- the relationship of the Managed Objects and attributes to both the operation of the layer and to other objects and attributes of the layer; and
- the action type operations on the attributes of Network Layer Managed Objects that are available to OSI Systems Management.

Annexes D, E, F and G, which are integral parts of this Recommendation | International Standard, provide ICS proformas associated with Network Layer management information.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation | International Standard. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of the currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model: The Basic Model*.
- ITU-T Recommendation X.213 (1995) | ISO/IEC 8348:1996, *Information technology – Open Systems Interconnection – Network service definition*.
- ITU-T Recommendation X.233 (1993) | ISO/IEC 8473-1:1994, *Information technology – Protocol for providing the connectionless-mode network service: Protocol specification*.
- ITU-T Recommendation X.263 (1995) | ISO/IEC TR 9577:1996, *Information technology – Protocol Identification in the network layer*.
- ITU-T Recommendation X.284 (1997) | ISO/IEC 10737:1998, *Information technology – Elements of management information related to the OSI Transport Layer*.
- CCITT Recommendation X.612 (1992) | ISO/IEC 9574:1992, *Information technology – Provision of the OSI Connection – mode network service by packet-mode terminal equipment connected to an Integrated Services Digital Network (ISDN)*.
- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview*.
- ITU-T Recommendation X.710 (1997) | ISO/IEC 9595:1998, *Information technology – Open Systems Interconnection – Common management information service*.
- ITU-T Recommendation X.711 (1997) | ISO/IEC 9596-1:1998, *Information technology – Open Systems Interconnection – Common management information protocol: Specification*.

- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model.*
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information.*
- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects.*
- ITU-T Recommendation X.723 (1993) | ISO/IEC 10165-5:1994, *Information technology – Open Systems Interconnection – Structure of management information: Generic management information.*
- ITU-T Recommendation X.724 (1996) | ISO/IEC 10165-6:1997, *Information technology – Open Systems Interconnection – Structure of management information: Requirements and guidelines for implementation conformance statement proformas associated with OSI management.*
- CCITT Recommendation X.730 (1992) | ISO/IEC 10164-1:1993, *Information technology – Open Systems Interconnection – Systems management: Object management function.*
- CCITT Recommendation X.731 (1992) | ISO/IEC 10164-2:1992, *Information technology – Open Systems Interconnection – Systems management: State management function.*
- CCITT Recommendation X.732 (1992) | ISO/IEC 10164-3:1993, *Information technology – Open Systems Interconnection – Systems management: Attributes for representing relationships.*
- CCITT Recommendation X.733 (1992) | ISO/IEC 10164-4:1992, *Information technology – Open Systems Interconnection – Systems management: Alarm Reporting Function.*
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems management: Event report management function.*
- CCITT Recommendation X.735 (1992) | ISO/IEC 10164-6:1993, *Information technology – Open Systems Interconnection – Systems management: Log control function.*

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1).*
ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1).*
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- CCITT Recommendation X.209 (1988), *Specification of basic encoding rules for Abstract Syntax Notation one (ASN.1).*
ISO/IEC 8825:1990, *Information technology – Open Systems Interconnection – Specification of Basic Encoding Rules for Abstract Syntax Notation One (ASN.1).*
- ITU-T Recommendation X.223 (1993), *Use of X.25 to provide the OSI connection-mode network service for ITU-T applications.*
ISO/IEC 8878:1992, *Information technology – Telecommunications and information exchange between systems – Use of X.25 to provide the OSI Connection-mode Network Service.*
- ITU-T Recommendation X.290 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – General concepts.*
ISO/IEC 9646-1:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 1: General concepts.*
- ITU-T Recommendation X.291 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Abstract test suite specification.*
ISO/IEC 9646-2:1994, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 2: Abstract Test Suite specification.*
- ITU-T Recommendation X.296 (1995), *OSI conformance testing methodology and framework for protocol Recommendations for ITU-T applications – Implementation conformance statements.*
ISO/IEC 9646-7:1995, *Information technology – Open Systems Interconnection – Conformance testing methodology and framework – Part 7: Implementation Conformance Statements.*
- CCITT Recommendation X.700 (1992), *Management Framework for Open Systems Interconnection for CCITT applications.*
ISO/IEC 7498-4:1989, *Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 4: Management framework.*

2.3 Additional references

- CCITT Recommendation D.10 (1991), *General tariff principles for international public data communication services.*
- CCITT Recommendation D.11 (1991), *Special tariff principles for international packet-switched public data communication services by means of the virtual call facility.*
- CCITT Recommendation D.12 (1980), *Measurement unit for charging by volume in the international packet-switched data communication service.*
- ITU-T Recommendation E.164 (1997), *The international public telecommunication numbering plan.*
- ITU-T Recommendation X.2 (1996), *International data transmission services and optional user facilities in public data networks and ISDNs.*
- ITU-T Recommendation X.25 (1993), *Interface between Data Terminal Equipment (DTE), and Data Circuit-terminating Equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*
- ITU-T Recommendation X.121 (1996), *International numbering plan for public data networks.*
- ISO/IEC 8208:1995, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment.*
- ISO 8648:1988, *Information processing systems – Open Systems Interconnection – Internal organization of the Network Layer.*
- ISO/IEC 8881:1989, *Information processing systems – Data communications – Use of the X.25 packet level protocol in local area networks.*
- ISO 9542:1988, *Information processing systems – Telecommunications and information exchange between systems – End system to Intermediate system routing exchange protocol for use in conjunction with the Protocol for providing the connectionless-mode network service (ISO 8473).*
- ISO/IEC 10030:1990, *Information technology – Telecommunications and information exchange between systems – End System Routing Information Exchange Protocol for use in conjunction with ISO/IEC 8878.*
- ISO/IEC 10177:1993, *Information technology – Telecommunications and information exchange between systems – Provision of the connection-mode Network internal layer service by intermediate systems using ISO/IEC 8208, the X.25 Packet Layer Protocol.*
- ISO/IEC TR 13532:1995, *Information technology – Telecommunications and information exchange between systems – Protocol combinations to provide and support the OSI Network Service.*
- ISO/IEC 10589:1992, *Information technology – Telecommunications and information exchange between systems – Intermediate system to intermediate system intra-domain routing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473).*

3 Definitions

For the purposes of this Recommendation | International Standard, the following definitions apply.

3.1 Basic Reference model

This Recommendation | International Standard makes use of the following terms defined in *OSI Reference Model* (see ITU-T Rec. X.200 | ISO/IEC 7498-1):

- a) Open System;
- b) (N)-Service Access Point;
- c) Network Layer;
- d) Network Protocol;
- e) Layer Management;
- f) Systems Management.

3.2 Information model

This Recommendation | International Standard makes use of the following terms defined in *Structure of Management Information: Management Information Model* (see CCITT Rec. X.720 | ISO/IEC 10165-1):

- a) Attributes;
- b) Attribute Type;
- c) Containment;
- d) Distinguished Name;
- e) Inheritance;
- f) Managed Object;
- g) Management Operations;
- h) Notifications;
- i) Object Class;
- j) Relative Distinguished Name;
- k) Subclass;
- l) Superclass.

3.3 Guidelines for the Definition of Managed Objects (GDMO)

This Recommendation | International Standard makes use of the following terms defined in *Structure of Management Information: Guidelines for the Definition of Managed Objects* (see CCITT Rec. X.722 | ISO/IEC 10165-4).

- a) Managed Object Class Definition;
- b) Template;
- c) Parameter.

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3.4 Management framework

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This Recommendation | International Standard makes use of the following term defined in *Management Framework for Open Systems Interconnection* (see CCITT Rec. X.700 | ISO/IEC 7498-4).

- Management Information.

4 Abbreviations

Within the Managed Object definitions and GDMO templates, the following abbreviations are used in the standard-name element of a document-identifier when making references to other documents.

DMI	CCITT Rec. X.721 (1992) ISO/IEC 10165-2:1992
GMI	ITU-T Rec. X.723 (1993) ISO/IEC 10165-5:1994

For the purposes of this Recommendation | International Standard, the following symbols and abbreviations apply:

BCUG	Bilateral Closed User Group
CLNP	Connectionless-mode Network Protocol
CLNS	Connectionless-mode Network Service
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
CONS	Connection-mode Network Service
CUG	Closed User Group
ES	End System
ESH	End System Hello
ER PDU	Error Report Protocol Data Unit
IS	Intermediate System
ISH	Intermediate System Hello
IVMO	Initial Values Managed Object
LCN	Logical Channel Number
MCS	Management Conformance Summary

MICS	Management Information Conformance Statement
MO	Managed Object
MOCS	Managed Object Conformance Statement
MRCS	Managed Relationship Conformance Statement
NSAP	Network Service Access Point
NSE	Network Service Element
NUI	Network User Identification
PLE	Packet Layer Entity
PVC	Permanent Virtual Circuit
RD PDU	Redirect Protocol Data Unit
RDN	Relative Distinguished Name
SNDCF	Subnetwork Dependent Convergence Function
SNPA	Subnetwork Point of Attachment
VC	Virtual Call

5 Elements of network layer management information

5.1 Managed object hierarchy

5.1.1 Summary of managed objects

The following set of managed object classes are defined for the OSI Network Layer:

- a) The network subsystem managed object (see 5.3).
- b) The network entity managed object (see 5.4).
- c) The NSAP managed object (see 5.5).
- d) The connectionless-mode network service managed object (see 5.6).
- e) The linkage managed object (see 5.7).
- f) The connection-mode network service managed object (see 5.8).
- g) The network connection managed object (see 5.9).
- h) The X.25 PLE DTE managed object (see 5.10.3).
- i) The X.25 PLE DCE managed object (see 5.10.4).
- j) The X.25 PLE DTE initial values managed object (see 5.10.5).
- k) The X.25 PLE DCE initial values managed object (see 5.10.6).
- l) The permanent virtual circuit DTE managed object (see 5.11.4).
- m) The permanent virtual circuit DCE managed object (see 5.11.5).
- n) The virtual call initial values managed object (see 5.11.6).
- o) The virtual call DTE managed object (see 5.11.7).
- p) The virtual call DCE managed object (see 5.11.8).
- q) The Recommendation D Series counts managed object (see 5.11.9).

The following Managed Object classes are never instantiated, but exist only for the purposes of deriving subclasses.

- a) The X.25 PLE managed object (see 5.10.1).
- b) The X.25 PLE initial values managed object (see 5.10.2).
- c) The virtual circuit managed object (see 5.11.1).
- d) The virtual circuit DTE managed object (see 5.11.2).
- e) The virtual circuit DCE managed object (see 5.11.3).

These Managed Objects represent OSI Management's view of those elements of an Open System which support the OSI Network Service subject to OSI management operations.

5.1.2 Containment hierarchy

The containment hierarchy is illustrated in Figure 1. Managed Objects which can have multiple instances are illustrated by shadowed (multiple) boxes. These objects are defined in detail in the following subclauses.

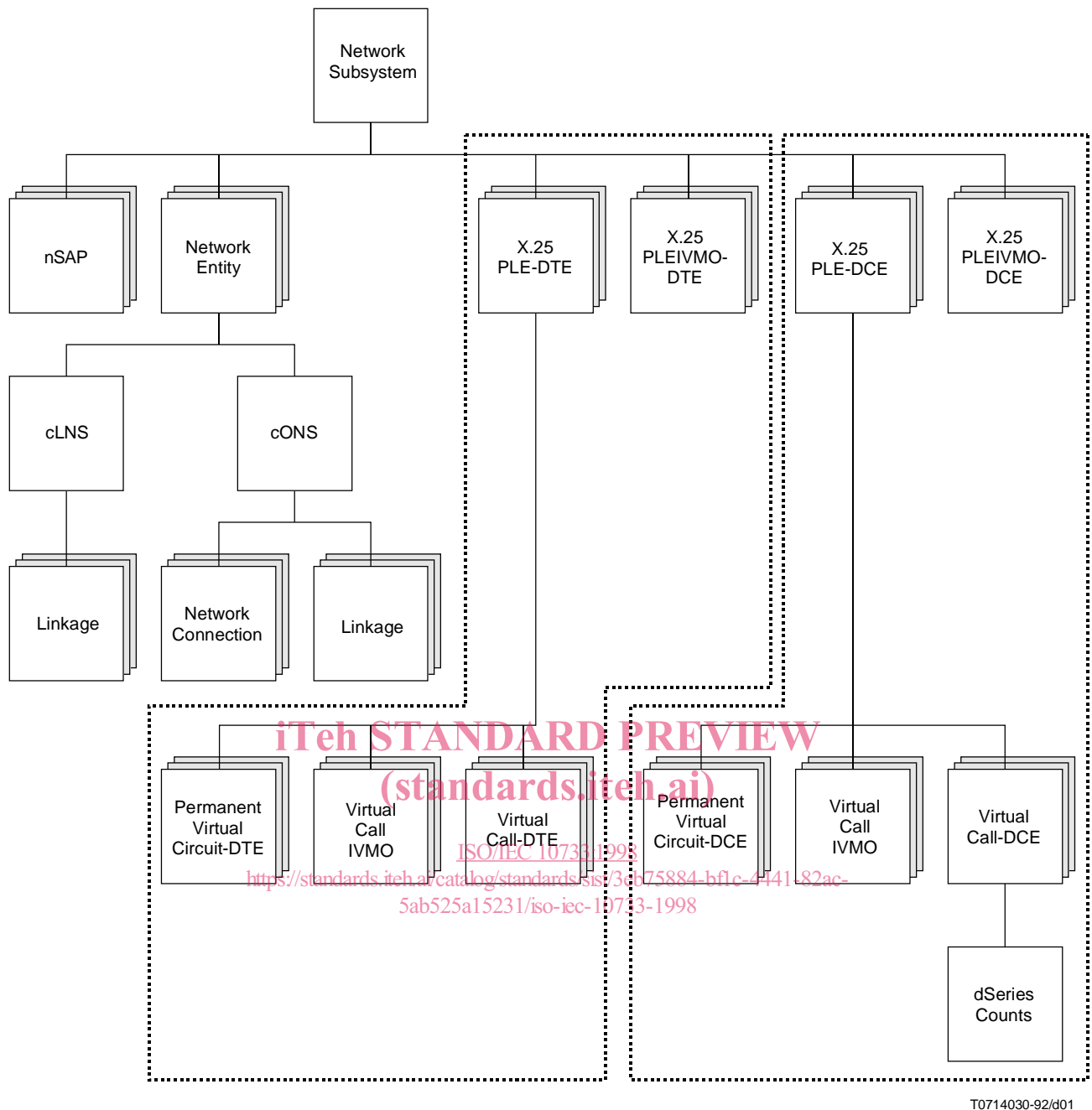


Figure 1 – Network Layer containment hierarchy

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The networkSubsystem MO is subordinate to the system MO. The x25PLE MO and IVMOs are examples of what are termed ‘SNPA’ MOs. The ‘SNPA’ MOs are subnetwork specific MOs. It is expected that there will in future be a number of additional ‘SNPA’ MOs, for example for ISDN.

The ‘SNPA’ MO is concerned with the protocol used to access a subnetwork. For example, there is an ‘SNPA’ MO corresponding to each X.25 Packet layer entity. The cLNS MO is concerned with the functions of the CLNS protocols (see ITU-T Rec. X.233 | ISO/IEC 8473-1, ISO 9542 and ISO/IEC 10589) which apply to the general operation of the protocol as a whole rather than being specifically related to individual points of attachment, whereas the linkage MO applies to the subnetwork dependent convergence functions. The cONS MO and its associated linkage MOs apply similarly to protocols associated with CONS (see ITU-T Rec. X.223 | ISO/IEC 8878, CCITT Rec. X.612 | ISO/IEC 9574, ISO/IEC 10030, ISO/IEC 10177, etc.)

For the requirements regarding which MOs in the containment tree shall be instantiated for a conforming implementation, see the applicable clauses of the conformance statement.

5.1.3 Relationships

5.1.3.1 General

The following subclauses describe the individual relationships. The use of relationship attributes is illustrated by examples in Annex C.

5.1.3.2 Linkage

There is a relationship (sN-ServiceProvider and sN-SAP both pointing to the same MO) between linkage MOs and 'SNPA' MOs. For example, a linkage concerned with the operation of the ITU-T Rec. X.233 | ISO/IEC 8473-1 SNDCF for X.25 has a relationship with an x25PLE-DTE MO. A linkage has a relationship identifying only one 'SNPA', so in the case of a network entity containing one ITU-T Rec. X.233 | ISO/IEC 8473-1 protocol machine operating over a number of X.25 Packet Layer Entities, there would be a number of linkage MOs, each related to a different x25PLE-DTE MO. But although one linkage is related to only one 'SNPA', it is possible for a number of other linkages to be related to the same 'SNPA'; for example, there could be cONS Linkages and cLNS linkages both using the same x25PLE-DTE and therefore the same 'SNPA' MO.

In some cases of network layer operation there is no specific access protocol; for example, ITU-T Rec. X.233 | ISO/IEC 8473-1 contains an SNDCF for use over the data link service directly. In such cases, the linkage has relationships (sN-ServiceProvider and sN-SAP pointing to different MOs), not to an 'SNPA' but to appropriate MOs in the Data Link Layer.

5.1.3.3 NSAPs

There is a relationship (localSAPNames) between a networkEntity MO and an nSAP MO. Each nSAP MO is related to only one networkEntity, although one networkEntity may be related to several nSAP MOs.

5.1.3.4 Layer n + 1 clients

The nSAP MO has a set of relationships (userEntityName) to Layer n + 1 clients (typically the Transport Layer Entity). The Transport Layer Entity has a relationship (actualNSAP) to the nSAP MO.

5.1.3.5 Layer n – 1 services

Both the linkage and x25PLE MOs have relationships (sN-ServiceProvider and sN-SAP) to the appropriate Data Link Layer MOs.

5.1.3.6 Connections

There is a relationship (underlyingConnectionNames) between a transportConnection MO and its underlying networkConnection MO (if one exists), and between the networkConnection MO and the underlying virtualCall-DTE MO. The relationship between the virtualCall-DTE MO and any underlying Datalink Layer MO is implicitly available as a result of the parent x25PLE-DTE or x25PLE-DCE MOs relationships to the Data Link Layer, as described above.

In addition there is a relationship (localNSAPMO) from the networkConnection MO to the corresponding nSAP MO.

5.1.4 Minimum event filtering capabilities

The network layer management definitions embodied in this Recommendation | International Standard imply the frequent, and possibly excessive, generation of notifications during regular layer operation. These notifications are especially useful for effective fault management, where they facilitate the tracing and pinpointing of error situations. To avoid the excessive dissemination of these event reports under normal operating conditions, it is advisable for a managed system to have, as a minimum, the capability to perform discrimination based upon:

- a) The source managed object class.
- b) The object identifier values in the probable cause and specific problems field of communication alarms, and the communication type field communication informations.

5.1.5 Use of optional fields

Where reference is made in this Recommendation | International Standard to ASN.1 syntax defined in ITU-T Rec. X.723 | ISO/IEC 10165-5 or CCITT Rec. X.721 | ISO/IEC 10165-2, only the following fields shall be employed:

- a) those which are not OPTIONAL in the ASN.1 syntax;
- b) those which are OPTIONAL, but whose use is explicitly required by this Recommendation | International standard;
- c) those which are OPTIONAL, but whose ASN.1 type is SET OF ManagementExtension.

The use of any other fields is prohibited.