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Information technology — Telecommunications and information exchange between systems — Elements of management information related to OSI Network Layer standards

*Technologies de l'information — Télécommunications et échange
d'informations entre systèmes — Éléments d'information de gestion
relatifs à la structure de 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*, Sub-Committee SC 6, *Telecommunications and information exchange between systems*.

Annex A forms an integral part of this International Standard. Annexes B and C are for information only.

Introduction

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

This International Standard is positioned with respect to other related International Standards by the layers defined in the *Reference Model for Open System Interconnection* (ISO 7498). In particular, it is concerned with the definition of Network Layer management information.

Information technology — Telecommunications and information exchange between systems — Elements of management information related to OSI Network Layer standards

1 Scope

This International Standard provides the specification of management information within an Open System related to those operations of the OSI Network Layer specified by CCITT Recommendations and International Standards. Specifics on how Network layer management is accomplished is beyond the scope of this document. 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* (ISO/IEC 10165 and CCITT Recommendations X.720 - X.723),
- 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.

2 Normative references

The following CCITT Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this 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 International Standard are encouraged to investigate the possibility of applying the most recent editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The CCITT Secretariat maintains a list of the currently valid CCITT Recommendations.

2.1 Identical CCITT Recommendations | International Standards

CCITT Recommendation X.213 (1992) | ISO/IEC 8348 : 1993, *Information technology — Open Systems Interconnection — Network Service Definition*.

CCITT Recommendation X.701 (1992) | ISO/IEC 10040 : 1992, *Information technology — Open Systems Interconnection — Systems management overview*.

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*.

CCITT Recommendation X.723 (1992) | ISO/IEC 10165-5 : 1993, *Information technology — Open Systems Interconnection — Structure of management information : Generic management information*.

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 : 1993, *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.*

2.2 Paired CCITT Recommendations | International Standards equivalent in technical content

CCITT Recommendation X.25 (1988), *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.*

ISO/IEC 8208 : 1990, *Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment.*

CCITT Recommendation X.200 (1988), *Reference Model of Open Systems Interconnection for CCITT Applications.*

ISO 7498 : 1984, *Information processing systems — Open Systems Interconnection — Basic Reference Model.*

CCITT Recommendation X.208 (1988), *Specification of abstract syntax notation one (ASN.1).*

ISO/IEC 8824 : 1990, *Information technology — Open Systems Interconnection — Specification of the Abstract Syntax Notation One (ASN.1).*

CCITT Recommendation X.223 (1988), *Use of X.25 to Provide the OSI Connection-mode Network Service for CCITT Applications.*

ISO/IEC 8878 : 1991, *Information technology — Telecommunications and information exchange between systems — Use of X.25 to provide the OSI Connection-mode Network Service.*

CCITT Recommendation X.700¹, *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.*

CCITT Recommendation X.710 (1991), *Common Management Information Service Definition for CCITT Applications.*

ISO/IEC 9595 : 1991, *Information technology — Open Systems Interconnection — Common management information service definition.*

CCITT Recommendation X.711 (1991), *Common Management Information Protocol Specification for CCITT Applications.*

ISO/IEC 9596-1 : 1991, *Information technology — Open Systems Interconnection — Common management information protocol — Part 1: Specification.*

2.3 Additional references

ISO 8473 : 1988, *Information processing systems — Data communications — Protocol for providing the Connectionless-mode network service.*

ISO 8648 : 1988, *Information processing systems — Open Systems Interconnection — Internal organization of the Network Layer.*

¹Presently at the state of draft Recommendation

ISO/IEC 8880-1 : 1990, *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI Network Service — Part 1: General principles.*

ISO/IEC 8880-2 : 1990, *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI Network Service — Part 2: Provision and support of the connection-mode Network Service.*

ISO/IEC 8880-3 : 1990, *Information technology — Telecommunications and information exchange between systems — Protocol combinations to provide and support the OSI Network Service — Part 3: Provision and support of the connectionless-mode Network Service.*

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 routeing exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473).*

ISO/TR 9577 : 1990, *Information technology — Telecommunications and information exchange between systems — Protocol identification in the Network Layer.*

ISO/IEC 10030 : 1990, *Information technology — Telecommunications and information exchange between systems — End system routeing information exchange protocol for use in conjunction with ISO 8878.*

ISO/IEC 10177 : 1993, *Information technology — Data communications — Intermediate system support of the OSI connection-mode network service using ISO/IEC 8208 in accordance with ISO/IEC 10028.*

ISO/IEC 10589 : 1992, *Information technology — Telecommunications and information exchange between systems — Intermediate system to intermediate system intra-domain routeing information exchange protocol for use in conjunction with the protocol for providing the connectionless-mode Network Service (ISO 8473).*

CCITT Recommendation D.10, *General tariff principles for international public data networks.*

CCITT Recommendation D.11, *Special tariff principles for international packet-switched public data communication services by means of the virtual call facility.*

CCITT Recommendation D.12, *Measurement unit for charging by volume in the international packet-switched data communication service.*

CCITT Recommendation E.164, *The numbering plan for the ISDN era.*

CCITT Recommendation X.2 (1988), *International data transmission services and optional user facilities in public data networks and ISDNs.*

CCITT Recommendation X.121 (1988), *International numbering plan for public data networks.*

3 Definitions

3.1 Basic reference model

This International Standard makes use of the following terms defined in ISO 7498.

- 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 International Standard makes use of the following terms defined in 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 GDMO

This International Standard makes use of the following terms defined in ISO/IEC 10165-4.

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

3.4 Management framework

This International Standard makes use of the following terms defined in ISO/IEC 7498-4.

- a) Management Information

4 Symbols and 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	CCITT Rec. X.723 ISO/IEC 10165-5

This International Standard makes use of the following symbols and abbreviations.

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 Definition

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
MO	Managed Object
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 X25 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 clauses of this International Standard.

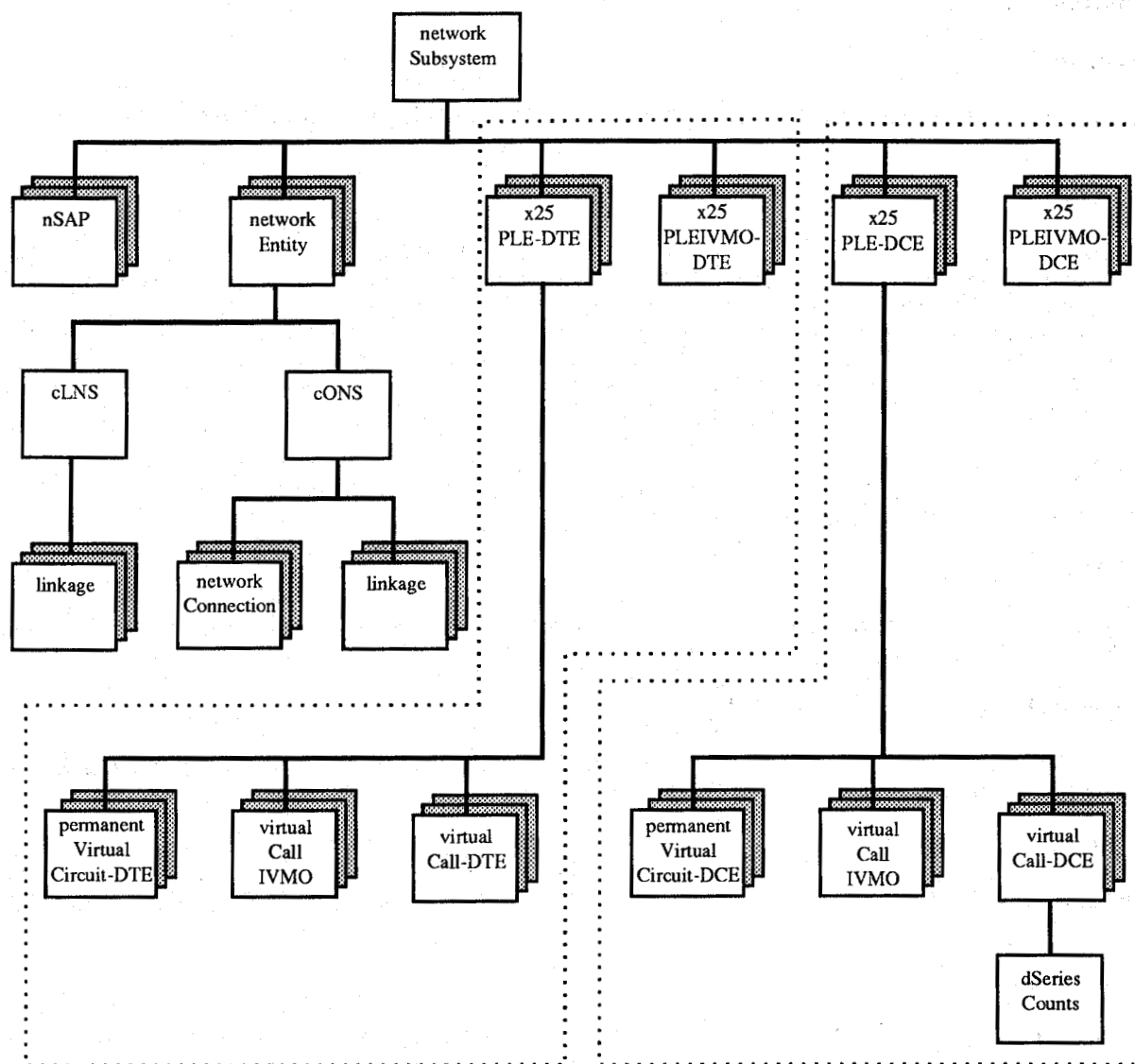


Figure 1 - Network Layer Containment Hierarchy

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 (ISO 8473, 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 (ISO/IEC 8878, ISO/IEC 9574, ISO 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 clauses 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 ISO 8473 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 ISO 8473 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, ISO 8473 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 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 International Standard to ASN.1 syntax defined in Rec. X.723 | ISO/IEC 10165-5 or 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 International Standard;
- c) those which are OPTIONAL, but whose ASN.1 type is SET OF ManagementExtension.

The use of any other fields is prohibited.

5.2 Common behaviour templates

commonCreationDeletion-B BEHAVIOUR

DEFINED AS

!Managed object class imports the ISO/IEC 10165-2 objectCreation and objectDeletion notifications. Used as follows:

objectCreation - Generated whenever an instance of the managed object class is created. Implementations may optionally include the sourceIndicator parameter in the notification. If creation occurred as a result of internal operation of the resource, the value 'resourceOperation' is used. If creation occurred in response to a management operation, the value 'managementOperation' is used. A value of 'unknown' may be returned if it is not possible to determine the source of the operation. None of the other optional parameters are used.

objectDeletion - Generated whenever an instance of the managed object class is deleted. Implementations may optionally include the sourceIndicator parameter in the notification. If deletion occurred as a result of internal operation of the resource, the value 'resourceOperation' is used. If deletion occurred in response to a management operation, the value 'managementOperation' is used. A value of 'unknown' may be returned if it is not possible to determine the source of the operation. None of the other optional parameters are used.!!;

commonStateChange-B BEHAVIOUR

DEFINED AS

!Managed object class imports the ISO/IEC 10165-2 stateChange notification. Used to report the changes to the operationalState attribute, and where present, the administrativeState attribute. A single parameter set is included in the State change definition field. Only the (mandatory) attributeId and (optional) newAttributeValue parameters are used.!!;

octetsSentReceivedCounter-B BEHAVIOUR

DEFINED AS

The octetsSentCounter and octetsReceivedCounter shall count only user data octets in valid data packets. They shall not count user data octets in data packets which are rejected for any reason, nor user data octets in non data packets;

successfulConnectionEstablishment-B BEHAVIOUR

DEFINED AS

This Package imports the communicationsInformation notification from "GMI".

It is used to report the following events.

successfulConnectionEstablishment: Generated when a connection is successfully established. However, the precise synchronization between the notification and the corresponding protocol and service interface interactions is not defined by this Specification.

The value NLM.successfulConnectionEstablishment shall be reported in the informationType field.;

**deactivateConnection-B BEHAVIOUR
DEFINED AS**

The Deactivate action causes the connection to be terminated. The termination should occur as rapidly as practical, but no particular time constraints are implied. Typically, this action simulates a disconnect request received across the service interface. If a more rapid means for terminating the connection exists, then this should be used. The termination shall occur in conformance to the protocol standard. The Managed Object remains in existence after completion of the Deactivate action. It is subsequently deleted when the connection is terminated, in the same way as if the connection has been terminated by other means. A deactivate action may fail (with the ProcessingError response) if it is temporarily not possible to terminate the connection.;

**resettingTimer-B BEHAVIOUR
DEFINED AS**

This attribute specifies the interval between certain events in the operation of the protocol state machine. If the value of this attribute is changed to a new value while the protocol state machine is in operation, the implementation shall take the necessary steps to ensure that for any time interval which was in progress when the corresponding attribute was changed, the next expiration of that interval takes place no later than the expiration of the interval in progress or the specified interval whichever is the sooner. The precision with which this time shall be implemented shall be the same as that associated with the basic operation of the timer attribute;

5.3 The network subsystem managed object

- Managed Object for Network Layer Subsystem
-
- There is exactly one of these MOs within a system. It exists to provide a container for the
- Network Entity MOs, nSAP MOs and the 'SNPA' MOs.
-
-
- The networkSubsystem managed object can not be created or deleted
- explicitly by management operation. It exists inherently in a system;
- created and deleted as part of system operation.
-

networkSubsystem MANAGED OBJECT CLASS

DERIVED FROM "GMI":subsystem;

CHARACTERIZED BY networkSubsystem-P PACKAGE

ATTRIBUTES

"GMI":subsystemId

INITIAL VALUE NLM.networkSubsystemId-Value

GET;

::

REGISTERED AS {NLM.moi networkSubsystem (1)};

-- Name Bindings

networkSubsystem-system NAME BINDING

SUBORDINATE OBJECT CLASS networkSubsystem AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS "DMI":system AND SUBCLASSES;

WITH ATTRIBUTE "GMI":subsystemId;

REGISTERED AS {NLM.nboi networkSubsystem-system (1)};

5.4 The network entity managed object

- There may be multiple instances of these MOs within a system.
- Its definition permits it to be deleted and created explicitly by management operation, or to be created and deleted automatically as part of system operation.

networkEntity MANAGED OBJECT CLASS

```

DERIVED FROM "GMI":communicationsEntity;
CHARACTERIZED BY networkEntity-P PACKAGE
  BEHAVIOUR commonCreationDeletion-B;
  ATTRIBUTES
    networkEntityTitles
      GET-REPLACE
      ADD-REMOVE,
    systemTypes GET;
  NOTIFICATIONS
    "DMI":objectDeletion,
    "DMI":objectCreation;
  ;;

```

REGISTERED AS {NLM.moi networkEntity (22)};

-- Name Bindings

networkEntity-networkSubsystem-Automatic NAME BINDING

```

SUBORDINATE OBJECT CLASS networkEntity AND SUBCLASSES;
NAMED BY
  SUPERIOR OBJECT CLASS networkSubsystem AND SUBCLASSES;
  WITH ATTRIBUTE "GMI":communicationsEntityId;
  BEHAVIOUR networkEntity-networkSubsystem-Automatic-B BEHAVIOUR
  DEFINED AS This name binding shall be used when the
    networkEntity MO is created automatically by the operation
    of the system. The details of these operations are outside
    the scope of this Specification.;;

```

REGISTERED AS {NLM.nboi networkEntity-networkSubsystem-Automatic (27)};

networkEntity-networkSubsystem-Management NAME BINDING

```

SUBORDINATE OBJECT CLASS networkEntity AND SUBCLASSES;
NAMED BY
  SUPERIOR OBJECT CLASS networkSubsystem AND SUBCLASSES;
  WITH ATTRIBUTE "GMI":communicationsEntityId;
  BEHAVIOUR networkEntity-networkSubsystem-Management-B BEHAVIOUR
  DEFINED AS This name binding shall be used when the
    networkEntity MO is created automatically by system management.
  ;;

```

CREATE;

DELETE;

REGISTERED AS {NLM.nboi networkEntity-networkSubsystem-Management (28)};

-- Attributes**networkEntityTitles ATTRIBUTE****WITH ATTRIBUTE SYNTAX NLM.NAddresses;****MATCHES FOR EQUALITY;****BEHAVIOUR networkEntityTitles-B BEHAVIOUR****DEFINED AS** The set of Network Entity Titles

(having the same abstract syntax as an NSAP address),

which unambiguously identify the Network Entity in

an End or Intermediate System. The value may be entered by a system

management operation or it may be derived by some local means, for example

by autoconfiguration.;;

REGISTERED AS {NLM.aoi networkEntityTitles (3)};**systemTypes ATTRIBUTE****WITH ATTRIBUTE SYNTAX NLM.SystemTypes;****MATCHES FOR EQUALITY;****BEHAVIOUR systemTypes-B BEHAVIOUR****DEFINED AS** The set of system roles supported by this Network Entity.

This may be End System, Intermediate System or both. The actual

role in which a particular instance of the protocol machine

is operating is determined by the operationalSystemType attribute

of the cLNS or cONS MO.;;

REGISTERED AS {NLM.aoi systemTypes (108)};

5.5 The NSAP managed object

- There is one nSAP MO for each set of NSAPs supported by the Network Subsystem associated with a single Transport layer client.
- Each NSAP MO corresponds to a set of one or more NSAPs supported by the Network Subsystem.
- There is not more than one Transport layer client associated with a single nSAP MO, but there may be more than one nSAP MO, and corresponding sets of NSAPs, associated with a single Transport layer client.
- Its definition permits it to be created and deleted explicitly by management operation or to be created and deleted automatically as part of system operation.

nSAP MANAGED OBJECT CLASS

```

DERIVED FROM "GMI":sap2;
CHARACTERIZED BY nSAP-P PACKAGE
  BEHAVIOUR commonCreationDeletion-B;
ATTRIBUTES
  "GMI":sap2Address
    INITIAL VALUE DERIVATION RULE nAddressesIV-B
    GET;
NOTIFICATIONS
  "DMI":objectDeletion,
  "DMI":objectCreation;
;;
REGISTERED AS {NLM.moi nSAP (4)};

```

-- Behaviours

nAddressesIV-B BEHAVIOUR

DEFINED AS If the package is created using the nSAP-networkSubsystem-Automatic name binding the initial value of this attribute is not constrained by this Specification. However, if the package is created using the nSAP-networkSubsystem-Management name binding the initial value shall be specified in the CMIP create;

-- Name Bindings

nSAP-networkSubsystem-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS nSAP AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS networkSubsystem AND SUBCLASSES;
WITH ATTRIBUTE "GMI":sapId;

BEHAVIOUR nSAP-networkSubsystem-Automatic-B BEHAVIOUR

DEFINED AS This name binding shall be used when the nSAP MO is created automatically by the operation of the network entity. For example, by the use of autoconfiguration or dynamic NSAP Address assignment techniques. The details of the operation of these techniques are outside the scope of this Specification.;;

REGISTERED AS {NLM.nboi nSAP-networkSubsystem-Automatic (4)};

nSAP-networkSubsystem-Management NAME BINDING**SUBORDINATE OBJECT CLASS nSAP AND SUBCLASSES;****NAMED BY****SUPERIOR OBJECT CLASS networkSubsystem AND SUBCLASSES;****WITH ATTRIBUTE "GMI":sapId;****BEHAVIOUR nSAP-networkSubsystem-Management-B BEHAVIOUR****DEFINED AS** This name binding shall be used when the nSAP MO is created by system management.

The value of the sap2Address attribute shall be specified in the CMIP create;;

CREATE;**DELETE;****REGISTERED AS {NLM.nboi nSAP-networkSubsystem-Management (5)};**

5.6 The connectionless-mode network service managed object

- There is no more than one of these MOs per network entity.
- Its definition permits it to be created and deleted explicitly by management operation, but in some systems it will exist inherently and neither creation nor deletion by management operation will be possible. Name bindings are defined for both cases.
- When the protocol machine is operable, the operationalState shall have the value 'enabled'; otherwise it shall have the value 'disabled'.
- Transitions of operationalState shall be reported using the stateChange notification. A cLNS MO may be created in the 'enabled' operational state.

cLNS MANAGED OBJECT CLASS

```

DERIVED FROM "GMI":clProtocolMachine;
CHARACTERIZED BY cLNS-P PACKAGE
  BEHAVIOUR commonStateChange-B,
    commonCreationDeletion-B;
ATTRIBUTES
  "DMI":administrativeState GET-REPLACE,
  "GMI":clProtocolMachineId
    INITIAL VALUE NLM.cLNSId-Value
    GET,
  supportedProtocols GET,
  operationalSystemType
    INITIAL VALUE DERIVATION RULE operationalSystemTypeIV-B
    GET;
ATTRIBUTE GROUPS
  "DMI":state
    "DMI":administrativeState
    "DMI":operationalState;
ACTIONS
  "GMI":activate,
  "GMI":deactivate;
NOTIFICATIONS
  "DMI":objectCreation,
  "DMI":objectDeletion,
  "DMI":stateChange;
;;
CONDITIONAL PACKAGES
cLNS8473-P
  PRESENT IF The protocol defined in ISO 8473 is used to implement the CLNS,
cLNSChecksum-P
  PRESENT IF The ISO 8473 Generate Checksum option is implemented,

```

-- The following packages are associated with ISO/IEC 10589

"ISO/IEC 10589":cLNSISISBasic-P
 PRESENT IF The system is an ISO/IEC 10589 IS,
 "ISO/IEC 10589":cLNSISISAuthentication-P
 PRESENT IF The system is an ISO/IEC 10589 IS
 and the authentication procedures are implemented,
 "ISO/IEC 10589":cLNSISISPartitionRepair-P
 PRESENT IF The system is an ISO/IEC 10589 Level 2 IS
 and the partition repair procedures are implemented,
 "ISO/IEC 10589":cLNSISISLevel2-P
 PRESENT IF The system is an ISO/IEC 10589 Level 2 IS,
 "ISO/IEC 10589":cLNSISISLevel2Authentication-P
 PRESENT IF The system is an ISO/IEC 10589 Level 2 IS
 and the authentication procedures are implemented;
 REGISTERED AS {NLM.moi cLNS (21)};

-- Packages

cLNS8473-P PACKAGE

BEHAVIOUR cLNS8473-P-B BEHAVIOUR

DEFINED AS Present when ISO 8473 is used to provide the CLNS;,
 cLNS8473PImportedNotifications-B,
 cLNS8473PImportedCounters-B;

ATTRIBUTES

"DMI":octetsSentCounter GET,
 "DMI":octetsReceivedCounter GET,
 segmentsReceived GET,
 segmentsSent GET,
 segmentsDiscarded GET,
 assemblingSegmentsDiscarded GET,
 errorReportsReceived GET,
 pDUDiscards GET,
 congestionDiscards GET,
 maximumLifetime GET-REPLACE;

ATTRIBUTE GROUPS

"GMI":counters
 "DMI":octetsSentCounter
 "DMI":octetsReceivedCounter
 segmentsReceived
 segmentsDiscarded
 assemblingSegmentsDiscarded
 errorReportsReceived
 pDUDiscards
 congestionDiscards;

NOTIFICATIONS

"DMI":communicationsAlarm
 notificationPDUHeader;

REGISTERED AS {NLM.poi cLNS8473-P (20)};

cLNSChecksum-P PACKAGE**BEHAVIOUR cLNSChecksum-P-B BEHAVIOUR**

DEFINED AS When present checksum generation is controlled by the enableChecksum attribute;;

ATTRIBUTES

enableChecksum REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.false

GET-REPLACE;

REGISTERED AS {NLM.poi cLNSChecksum-P (1)};

-- Behaviours**cLNS8473PImportedCounters-B BEHAVIOUR**

DEFINED AS The cLNS8473-P package imports octetsSentCounter and octetsReceivedCounter from ISO/IEC 10165-2. They are used to count the number of octets of data transmitted or received by the local network entity in ISO 8473 Data PDUs. (i.e. those which have a source or destination N-Address, respectively, which corresponds to that one of those of the local network entity.)

cLNS8473PImportedNotifications-B BEHAVIOUR

DEFINED AS The cLNS8473-P package imports the communicationsAlarm notification from Rec. 721 of ISO/IEC 10165-2.

It is used to report the following cLNS managed object events.

pDUDiscard:

Generated when a data NPDU is discarded due to any of the reasons specified in ISO 8473 Table 7, with the exception of 'PDU Discarded due to Congestion'. The header of the PDU in error shall be reported as a parameter in the additionalInformation field of the communicationsAlarm, using the notificationPDUHeader parameters. The significance sub-parameter of each item of additionalInformation shall be set to the value 'False' (i.e. not significant) so that a managing system receiving the event report will be less likely to reject it. The value NLM.pDUDiscard and that corresponding to the Reason For Discard shall both be reported in the specificProblems parameter. The probableCause shall be set to NLM.communicationsProtocolError. The perceivedSeverity shall be set to 'Minor'. A subsequent communicationsAlarm with a perceivedSeverity value of 'Cleared' shall not be generated. No other fields or parameters shall be used, with the exception of further parameters in the AdditionalInformation field. A PDU which does not contain one of the protocol identifiers defined in ISO 8473 shall not cause this event. A PDU with a protocol ID 1000 0001 shall not cause this event if it does not also contain the Version/Protocol Identifier extension defined in 7.2.4 of ISO 8473. If an error report PDU is generated, the PDU header and Discard Reason in the error report shall be the same as those in the corresponding notification.

operationalSystemTypeIV-B BEHAVIOUR

DEFINED AS If the MO is created by management operation (using the cLNS-networkEntity-Management or cONS-networkEntity-Management name binding), the initial value of the operationalSystemType attribute shall be specified in the CMIP create. Otherwise, the value shall be determined in an implementation specific manner. The value shall be one of those present in the systemTypes attribute of the superior Network Entity MO.

;

-- Name Bindings**cLNS-networkEntity-Management NAME BINDING**

SUBORDINATE OBJECT CLASS cLNS AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS networkEntity AND SUBCLASSES;
WITH ATTRIBUTE "GMI":cIProtocolMachineId;

BEHAVIOUR cLNS-networkEntity-Management-B BEHAVIOUR

DEFINED AS The name binding that applies when the cLNS managed object can be created and deleted by management;;

CREATE;

DELETE ONLY-IF-NO-CONTAINED-OBJECTS;

REGISTERED AS {NLM.nboi cLNS-networkEntity-Management (3)};

cLNS-networkEntity-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS cLNS AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS networkEntity AND SUBCLASSES;
WITH ATTRIBUTE "GMI":cIProtocolMachineId;

BEHAVIOUR cLNS-networkEntity-Automatic-B BEHAVIOUR

DEFINED AS The name binding that applies when the cLNS managed object cannot be created or deleted by management;;

REGISTERED AS {NLM.nboi cLNS-networkEntity-Automatic (16)};

-- Attributes**assemblingSegmentsDiscarded ATTRIBUTE**

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR assemblingSegmentsDiscarded-B BEHAVIOUR

DEFINED AS Counter of segments discarded due to reassembly time expiry.

This is the number of data and error report NPDUs discarded due to reassembly time expiry;;

REGISTERED AS {NLM.aoi assemblingSegmentsDiscarded (8)};

congestionDiscards ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR congestionDiscards-B BEHAVIOUR

DEFINED AS Counter of PDUs discarded due to congestion.

This is the number of data or error report PDUs discarded due to congestion.

This counter is incremented irrespective of the setting of the Error Report bit in the received PDU;;

REGISTERED AS {NLM.aoi congestionDiscards (11)};

enableChecksum ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR enableChecksum-B BEHAVIOUR

DEFINED AS When True, the generation of checksums is enabled.;;

REGISTERED AS {NLM.aoi enableChecksum (4)};

errorReportsReceived ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR errorReportsReceived-B BEHAVIOUR

DEFINED AS Counter of received error reports.

This is the number of error report NPDUs received which were addressed to the local network entity.;;

REGISTERED AS {NLM.aoi errorReportsReceived (9)};

maximumLifetime ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.Lifetime;

MATCHES FOR EQUALITY, ORDERING;

BEHAVIOUR maximumLifetime-B BEHAVIOUR

DEFINED AS Maximum PDU lifetime (in half seconds).

This attribute controls the maximum value (in half seconds) which may be placed in the lifetime field of any ISO 8473 data or error report PDU generated by the local network entity. It does not affect the lifetime field of any PDUs not generated by this network entity, for example those relayed by this system acting as an Intermediate System. PDUs generated by the local network entity are permitted to have a lower value of lifetime field than this attribute, but shall not have a larger value. The means by which the value of the lifetime field is determined for an individual PDU is outside the scope of this Specification, provided that it meets the above constraints.;;

REGISTERED AS {NLM.aoi maximumLifetime (102)};

operationalSystemType ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.SystemType;

MATCHES FOR EQUALITY;

BEHAVIOUR operationalSystemType-B BEHAVIOUR

DEFINED AS The system role in which this instance is operating.

A value of ES indicates that the system

shall perform no forwarding operations upon non-local PDUs.

A value of IS indicates that the system is permitted to perform

forwarding operations, but the decision to forward individual PDUs,

or not to forward them, shall be taken on the basis of the available

routing information.;;

REGISTERED AS {NLM.aoi operationalSystemType (109)};

pDUDiscards ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR pDUDiscards-B BEHAVIOUR

DEFINED AS Counter of PDUs discarded (except for congestion).

This is the number of data or error report PDUs discarded for any of the reasons specified in ISO 8473 Table 7 with the exception of 'PDU discarded due to congestion'.

This counter is incremented irrespective of the setting of the Error Report bit in the received PDU;;

-- Note: this counter is therefore a count of the number of

-- communicationsAlarm notifications with a specificProblem value of

-- pDUDiscard generated (as opposed to CMIP events,

-- may be suppressed) as required by GDMO 9.8.5.

REGISTERED AS {NLM.aoi pDUDiscards (10)};

segmentsDiscarded ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR segmentsDiscarded-B BEHAVIOUR

DEFINED AS Counter of segments discarded.

This is the number of data and error report NPDUs discarded without being delivered to a Network Service user or forwarded. This includes segments discarded for any reason except reassembly time expiry;;

REGISTERED AS {NLM.aoi segmentsDiscarded (7)};

segmentsReceived ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR segmentsReceived-B BEHAVIOUR

DEFINED AS Counter of segments received.

This is the number of data and error report NPDUs received prior to reassembly, including those which may subsequently be discarded;;

REGISTERED AS {NLM.aoi segmentsReceived (6)};

segmentsSent ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR segmentsSent-B BEHAVIOUR

DEFINED AS Counter of segments Sent.

This is the number of data and error report NPDUs sent after segmentation processing occurs;;

REGISTERED AS {NLM.aoi segmentsSent (118)};

supportedProtocols ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.SupportedProtocols;

MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;

BEHAVIOUR supportedProtocols-B BEHAVIOUR

DEFINED AS The set of Connectionless Network protocols supported

by this instance of the cLNS protocol machine, expressed except

where otherwise indicated (for example because there are more than one protocol described in a single International Standard)

as the registered object identifiers of the relevant

International Standard. The operation of a particular protocol

over a particular linkage is determined by the linkage

operationalProtocols attribute. The value of the

supportedProtocols attribute is determined by the implementation.;;

REGISTERED AS {NLM.aoi supportedProtocols (110)};

-- Parameters

notificationPDUHeader PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX NLM.OctetString;

BEHAVIOUR notificationPDUHeader-B BEHAVIOUR

DEFINED AS The header of the data NPDU header which caused this event;;

REGISTERED AS {NLM.proi notificationPDUHeader (1)};

5.7 The linkage managed object

- Linkage Managed Object
-
- There is one of these MOs associated with each separate provision
- of the underlying service to the superior protocol machine.
- Its definition permits it to be created and deleted explicitly by
- management operation, but in some systems it will exist inherently
- and neither creation nor deletion by management operation will be
- possible. Name bindings are defined for both cases.
-
- When the linkage is operable, the operationalState shall
- have the value 'enabled'; otherwise it shall have the value 'disabled'.
- Transitions of operationalState shall be reported using the
- stateChange notification. An linkage MO may be created in the
- 'enabled' operational state.
-

linkage MANAGED OBJECT CLASS

DERIVED FROM "DMI":top;

CHARACTERIZED BY linkage-P PACKAGE

BEHAVIOUR commonCreationDeletion-B,
commonStateChange-B;

ATTRIBUTES

linkageId GET,

"DMI":operationalState GET,

"DMI":administrativeState GET-REPLACE,

sN-ServiceProvider

INITIAL VALUE DERIVATION RULE sN-ServiceProviderIV-B
GET,

sN-SAP GET,

operationalProtocols

INITIAL VALUE DERIVATION RULE operationalProtocolIV-B
GET;

ATTRIBUTE GROUPS

"DMI":state

"DMI":administrativeState

"DMI":operationalState;

ACTIONS

"GMI":activate,

"GMI":deactivate;

NOTIFICATIONS

"DMI":stateChange,

"DMI":objectCreation,

"DMI":objectDeletion;

::

CONDITIONAL PACKAGES

linkage-ISO9542IS-P

PRESENT IF support for ISO 9542 operating as an IS,

linkage-ISO9542ES-P

PRESENT IF support for ISO 9542 operating as an ES,

linkage-ISO9542Checksum-P

PRESENT IF support for ISO 9542 PDU Header Checksum Generation function,

linkageInitialMinimumTimer-P

PRESENT IF support for the initial minimum timer attribute of the ISO 8473
SND CF when operating ISO 8473 over an ISO/IEC 8208 or
CO Datalink Service,

linkageReserveTimer-P

PRESENT IF support for the reserve timer attribute of the ISO 8473 SND CF
when operating ISO 8473 over an ISO/IEC 8208 or
CO Datalink Service,

linkageIdleTimer-P

PRESENT IF support for the idle timer attribute of the ISO 8473 SND CF
when operating ISO 8473 over an ISO/IEC 8208 or
CO Datalink Service,

linkage-ISO8473-ISO8208SND CF-P

PRESENT IF operating ISO 8473 over ISO/IEC 8208 ,

linkageCODLService-P

PRESENT IF operating ISO 8473 over the CO Datalink Service,

-- The following packages are associated with ISO/IEC 10589

"ISO/IEC 10589":linkageISISBasic-P

PRESENT IF the system is an ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISAuthentication-P

PRESENT IF the authentication procedures are implemented
on an ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISBroadcast-P

PRESENT IF the linkage is a broadcast circuit
on an ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISDACAIEstablishmentMetricIncrement-P

PRESENT IF the linkage is a DA Circuit and support is implemented for
call establishment metric increment values greater than zero on an
ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISPtToPt-P

PRESENT IF the linkage is a point to point circuit
on an ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISStatic-P

PRESENT IF the linkage is an X.25 static circuit (IN or OUT)
on an ISO/IEC 10589 IS,

"ISO/IEC 10589":linkageISISLevel2-P

PRESENT IF the system is an ISO/IEC 10589 level 2 IS,

"ISO/IEC 10589":linkageISISlevel2Broadcast-P

PRESENT IF the linkage is a broadcast circuit on an ISO/IEC 10589 level 2 IS;

REGISTERED AS {NLM.moi linkage (23)};

-- Packages

linkageCODLService-P PACKAGE

BEHAVIOUR linkageCODLService-P-B BEHAVIOUR

DEFINED AS Controls the operation of CO Datalink as an SND CF for ISO 8473;;

ATTRIBUTES

callsPlaced GET,

callsFailed GET;

ATTRIBUTE GROUPS

"GMI":counters

callsPlaced

callsFailed;

REGISTERED AS {NLM.poi linkageCODLService-P (9)};

linkageIdleTimer-P PACKAGE**BEHAVIOUR linkageIdleTimer-P-B BEHAVIOUR**

DEFINED AS Controls the ability, when implemented, of an ISO/IEC 8208 or CO Datalink SNDCF for ISO 8473 to close an established Virtual Call when it is idle. ;;

ATTRIBUTES

idleTimer REPLACE-WITH-DEFAULT

GET-REPLACE;

REGISTERED AS {NLM.poi linkageIdleTimer-P (5)};

linkageInitialMinimumTimer-P PACKAGE**BEHAVIOUR linkageInitialMinimumTimer-P-B BEHAVIOUR**

DEFINED AS Controls the ability, when implemented, of an ISO/IEC 8208 or CO Datalink SNDCF for ISO 8473 to close an established Virtual Call when it is idle, but only after a minimum time after its establishment;;

ATTRIBUTES

initialMinimumTimer REPLACE-WITH-DEFAULT

GET-REPLACE;

REGISTERED AS {NLM.poi linkageInitialMinimumTimer-P (7)};

linkage-ISO8473-ISO8208SNDCF-P PACKAGE**BEHAVIOUR linkage-ISO8473-ISO8208SNDCF-P-B BEHAVIOUR**

DEFINED AS Controls the operation of ISO/IEC 8208 as an SNDCF for ISO 8473;;

ATTRIBUTES

callsPlaced GET,

callsFailed GET;

ATTRIBUTE GROUPS

"GMI":counters

callsPlaced

callsFailed;

REGISTERED AS {NLM.poi linkage-ISO8473-ISO8208SNDCF-P (4)};

linkage-ISO9542Checksum-P PACKAGE**BEHAVIOUR linkage-ISO9542Checksum-P-B BEHAVIOUR**

DEFINED AS When present, checksum generation is controlled by the enableChecksum attribute;;

ATTRIBUTES

enableChecksum REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.false

GET-REPLACE;

REGISTERED AS {NLM.poi linkage-ISO9542Checksum-P(17)};

linkage-ISO9542ES-P PACKAGE**BEHAVIOUR****linkage-ISO9542ES-P-B BEHAVIOUR**

DEFINED AS Controls the operation of ISO 9542 on an End System;;

linkage-ISO9542ImportedAlarmNotifications-B,

linkage-ISO9542ISReachabilityChange-B,

linkage-ISO9542ESReachabilityChange-B;

ATTRIBUTES

iSO9542OperationalSubsets GET-REPLACE,

holdingTimerMultiplier

REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.holdingTimerMultiplierDefault

PERMITTED VALUES NLM.HoldingTimerMultiplierPermitted

REQUIRED VALUES NLM.HoldingTimerMultiplierRequired

GET-REPLACE,

manualISSNPAAddress REPLACE-WITH-DEFAULT

GET-REPLACE ADD-REMOVE,

defaultESConfigTimer REPLACE-WITH-DEFAULT

GET-REPLACE,

activeESConfigTimer GET,

iSReachabilityChanges GET,

invalid9542PDUs GET;

ATTRIBUTE GROUPS

"GMI":counters

iSReachabilityChanges

invalid9542PDUs;

NOTIFICATIONS

"DMI":communicationsAlarm,

"GMI":communicationsInformation

reachabilityChange;

REGISTERED AS {NLM.poi linkage-ISO9542ES-P (21)};

linkage-ISO9542IS-P PACKAGE

BEHAVIOUR linkage-ISO9542IS-P-B BEHAVIOUR

DEFINED AS Controls the operation of ISO 9542 on an Intermediate System,;

linkage-ISO9542ImportedAlarmNotifications-B,

linkage-ISO9542ISReachabilityChange-B,

linkage-ISO9542ESReachabilityChange-B;

ATTRIBUTES

iSO9542OperationalSubsets GET-REPLACE,

holdingTimerMultiplier

REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.holdingTimerMultiplierDefault

PERMITTED VALUES NLM.HoldingTimerMultiplierPermitted

REQUIRED VALUES NLM.HoldingTimerMultiplierRequired

GET-REPLACE,

iSConfigurationTimer REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.iSConfigurationTimerDefault

GET-REPLACE,

suggestedESConfigurationTimer REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.suggestedESConfigurationTimerDefault

GET-REPLACE,

redirectHoldingTime

REPLACE-WITH-DEFAULT

DEFAULT VALUE NLM.redirectHoldingTime-Default

PERMITTED VALUES NLM.RedirectHoldingTime-Permitted

GET-REPLACE,

eSReachabilityChanges GET,
invalid9542PDUs GET;

ATTRIBUTE GROUPS

"GMI":counters
eSReachabilityChanges
invalid9542PDUs;

NOTIFICATIONS

"DMI":communicationsAlarm,
"GMI":communicationsInformation
reachabilityChange;

REGISTERED AS {NLM.poi linkage-ISO9542IS-P (22)};

linkageReserveTimer-P PACKAGE

BEHAVIOUR linkageReserveTimer-P-B BEHAVIOUR

DEFINED AS Controls the ability, when implemented, of an ISO/IEC 8208 or CO Datalink SND CF for ISO 8473 to close an established Virtual Call when it is idle, but retain resources for its re-establishment ;;

ATTRIBUTES

reserveTimer REPLACE-WITH-DEFAULT
GET-REPLACE;

REGISTERED AS {NLM.poi linkageReserveTimer-P (6)};

-- Behaviours

linkage-ISO9542ISReachabilityChange-B BEHAVIOUR

DEFINED AS

This package imports the communicationsInformation notification from Rec. X.723 | ISO/IEC 10165-5.
It is used to report the following events.

iSReachabilityChange:

Generated when an ES or IS detects a change in the reachability of a neighboring IS.
The value NLM.iSReachabilityChange shall be reported in the informationType field.
The new State, NET of the IS concerned, snpaAddress (where available) and the reason for the change shall be reported in the informationData field using the reachabilityChange PARAMETER.

;

linkage-ISO9542ESReachabilityChange-B BEHAVIOUR

DEFINED AS

This package imports the communicationsInformation notification from Rec. X.723 | ISO/IEC 10165-5.
It is used to report the following events.

eSReachabilityChange:

Generated when an ES or IS detects a change in the reachability of a neighboring ES.
The value NLM.eSReachabilityChange shall be reported in the informationType field.
The new State, set of NSAPAddresses of the IS concerned, the snpaAddress (where available) and the reason for the change shall be reported in the informationData field using the reachabilityChange PARAMETER.

linkage-ISO9542ImportedAlarmNotifications-B BEHAVIOUR

DEFINED AS This package imports the communicationsAlarm notification from Rec. X.721 (1992) | ISO/IEC 10165-2.
It is used to report the following events.

invalid9542PDU:

Generated when an ISO 9542 PDU is received which is discarded as result of the PDU Header Error Detection or Protocol Error Processing Functions specified in ISO 9542.
The significance sub-parameter of each item of additionalInformation shall be set to the value 'False' (i.e. not significant) so that a managing system receiving the event report will be less likely to reject it.
The value NLM.iISO9542PDUDiscard shall be reported in the specificProblems parameter.
The probableCause shall be set to NLM.communicationsProtocolError.
The perceivedSeverity shall be set to 'Minor'. A subsequent communicationsAlarm with a perceivedSeverity value of 'Cleared' shall not be generated.
No other fields or parameters shall be used, with the exception of further parameters in the AdditionalInformation field.

operationalProtocolIV-B BEHAVIOUR

DEFINED AS If the linkage MO is created by management operation (using the linkage-cLNS-Management name binding), the initial value of the operationalProtocols attribute shall be specified in the CMIP create.
Otherwise, the value shall be determined in an implementation specific manner;

sN-ServiceProviderIV-B BEHAVIOUR

DEFINED AS If the linkage MO is created by management operation (using the linkage-cONS-Management or linkage-cONS-Management name bindings), the initial value of the sN-ServiceProvider attribute shall be specified in the CMIP create.
Otherwise, the value shall be determined in an implementation specific manner;

-- Name Bindings**linkage-cLNS-Management NAME BINDING**

SUBORDINATE OBJECT CLASS linkage AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS cLNS AND SUBCLASSES;
WITH ATTRIBUTE linkageId;

BEHAVIOUR sN-ServiceProviderIV-B, operationalProtocolIV-B,
linkage-cLNS-Management-B BEHAVIOUR

DEFINED AS The name binding which applies when the linkage managed object
can be created and deleted by management as a subordinate object of the cLNS
managed object class;;

CREATE WITH-REFERENCE-OBJECT;

DELETE;

REGISTERED AS {NLM.nboi linkage-cLNS-Management (20)};

linkage-cONS-Management NAME BINDING

SUBORDINATE OBJECT CLASS linkage AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS cONS AND SUBCLASSES;
WITH ATTRIBUTE linkageId;

BEHAVIOUR sN-ServiceProviderIV-B,
linkage-cONS-Management-B BEHAVIOUR

DEFINED AS The name binding which applies when the linkage managed object
can be created and deleted by management as a subordinate object of the cONS
managed object class;;

CREATE WITH-REFERENCE-OBJECT;

DELETE;

REGISTERED AS {NLM.nboi linkage-cONS-Management (21)};

linkage-cLNS-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS linkage AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS cLNS AND SUBCLASSES;
WITH ATTRIBUTE linkageId;

BEHAVIOUR sN-ServiceProviderIV-B, operationalProtocolIV-B,
linkage-cLNS-Automatic-B BEHAVIOUR

DEFINED AS The name binding which applies when the linkage managed object
can not be created and deleted by management as a subordinate object of the cLNS
managed object class;;

REGISTERED AS {NLM.nboi linkage-cLNS-Automatic (22)};

linkage-cONS-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS linkage AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS cONS AND SUBCLASSES;
WITH ATTRIBUTE linkageId;

BEHAVIOUR sN-ServiceProviderIV-B,
linkage-cONS-Automatic-B BEHAVIOUR

DEFINED AS The name binding which applies when the linkage managed object
can not be created and deleted by management as a subordinate object of the cONS
managed object class;;

REGISTERED AS {NLM.nboi linkage-cONS-Automatic (23)};

-- Attributes**activeESConfigTimer ATTRIBUTE**

DERIVED FROM "GMI":timer;

BEHAVIOUR activeESConfigTimer-B BEHAVIOUR

DEFINED AS Currently active value for the ISO 9542 ES configuration timer
in seconds.;;

REGISTERED AS {NLM.aoi activeESConfigTimer (22)};

callsFailed ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR callsFailed-B BEHAVIOUR

DEFINED AS Counter of the number of X.25 call failures
while attempting establishment by the SND CF;;

REGISTERED AS {NLM.aoi callsFailed (30)};

callsPlaced ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR callsPlaced-B BEHAVIOUR

DEFINED AS Counter of the number of X.25 VCs successfully established
by the SND CF;;

REGISTERED AS {NLM.aoi callsPlaced (29)};

defaultESConfigTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR resettingTimer-B, defaultESConfigTimer-B BEHAVIOUR

DEFINED AS Default value for the ISO 9542 ES configuration timer
in seconds. This value is used when the ES has not received,
or has not chosen to accept, a suggested configuration timer
value from an Intermediate System;;

REGISTERED AS {NLM.aoi defaultESConfigTimer (21)};

eSReachabilityChanges ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR eSReachabilityChanges-B BEHAVIOUR

DEFINED AS Count of the number of changes in reachability of End Systems
from this system;;

REGISTERED AS {NLM.aoi eSReachabilityChanges (27)};

holdingTimerMultiplier ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.Integer;

BEHAVIOUR holdingTimerMultiplier-B BEHAVIOUR

DEFINED AS The factor to derive holding timer from configuration timer.

This value, when multiplied by a configuration timer yields the value of
the holding timer parameter issued with configuration information. The semantics of
this parameter are such that it is permissible to also add a delta value to the result to
compensate for possible delays and imprecision of timers. The result of the calculation
is truncated, upon overflow, to the maximum value for the parameter permitted by the
protocol (65535);;

REGISTERED AS {NLM.aoi holdingTimerMultiplier (20)};

idleTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR idleTimer-B BEHAVIOUR

DEFINED AS Time in seconds before release of an idle call.

This timer determines the interval (in seconds) for which a call is permitted to remain idle (i.e. no data traffic in either direction) before being released by the SNDCF;;

REGISTERED AS {NLM.aoi idleTimer (31)};

initialMinimumTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR initialMinimumTimer-B BEHAVIOUR

DEFINED AS Minimum time in seconds to retain call after establishment.

This timer determines the interval (in seconds) that a call shall remain connected after being established, irrespective of traffic. (Note. This should be set small enough so that the call is cleared before the start of the next charging interval.);

REGISTERED AS {NLM.aoi initialMinimumTimer (33)};

invalid9542PDUs ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR invalid9542PDUs-B BEHAVIOUR

DEFINED AS Counter of invalid 9542 PDUs received.

This is the number of ISO 9542 PDUs received which are discarded as result of the PDU Header Error Detection or Protocol Error Processing Functions specified in ISO 9542;;

-- Note: this counter is therefore a count of the number of

-- communicationsAlarm notifications with a specificProblem value of

-- NLM.iSO9542PDUDiscard generated.

REGISTERED AS {NLM.aoi invalid9542PDUs (101)};

iSConfigurationTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR resettingTimer-B, iSConfigurationTimer-B BEHAVIOUR

DEFINED AS Value in seconds for the ISO 9542 IS configuration timer.

It is used to determine how often an IS reports configuration information to ESs;;

REGISTERED AS {NLM.aoi iSConfigurationTimer (24)};

iSO9542OperationalSubsets ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.ISO9542Subsets;

MATCHES FOR EQUALITY;

BEHAVIOUR iSO9542OperationalSubsets-B BEHAVIOUR

DEFINED AS The set of ISO 9542 subsets operational on this linkage;;

REGISTERED AS {NLM.aoi iSO9542OperationalSubsets (115)};

iSReachabilityChanges ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR iSReachabilityChanges-B BEHAVIOUR

DEFINED AS Counter of the number of changes in reachability of Intermediate Systems from this system;;

REGISTERED AS {NLM.aoi iSReachabilityChanges (23)};

linkageId ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.GraphicString;

MATCHES FOR EQUALITY, SUBSTRINGS;

BEHAVIOUR linkageId-B BEHAVIOUR

DEFINED AS The naming attribute of the linkage MO instance;;

REGISTERED AS {NLM.aoi linkageId (17)};

manualISSNPAAddress ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.ManualISSNPAAddress;

MATCHES FOR SET-COMPARISON, SET-INTERSECTION;

BEHAVIOUR manualISSNPAAddress-B BEHAVIOUR

DEFINED AS The set of SNPA Addresses to which calls associated with the SND CF are to be established in the absence of any other information. The maximum set cardinality shall be implementation specific. An attempt to set the value of an element of this set to a type of SNPAAddress which is not supported by this linkage shall result in a failure of the SET operation.;;

REGISTERED AS {NLM.aoi manualISSNPAAddress (28)};

operationalProtocols ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.SupportedProtocols;

MATCHES FOR EQUALITY, SET-COMPARISON, SET-INTERSECTION;

BEHAVIOUR operationalProtocols-B BEHAVIOUR

DEFINED AS The set of network layer protocols supported by this instance of the linkage MO, expressed as the registered object identifiers of the relevant International Standard.;;

REGISTERED AS {NLM.aoi operationalProtocols (111)};

redirectHoldingTime ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.RedirectHoldingTime;

MATCHES FOR EQUALITY, ORDERING;

BEHAVIOUR redirectHoldingTime-B BEHAVIOUR

DEFINED AS The holding time (in seconds) to be specified in Redirect PDUs generated by this system.;;

REGISTERED AS {NLM.aoi redirectHoldingTime (26)};

reserveTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR reserveTimer-B BEHAVIOUR

DEFINED AS Time in seconds to reserve resources for call re-establishment.

This timer determines the interval (in seconds) for which an attempt shall be made to retain those resources, as determined by the implementation, whose retention will increase the probability of successful re-establishment of an idled VC.;;

REGISTERED AS {NLM.aoi reserveTimer (32)};

sN-SAP ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.LocalDistinguishedName;

MATCHES FOR EQUALITY;

BEHAVIOUR sN-SAP-B BEHAVIOUR

DEFINED AS Distinguished name of the service provider SAP MO
(if present).

This is obtained via an internal interface when the linkage is enabled. The sN-SAP may be a relationship to a SAP MO in the Datalink Layer, or it may be a relationship to another Managed Object within the Network Layer which is not a SAP MO.

For example, when operating ISO 8473 over the ISO/IEC 8208 SNDCF, it is a relationship to the same x25PLE-DTE MO which is pointed to by the sN-ServiceProvider Attribute. ;;

REGISTERED AS {NLM.aoi sN-SAP (18)};

sN-ServiceProvider ATTRIBUTE

WITH ATTRIBUTE SYNTAX NLM.LocalDistinguishedName;

MATCHES FOR EQUALITY;

BEHAVIOUR sN-ServiceProvider-B BEHAVIOUR

DEFINED AS Distinguished name of the SN service provider MO.

This attribute identifies the subnetwork entity to be used to support the linkage, when enabled. The subnetwork service provider may be in the Datalink Layer, or it may be in the Network Layer

(for example when operating ISO 8473 over the ISO/IEC 8208 SNDCF).;;

REGISTERED AS {NLM.aoi sN-ServiceProvider (19)};

suggestedESConfigurationTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR resettingTimer-B, suggestedESConfigurationTimer-B BEHAVIOUR

DEFINED AS Value to be used for the ISO 9542 suggested ES configuration timer value (in seconds),

advertised in IS hellos generated by this network entity;;

REGISTERED AS {NLM.aoi suggestedESConfigurationTimer (25)};

-- Parameters**reachabilityChange PARAMETER**

CONTEXT EVENT-INFO;

WITH SYNTAX NLM.ReachabilityChangeSyntax;

REGISTERED AS {NLM.proi reachabilityChange (12)};

5.8 The connection-mode network service managed object

-- There is no more than one of these MOs per network entity.
 -- Its definition permits it to be created and deleted explicitly by
 -- management operation, but in some systems it will exist inherently
 -- and neither creation nor deletion by management operation will be
 -- possible. Name bindings are defined for both cases.

-- When the protocol machine is operable, the operationalState shall
 -- have the value 'enabled'; otherwise it shall have the value 'disabled'.
 -- Transitions of operationalState shall be reported using the
 -- stateChange notification. A cONS MO may be created in the
 -- 'enabled' operational state.

cONS MANAGED OBJECT CLASS

DERIVED FROM "GMI":coProtocolMachine;

CHARACTERIZED BY cONS-P PACKAGE

BEHAVIOUR commonStateChange-B,
 commonCreationDeletion-B;

ATTRIBUTES

"DMI":administrativeState GET-REPLACE,

"GMI":coProtocolMachineId

INITIAL VALUE NLM.cONSId-Value

GET,

operationalSystemType

INITIAL VALUE DERIVATION RULE operationalSystemTypeIV-B

GET;

ATTRIBUTE GROUPS

"DMI":state

"DMI":administrativeState

"DMI":operationalState;

ACTIONS

"GMI":activate,

"GMI":deactivate,

"GMI":deactivateWhenNoUsers;

NOTIFICATIONS

"DMI":objectCreation,

"DMI":objectDeletion,

"DMI":stateChange;

::

REGISTERED AS {NLM.moi cONS (24)};

-- Name Bindings**cONS-networkEntity-Management NAME BINDING**

SUBORDINATE OBJECT CLASS cONS AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS networkEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":coProtocolMachineId;

BEHAVIOUR cONS-networkEntity-Management-B BEHAVIOUR

DEFINED AS The name binding that applies when the cONS managed object
can be created and deleted by management;;

CREATE;

DELETE ONLY-IF-NO-CONTAINED-OBJECTS;

REGISTERED AS {NLM.nboi cONS-networkEntity-Management (8)};

cONS-networkEntity-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS cONS AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS networkEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":coProtocolMachineId;

BEHAVIOUR cONS-networkEntity-Automatic-B BEHAVIOUR

DEFINED AS The name binding that applies when the cONS managed object
cannot be created or deleted by management;;

REGISTERED AS {NLM.nboi cONS-networkEntity-Automatic (17)};

5.9 The network connection managed object

There is one instance of this MO corresponding to each network connection. It is created and deleted by the operation of the protocol machine.

In some configurations the underlyingConnectionNames attribute may contain more than one distinguished name. In this case, the type of the underlying MO (and hence the particular underlying resource) can only be determined by inspection of the MO pointed to by this distinguished name.

networkConnection MANAGED OBJECT CLASS

DERIVED FROM "GMI":singlePeerConnection;

CHARACTERIZED BY networkConnection-P PACKAGE

BEHAVIOUR

commonCreationDeletion-B,

successfulConnectionEstablishment-B,

deactivateConnection-B,

networkConnection-P-B BEHAVIOUR

DEFINED AS The "GMI":underlyingConnectionNames

attribute shall contain the distinguished name(s) of the other MO(s) which represent the resources used to support this connection. In the case of the CONS operating directly over X.25, this shall be the single distinguished name of the underlying virtual call or permanent virtual circuit MO;;

ATTRIBUTES

localNSAPMO GET,

remoteNSAPAddress GET;

ACTIONS

"GMI":deactivate;

NOTIFICATIONS

"DMI":objectCreation,

"DMI":objectDeletion,

"GMI":communicationsInformation;

;;

REGISTERED AS {NLM.moi networkConnection (13)};

-- Name Bindings

networkConnection-cONS NAME BINDING

SUBORDINATE OBJECT CLASS networkConnection AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS cONS AND SUBCLASSES;

WITH ATTRIBUTE "GMI":connectionId;

DELETE;

REGISTERED AS {NLM.nboi networkConnection-cONS (19)};