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

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*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*



Reference number  
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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.

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# 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.

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## 2 Normative references

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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.700<sup>1</sup>, *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.*

<sup>1</sup>Presently 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 routing 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 routing 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 routing 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

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### 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.

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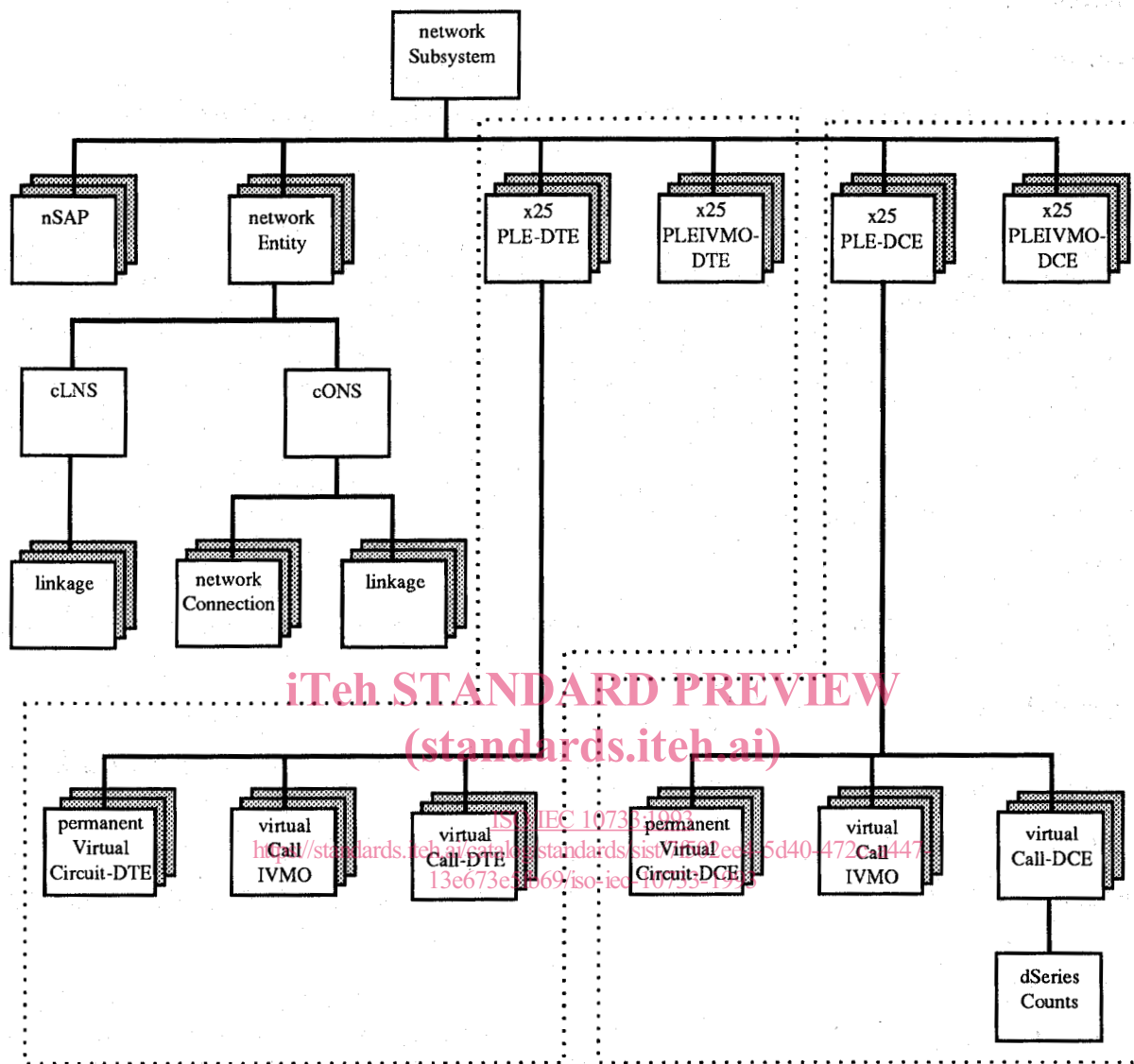


Figure 1 - Network Layer Containment Hierarchy

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.

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## 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;

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