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INTERNATIONAL TELECOMMUNICATION UNION

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STANDARDIZATION SECTOR
OF ITU

X.284

(07/94)

**DATA NETWORKS AND OPEN SYSTEM
COMMUNICATIONS**

**OPEN SYSTEMS INTERCONNECTION –
LAYER MANAGED OBJECTS**

**ELEMENTS OF MANAGEMENT INFORMATION
RELATED TO THE OSI TRANSPORT LAYER**

ITU-T Recommendation X.284

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(Previously “CCITT Recommendation”)

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FOREWORD

The ITU-T (Telecommunication Standardization Sector) is a permanent organ of the International Telecommunication Union (ITU). The ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T Study Groups which, in their turn, produce Recommendations on these topics.

The approval of Recommendations by the Members of the ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, March 1-12, 1993).

ITU-T Recommendation X.284 was prepared by ITU-T Study Group 7 (1993-1996) and was approved under the WTSC Resolution No. 1 procedure on the 1st of July 1994.

NOTE

In this Recommendation, the expression “Administration” is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

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DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS
(February 1994)
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SUMMARY

This Recommendation provides the specification of management information related to the Transport layer, including the managed object class definition of Transport layer managed objects, 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 allowable actions on the attributes of Transport layer managed objects.

INTRODUCTION

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

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

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Recommendation X.284

ELEMENTS OF MANAGEMENT INFORMATION RELATED TO THE OSI TRANSPORT LAYER¹⁾

(Geneva, 1994)

1 Scope

This Recommendation provides the specification of management information within an Open System related to those operations of the OSI Transport Layer specified by ITU-T Recommendations and ISO/IEC International Standards. Specifics on how Transport Layer management is accomplished is beyond the scope of this document. Transport Layer management information is defined by specifying:

- the managed object class definition of Transport Layer Managed Objects following guidelines put forth by the *Structure of Management Information* (ITU-T Recommendations X.720-X.723 and ISO/IEC 10165);
- the relationship of the Managed Objects and attributes to both the operation of the layer and to other objects and attributes of the layer; and
- the action type operations on the attributes of Transport Layer Managed Objects that are available to OSI Systems Management.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and Standards are subject to revision, and parties to agreements based on this Recommendation 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 Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model*.
- ITU-T Recommendation X.214 (1993) | ISO/IEC 8072:1993, *Information technology – Open Systems Interconnection – Transport service definition*.
- ITU-T Recommendation X.234 (1994) | ISO/IEC 8602:1994, *Information technology – Protocol for providing the OSI connectionless-mode transport service*.
- CCITT Recommendation X.701 (1992) | ISO/IEC 10040:1992, *Information technology – Open Systems Interconnection – Systems management overview plus Technical corrigendum 1* (1994).
- CCITT Recommendation X.720 (1992) | ISO/IEC 10165-1:1993, *Information technology – Open Systems Interconnection – Structure of management information: Management information model plus Technical corrigendum 1* (1994).
- CCITT Recommendation X.721 (1992) | ISO/IEC 10165-2:1992, *Information technology – Open Systems Interconnection – Structure of management information: Definition of management information plus Technical corrigendum 1* (1994).

¹⁾ This Recommendation was developed in collaboration with ISO/IEC and is technically identical to ISO/IEC 10737:1994, *Information technology – Telecommunications and Information Exchange Between Systems – Elements of Management Information Related to OSI Transport Layer Standards*.

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- CCITT Recommendation X.722 (1992) | ISO/IEC 10165-4:1992, *Information technology – Open Systems Interconnection – Structure of management information: Guidelines for the definition of managed objects*.
- ITU-T Recommendation X.723 (1993) | ISO/IEC 10165-5:1993, *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 plus Technical corrigendum 1 (1994)*.
- CCITT Recommendation X.734 (1992) | ISO/IEC 10164-5:1993, *Information technology – Open Systems Interconnection – Systems Management: Event report management function plus Technical corrigendum 1 (1994)*.

2.2 Paired Recommendations | International Standards equivalent in technical content

- CCITT Recommendation X.208 (1988), *Specification of Abstract Syntax Notation One (ASN.1)*.
ISO/IEC 8824:1990, *Information technology – Open Systems Interconnection – Specification of Abstract Syntax Notation One (ASN.1)*.
- ITU-T Recommendation X.224 (1993), *Protocol for providing the OSI connection-mode transport service*.
ISO/IEC 8073:1992, *Information technology – Open Systems Interconnection – Protocol for Providing the OSI connection-mode transport service*.
- CCITT Recommendation X.700 (1992), *Management Framework for Open Systems Interconnection (OSI) 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 service protocol specification – Part 1: Specification*.

3 Definitions

3.1 Basic reference model

This Recommendation makes use of the following terms defined in ITU-T Rec. X.200 | ISO/IEC 7498-1:

- Open System;
- (N)-service-access-point;
- Transport Layer;
- Transport Protocol;
- Layer Management;
- Systems management.

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3.2 Information model

This Recommendation makes use of the following terms defined in CCITT Rec. X.720 | ISO/IEC 10165-1:

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

3.3 GDMO

This Recommendation makes use of the following terms defined in CCITT Rec. X.722 | ISO/IEC 10165-4:

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

3.4 Management Framework

This Recommendation makes use of the following term defined in CCITT Rec. X.700 | ISO/IEC 7498-4:

- Management Information.

4 Abbreviations

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

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

This Recommendation makes use of the following abbreviations:

AK TPDU	Data Acknowledge TPDU
CMIP	Common Management Information Protocol
CMIS	Common Management Information Service
DR TPDU	Disconnect Request TPDU
EA TPDU	Expedited Acknowledge TPDU
ED TPDU	Expedited Data TPDU
ER TPDU	Error TPDU
GDMO	Guidelines for Definition of MOs
IVMO	Initial Values Managed Object
MO	Managed Object
OSI	Open Systems Interconnection

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PM	Protocol Machine
RDN	Relative Distinguished Name
TC	Transport Connection
TPDU	Transport Protocol Data Unit
TSAP	Transport Service Access Point

5 Elements of Transport Layer Management Information

5.1 Managed Object Hierarchy

5.1.1 Summary of managed objects

The following set of managed objects are defined for the Transport Layer:

- Transport Subsystem Managed Object (transportSubsystem, see 5.3);
- Transport Entity Managed Object (transportEntity, see 5.4);
- Connectionless Transport Protocol Machine Managed Object (clmodeTPM, see 5.5);
- Connection-Oriented Transport Protocol Machine Managed Object (comodeTPM, see 5.6);
- Transport SAP Managed Object (tSAP, see 5.7);
- Transport Connection Managed Object (transportConnection, see 5.8.1);
- Transport Connection Initial Values Managed Object (transportConnectionIVMO, see 5.8.2).

These Managed Objects represent OSI Management's view of those elements of an Open System which support the OSI Transport Service subject to OSI management operations. The containment hierarchy is illustrated in Figure 1. Managed Objects which can have multiple instances are illustrated by multiple boxes. These objects are defined in detail in the following subclauses.

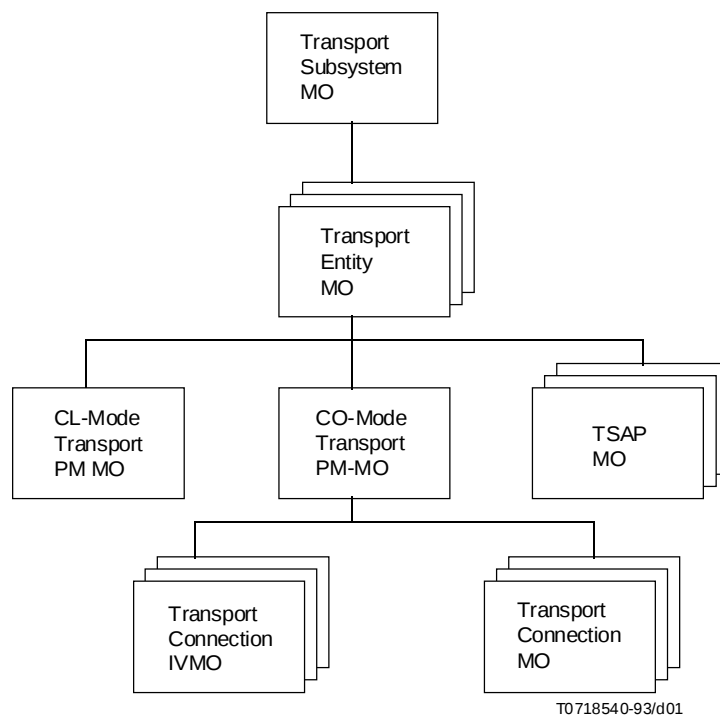


FIGURE 1/X.284

Transport Layer Containment Hierarchy

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5.1.2 Relationships

5.1.2.1 General description

The use of Relationship attributes is illustrated by examples in Annex C. The following describes the individual relationships for Transport Layer in more detail.

5.1.2.2 Layer n-1 Services

The Transport Layer Entity has a relation (actualNSAP) to the NSAP MO.

5.1.2.3 Connections

There is a relationship (underlyingConnectionNames) between a Transport Connection MO and its underlying Network LayerConnection MO (if one exists).

5.1.3 Minimum Event Filtering Capabilities

The Transport Layer management definitions embodied in this Recommendation 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 on:

- 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 of Communication informations.

5.1.4 Use of Optional Fields

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

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

The use of any other field is prohibited.

5.2 Common Transport Layer GDMO Definitions

commonCreationDeletion-B BEHAVIOUR

DEFINED AS

!Managed object class imports the X.721 | 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 X.721 | 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.!

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octetsSentReceivedCounter-B BEHAVIOUR

DEFINED AS

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

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 Recommendation. The value TLM.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 the 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 Transport Subsystem Managed Object

- *Managed Object for Transport Layer Subsystem*
- *There is exactly one of these MOs within*
- *a system. It exists to provide a container for the layer entity MOs.*
-
- *The transportSubsystem managed object cannot be created or deleted*
- *explicitly by management operation. It exists inherently in a system;*
- *created and deleted as part of system operation.*

transportSubsystem MANAGED OBJECT CLASS

DERIVED FROM "GMI":subsystem;

- *which is derived from "DMI":top*

CHARACTERIZED BY transportSubsystem-P PACKAGE

ATTRIBUTES

"GMI":subsystemId

INITIAL VALUE TLM.transportSubsystemId-Value
GET;

;;

REGISTERED AS {TLM.moi transportSubsystem (1)};

- Name Bindings

transportSubsystem-system NAME BINDING

SUBORDINATE OBJECT CLASS transportSubsystem AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS "DMI":system AND SUBCLASSES;

WITH ATTRIBUTE "GMI":subsystemId;

REGISTERED AS {TLM.nboi transportSubsystem-system (1)};

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5.4 The transport 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.*

transportEntity MANAGED OBJECT CLASS

DERIVED FROM "GMI":communicationsEntity;

- *which is derived from "DMI":top*

CHARACTERIZED BY transportEntity-P PACKAGE

**BEHAVIOUR tEPackageImportedNotifications-B,
commonCreationDeletion-B;**

ATTRIBUTES

**actualNSAP GET,
checksumErrorsDetected GET,
protocolErrors GET,
targetNSAP GET-REPLACE ADD-REMOVE,
undecodedNSDUs GET;**

ATTRIBUTE GROUPS

- *The following attribute group is present in each of the transport*
- *MOs which define counters. It allows all of the*
- *counters to be retrieved in a single request.*

"GMI":counters

**checksumErrorsDetected
protocolErrors
undecodedNSDUs;**

NOTIFICATIONS

- *protocolErrorNotification;*
- *The following notification is issued by the entity MO*
- *because in some cases it may be impossible to associate the*
- *protocol Error with any of the protocol Machines.*

"DMI":communicationsAlarm

**tEProtocolErrorPDUHeader
tEProtocolErrorSourceAddress
tEProtocolErrorReasonCode,**

"DMI":objectDeletion,

"DMI":objectCreation;;;

REGISTERED AS {TLM.moi transportEntity (2)};

-- Behaviours

- *Definition of the tEPackageImportedNotifications and of the mapping*
- *of specific protocol error parameters into the fields of*
- *communicationsAlarm Notification.*
-

tEPackageImportedNotifications-B BEHAVIOUR

DEFINED AS

!Notification issued when a Transport Entity receives a PDU which is invalid or contains a protocol error. The notification includes the header of the invalid PDU, the source N-Address, and the reason why the PDU is considered to be in error. The Reason code appears only if the protocol error relates to the connection-mode protocol, and if it has been possible to relate the PDU to a particular connection. The reason code is the value placed in the corresponding parameter of the ER TPDU, if sent. The tEPackage imports the communicationsAlarm Notification from DMI, in order to report the ProtocolError event. The probableCause shall be set to TLM.communicationsProtocolError. The tEProtocolErrorPDUheader, tEProtocolErrorSourceAddress and tEProtocolErrorReasonCode are reported as parameters in the additionalInformation field of the communicationsAlarm. The significance subparameter of each item of the problemData shall be set to the value 'False' (i.e. not significant) so that a managing system receiving the event will be less likely to reject it. 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 additionalInformationfield.!

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-- Name Bindings

transportEntity-transportSubsystem-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS transportEntity AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS transportSubsystem AND SUBCLASSES;
WITH ATTRIBUTE "GMI":communicationsEntityId;
BEHAVIOUR transportEntity-transportSubsystem-Automatic-B BEHAVIOUR
DEFINED AS

!This name binding shall be used when the transportEntity MO is created automatically by the operation of the system. The details of this operation are outside the scope of this Recommendation!;;

REGISTERED AS {TLM.nboi transportEntity-transportSubsystem-Automatic (11)};

transportEntity-transportSubsystem-Management NAME BINDING

SUBORDINATE OBJECT CLASS transportEntity AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS transportSubsystem AND SUBCLASSES;
WITH ATTRIBUTE "GMI":communicationsEntityId;
BEHAVIOUR transportEntity-transportSubsystem-Management-B BEHAVIOUR
DEFINED AS

!This name binding shall be used when the transportEntity MO is created by management!;;

CREATE;

DELETE;

REGISTERED AS {TLM.nboi transportEntity-transportSubsystem-Management (12)};

-- Attributes

actualNSAP ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.LocalDistinguishedNames;
MATCHES FOR EQUALITY, SET-INTERSECTION;
BEHAVIOUR actualNSAP-B BEHAVIOUR
DEFINED AS

The actual MO name(s) of the NSAP(s)
in use by this Transport Entity;;

REGISTERED AS {TLM.aoi actualNSAP (4)};

checksumErrorsDetected ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR clChecksumErrorsDetected-B BEHAVIOUR
DEFINED AS

The number of PDUs received with an incorrect checksum!;

REGISTERED AS {TLM.aoi checksumErrorsDetected (6)};

protocolErrors ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR protocolErrors-B BEHAVIOUR
DEFINED AS

Counter associated to protocol errors!;

REGISTERED AS {TLM.aoi protocolErrors (7)};

targetNSAP ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.LocalDistinguishedNames;
MATCHES FOR EQUALITY, SET-INTERSECTION;
BEHAVIOUR targetNSAP-B BEHAVIOUR
DEFINED AS

The MO name(s) of the NSAP(s) to be used by this Transport Entity. The value of this attribute cannot be changed unless the Operational State of the entity is Off. An implementation may permit it to be set only at creation of the transportEntity MO. An implementation may permit the size of the set to be restricted to 1. An implementation may permit a null value (empty set) to be specified, in which case some system-dependent auto configuration takes place!;

REGISTERED AS {TLM.aoi targetNSAP (3)};

undecodedNSDUs ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR undecodedNSDUs-B BEHAVIOUR
DEFINED AS

Number of NSDUs that cannot be attributed to any protocol machines;;

REGISTERED AS {TLM.aoi undecodedNSDUs (5)};

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-- Parameters

tEProtocolErrorPDUHeader PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.PDUHeaderSyntax;

BEHAVIOUR pDUHeader-B BEHAVIOUR

DEFINED AS

Header of the invalid PDU that caused the event.

Returned in the problemData field of a communicationsAlarm notification!;

REGISTERED AS {TLM.proi tEProtocolErrorPDUHeader (1)};

tEProtocolErrorSourceAddress PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.SourceAddressSyntax;

BEHAVIOUR sourceAddress-B BEHAVIOUR

DEFINED AS

Source N-Address of the invalid PDU that caused the event. Returned in the problemData field of a

communicationsAlarm notification;;

REGISTERED AS {TLM.proi tEProtocolErrorSourceAddress (2)};

tEProtocolErrorReasonCode PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.ReasonCodeSyntax;

BEHAVIOUR reasonCode-B BEHAVIOUR

DEFINED AS

Reason why the PDU is in error as placed in the corresponding parameter of the ER TPDU. Returned in the problemData field of a communicationsAlarm notification. This parameter is optional!;

REGISTERED AS {TLM.proi tEProtocolErrorReasonCode (3)};

5.5 The connectionless-mode transport protocol Machine MO

-- There is no more than one of these MOs per Transport 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. An clmodeTPM MO may be created in the
-- 'enabled' operational state.

clmodeTPM MANAGED OBJECT CLASS

DERIVED FROM "GMI":clProtocolMachine;

-- which is derived from "DMI":top

CHARACTERIZED BY clmodeTPM-P PACKAGE

BEHAVIOUR

clPackageImportedNotifications-B,

commonStateChange-B,

commonCreationDeletion-B;

ATTRIBUTES

"DMI":administrativeState GET-REPLACE,

"GMI":clProtocolMachineId

INITIAL VALUE TLM.clmodeTPMId-Value

GET,

clChecksumOption REPLACE-WITH-DEFAULT GET-REPLACE,

"DMI":octetsSentCounter GET,

"DMI":octetsReceivedCounter GET,

"DMI":pdusSentCounter GET,

"DMI":pdusReceivedCounter GET,

undeliverablePDUsCounter GET;

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ATTRIBUTE GROUPS

```
"DMI":state
  "DMI":administrativeState
  "DMI":operationalState,
"GMI":counters
  "DMI":octetsSentCounter
  "DMI":octetsReceivedCounter
  "DMI":pdusSentCounter
  "DMI":pdusReceivedCounter
  undeliverablePDUsCounter;
```

ACTIONS

```
"GMI":activate,
"GMI":deactivate;
```

NOTIFICATIONS

```
"DMI":objectCreation,
"DMI":objectDeletion,
"DMI":stateChange,
"DMI":communicationsAlarm
  clPMPDUHeader
  clPMSourceAddress;
```

;;

REGISTERED AS {TLM.moi clmodeTPM (3)};

-- Behaviours

-- Definition of the clPackageImportedNotifications and
-- of the mapping of specific parameters into the fields
-- of communicationsAlarm Notification.

--

clPackageImportedNotifications-B BEHAVIOUR

DEFINED AS

!The clmodeTPM-P package imports communicationsAlarm from DMI, in order to report the Undeliverable PDU event. The probableCause is set to TLM.communicationsProtocolError. The clPMPDUHeader and clPMSourceAddress are reported as parameters in the additionalInformation field of the communicationsAlarm. The significance subparameter of each item of the additionalInformation shall be set to the value 'False' (i.e. not significant) so that a managing system receiving the event will be less likely to reject it. The perceivedSeverity shall be set to Minor. A subsequent communicationsAlarm with a perceived Severity value of 'Cleared' shall not be generated. No other fields or parameters shall be used, with the exception of further parameters in the additionalInformationfield.!!;

-- Name Bindings

clmodeTPM-transportEntity-Management NAME BINDING

SUBORDINATE OBJECT CLASS clmodeTPM AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;
WITH ATTRIBUTE "GMI":clProtocolMachineId;

BEHAVIOUR clmodeTPM-transportEntity-Management-B BEHAVIOUR

DEFINED AS

The name binding that applies when the clmodeTPM managed object can be explicitly created and deleted by management!;

CREATE;

DELETE ONLY-IF-NO-CONTAINED-OBJECTS;

REGISTERED AS {TLM.nboi clmodeTPM-transportEntity-Management (3)};

clmodeTPM-transportEntity-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS clmodeTPM AND SUBCLASSES;
NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;
WITH ATTRIBUTE "GMI":clProtocolMachineId;

BEHAVIOUR clmodeTPM-transportEntity-Automatic-B BEHAVIOUR

DEFINED AS

The name binding that applies when the clmodeTPM managed object cannot be explicitly created and deleted by management!;

REGISTERED AS {TLM.nboi clmodeTPM-transportEntity-Automatic (9)};

Superseded by a more recent version

-- Attributes

clChecksumOption ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR clChecksumOption-B BEHAVIOUR

DEFINED AS

Enables use of the checksum option in ITU-T Rec. X.234 | ISO/IEC 8602 PDUs (in the absence of over-riding local controls) use (TRUE) or non-use (FALSE)!;

REGISTERED AS {TLM.aoi clChecksumOption (9)};

undeliverablePDUsCounter ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR undeliverablePDUsCounter-B BEHAVIOUR

DEFINED AS

Counter associated with the notification as recommended in GDMO 9.8.5 (the notification may be suppressed);

REGISTERED AS {TLM.aoi undeliverablePDUsCounter (10)};

-- Parameters

clPMPDUHeader PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.PDUHeaderSyntax;

BEHAVIOUR clPMPDUHeader-B BEHAVIOUR

DEFINED AS

Header of the PDU that cannot be delivered. Returned in the problemData field of a communicationsAlarm notification;;

REGISTERED AS {TLM.proi clPMPDUHeader (4)};

clPMSourceAddress PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.SourceAddressSyntax;

BEHAVIOUR clPMSourceAddress-B BEHAVIOUR

DEFINED AS

Source N-Address.

Returned in the problemData field of a communicationsAlarm notification;;

REGISTERED AS {TLM.proi clPMSourceAddress (5)};

5.6 The Connection-Oriented Transport Protocol Machine MO

-- There is no more than one of these MOs per Transport 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. An comodeTPM MO may be created in the
-- 'enabled' operational state.

comodeTPM MANAGED OBJECT CLASS

DERIVED FROM "GMI":coProtocolMachine;

-- which is derived from "DMI":top

CHARACTERIZED BY comodeTPM-P PACKAGE

BEHAVIOUR

commonStateChange-B,

commonCreationDeletion-B,

comodeTPMImportedNotifications-B;

Superseded by a more recent version

ATTRIBUTES

"DMI":administrativeState GET-REPLACE,
"DMI":octetsReceivedCounter GET,
"DMI":octetsSentCounter GET,
"GMI":coProtocolMachineId
INITIAL VALUE TLM.comodeTPMId-Value GET,
localErrorDisconnects GET,
localSuccessfulConnections GET,
localUnsuccessfulConnections GET,
maxConnections REPLACE-WITH-DEFAULT GET-REPLACE,
maxOpenConnections REPLACE-WITH-DEFAULT GET,
openConnections GET,
remoteErrorDisconnects GET,
remoteSuccessfulConnections GET,
remoteUnsuccessfulConnections GET,
unassociatedTPDUs GET;

ATTRIBUTE GROUPS

"DMI":state
"DMI":administrativeState
"DMI":operationalState,

-- The following attribute group is present in each of the transport
-- MOs which define counters. It allows all of the
-- counters to be retrieved in a single request.

"GMI":counters

"DMI":octetsSentCounter
"DMI":octetsReceivedCounter
openConnections
localSuccessfulConnections
remoteSuccessfulConnections
localUnsuccessfulConnections
remoteUnsuccessfulConnections
localErrorDisconnects
remoteErrorDisconnects
unassociatedTPDUs
maxOpenConnections;

ACTIONS

"GMI":activate,
"GMI":deactivate;

NOTIFICATIONS

"DMI":objectCreation,
"DMI":objectDeletion,
"DMI":stateChange,

-- incomingConnectionRejected

"GMI":communicationsInformation
rejectionCause
callingNSAPAddress-PAR
calledNSAPAddress-PAR
callingTSelector-PAR
calledTSelector-PAR
networkConnectionIDs-PAR;;;

REGISTERED AS {TLM.moi comodeTPM (4)};

-- Behaviours

comodeTPMImportedNotifications-B BEHAVIOUR

DEFINED AS

!The comodeTPM-P package imports the communicationsInformation notification from "ITU-T Rec. X.723 | ISO/IEC 10165-5" in order to report when an incoming connection is rejected. The value TLM.incomingConnectionRejected shall be reported in the informationType field. The rejection Cause, Calling NSAP Address, Called NSPA Address, Calling TSelector, Called TSelector and Network ConnectionId shall be reported as parameters in the informationData field!;

Superseded by a more recent version

-- Name Bindings

comodeTPM-transportEntity-Management NAME BINDING

SUBORDINATE OBJECT CLASS comodeTPM AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":coProtocolMachineId;

BEHAVIOUR comodeTPM-transportEntity-Management-B BEHAVIOUR

DEFINED AS

The name binding that applies when the comodeTPM managed object can be explicitly created and deleted by management!;

CREATE;

DELETE ONLY-IF-NO-CONTAINED-OBJECTS;

REGISTERED AS {TLM.nboi comodeTPM-transportEntity-Management (4)};

comodeTPM-transportEntity-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS comodeTPM AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":coProtocolMachineId;

BEHAVIOUR comodeTPM-transportEntity-Automatic-B BEHAVIOUR

DEFINED AS

The name binding that applies when the comodeTPM managed object cannot be explicitly created and deleted by management!;

REGISTERED AS {TLM.nboi comodeTPM-transportEntity-Automatic (10)};

-- Attributes

localErrorDisconnects ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR localErrorDisconnects-B BEHAVIOUR

DEFINED AS

The number of transport disconnects initiated by the local entity upon issuing a DR TPDU with an error code other than "Normal disconnect initiated by Service User", or upon issuing an ER TPDU!;

REGISTERED AS {TLM.aoi localErrorDisconnects (18)};

localSuccessfulConnections ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR localSuccessfulConnections-B BEHAVIOUR

DEFINED AS

Number of transport connections initiated by the local entity which have reached the Open state!;

REGISTERED AS {TLM.aoi localSuccessfulConnections (14)};

localUnsuccessfulConnections ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;

BEHAVIOUR localUnsuccessfulConnections-B BEHAVIOUR

DEFINED AS

The number of (local) unsuccessful transport connections initiated by the local Transport Entity which failed to reach the Open State. (Retransmission of CR TPDUs is not included in this counter)!;

REGISTERED AS {TLM.aoi localUnsuccessfulConnections (16)};

maxConnections ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;

MATCHES FOR EQUALITY, ORDERING;

BEHAVIOUR maxConnections-B BEHAVIOUR

DEFINED AS

The maximum number of simultaneously open transport connections allowed by the Transport Entity. There may be a period during which the openConnection attribute has a value which is greater than maxConnections. During this period, it shall not be permitted to initiate or accept new connections. It is a local matter whether action is taken to reduce the number of open connections to a value less than or equal to maxConnections by terminating connections chosen in an implementation-dependent manner. Whether or not such action is taken, there may be a period during which the openConnections attribute has a value which is greater than maxConnections.!;

REGISTERED AS {TLM.aoi maxConnections (13)};

Superseded by a more recent version

maxOpenConnections ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR maxOpenConnections-B BEHAVIOUR
DEFINED AS

The highest number of simultaneously open transport connections which has occurred since the last REPLACE-WITH-DEFAULT operation. The effect of this operation is to set the attribute to the number of currently open connections. Multiple managers need to coordinate their actions to avoid confusion!;

REGISTERED AS {TLM.aoi maxOpenConnections (21)};

openConnections ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;
MATCHES FOR EQUALITY, ORDERING;
BEHAVIOUR openConnections-B BEHAVIOUR
DEFINED AS

The number of transport connections which are in the Open state as defined in the state tables for ITU-T Rec. X.224 | ISO/IEC 8073. Updated upon each connection establishment and release!;

REGISTERED AS {TLM.aoi openConnections (12)};

remoteErrorDisconnects ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR remoteErrorDisconnects-B BEHAVIOUR
DEFINED AS

The number of disconnects initiated by a peer Transport Entity upon issuing a DR TPDU with an error code other than "Normal disconnect initiated by Session Entity" or upon issuing an ER TPDU!;

REGISTERED AS {TLM.aoi remoteErrorDisconnects (19)};

remoteSuccessfulConnections ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR remoteSuccessfulConnections-B BEHAVIOUR
DEFINED AS

Number of transport connections initiated by a remote entity which have reached the Open state!;

REGISTERED AS {TLM.aoi remoteSuccessfulConnections (15)};

remoteUnsuccessfulConnections ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR remoteUnsuccessfulConnections-B BEHAVIOUR
DEFINED AS

The number of (remote) unsuccessful transport connections initiated by a remote Transport Entity which failed to reach the open state!;

REGISTERED AS {TLM.aoi remoteUnsuccessfulConnections (17)};

unassociatedTPDUs ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR unassociatedTPDUs-B BEHAVIOUR
DEFINED AS

The number of TPDUs received which could not be associated with a Transport Connection. This counter is incremented only for such TPDUs received over the CONS!;

REGISTERED AS {TLM.aoi unassociatedTPDUs (20)};

-- Parameters

rejectionCause PARAMETER

CONTEXT EVENT-INFO;
WITH SYNTAX TLM.DeletionCauseSyntax;
BEHAVIOUR rejectionCause-B BEHAVIOUR

DEFINED AS Reason why the incoming Connection was rejected!;

REGISTERED AS {TLM.proi rejectionCause (7)};

5.7 The TSAP Managed Object

-- There is one tSAP MO for each TSAP currently
-- recognized by the containing Transport Entity.
-- Its definition permits it to be created and deleted by Management
-- operation or to be created and deleted automatically as part
-- of system operation.

Superseded by a more recent version

- Some implementations may require TSAP MOs to be created
- explicitly through management before they can be used.
- Others may create them automatically when a user entity attaches
- itself to them (in some implementation-dependent fashion).
- In this case, it is recommended that the naming convention
- be used whereby the name of the Managed Object
- is the representation in hexadecimal of the Transport Selector of
- the TSAP, so that it is possible to configure Transport Users
- without system specific knowledge.

tSAP MANAGED OBJECT CLASS

DERIVED FROM "GMI":sap1;

- which is derived from "DMI":top;

CHARACTERIZED BY tSAP-P PACKAGE

BEHAVIOUR commonCreationDeletion-B;

ATTRIBUTES

"GMI":sap1Address

INITIAL VALUE DERIVATION RULE tSAPAddress-B GET;

NOTIFICATIONS

"DMI":objectCreation,

"DMI":objectDeletion;

::

REGISTERED AS {TLM.moi tSAP (5)};

-- Behaviours

tSAPAddress-B BEHAVIOUR

DEFINED AS

If the package is created using the tSAP-transportEntity-Automatic name binding, it is recommended that the naming convention be used whereby the name of the MO is the representation in Hexadecimal of the Transport Selector of the TSAP. If the package is created using the tSAP-transportEntity-Management name binding, the initial value shall be specified in the CMIP create!;

-- Name Bindings

tSAP-transportEntity-Automatic NAME BINDING

SUBORDINATE OBJECT CLASS tSAP AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":sapId;

BEHAVIOUR tSAP-transportEntity-Automatic-B BEHAVIOUR

DEFINED AS

This Name Binding corresponds to the use of TSAPs which are automatically created!;

REGISTERED AS {TLM.nboi tSAP-transportEntity-Automatic (5)};

tSAP-transportEntity-Management NAME BINDING

SUBORDINATE OBJECT CLASS tSAP AND SUBCLASSES;

NAMED BY

SUPERIOR OBJECT CLASS transportEntity AND SUBCLASSES;

WITH ATTRIBUTE "GMI":sapId;

BEHAVIOUR tSAP-transportEntity-management-B BEHAVIOUR

DEFINED AS

This Name Binding corresponds to the use of TSAPs which are explicitly created by management. The value of the tsapID attribute shall be included in the Create operation, otherwise the create operation will fail!;

CREATE;

DELETE;

REGISTERED AS {TLM.nboi tSAP-transportEntity-Management (6)};

5.8 The Transport Connection Managed Object and IVMO

5.8.1 The Transport Connection Managed Object

- There may be multiple instances of these Managed Objects
- within a connection-oriented protocol Machine. Each corresponds
- to a Transport Connection. A transportConnection is created
- automatically as part of system operation. A transportConnection may
- be deleted automatically as part of system operation or

Superseded by a more recent version

- may be deleted as a result of the deactivate management operation.
- A transportConnectionIVMO may be used as the source
- of initial values of attributes of a transportConnectionMO.
-
- This section defines the Transport Connection Managed Object. The
- Transport Connection Managed Object contains the set of attributes
- characterizing the manageable aspects of a
- Transport Layer Protocol Connection.
-
- An MO of this class exists corresponding to each active Transport
- Connection, i.e. for which a CR
- TPDU has been sent or received and which has not yet been
- terminated. An MO may also exist prior to transmission of a CR TPDU,
- corresponding to interactions across the service interface.
- The precise synchronization of the creation and deletion of the MO
- with the protocol exchanges corresponding to the Transport Connection
- is not however defined by this standard. For example,
- there may be a visible delay after transmission or reception of a CR
- TPDU or interaction at the service interface before the MO is created
- and becomes visible to management. A Transport
- Connection MO is not required for terminated connections whose
- References have been placed in the Frozen state (for Class 4
- operation), although according to the above the MO may remain
- visible for some time after the connection has in other respects been
- terminated.
-

transportConnection MANAGED OBJECT CLASS

DERIVED FROM "GMI":singlePeerConnection;

- which is derived from "DMI":top

CHARACTERIZED BY transportConnection-P PACKAGE

BEHAVIOUR

**initialValues-B,
connectionCreationDeletion-B,
successfulConnectionEstablishment-B,
deactivateConnection-B,
transportConnection-B BEHAVIOUR**

DEFINED AS

The following point should be noted with regard to items inherited from elsewhere: octets sent/received counters count only octets of user data, not protocol control information.!

ATTRIBUTES

**"DMI":octetsReceivedCounter GET,
"DMI":octetsSentCounter GET,
"DMI":pdusReceivedCounter GET,
"DMI":pdusRetransmittedErrorCounter GET,
"DMI":pdusSentCounter GET,
calledNSAPAddress GET,
calledTSelector GET,
callingNSAPAddress GET,
callingTSelector GET,
connectionDirection GET,
localReference GET,
maxTPDUSize GET,
networkConnectionIDs GET,
protocolClass GET,
protocolErrors GET,
remoteReference GET,
respondingNSAPAddress GET;**

ATTRIBUTE GROUPS

**"GMI":counters
"DMI":octetsReceivedCounter
"DMI":octetsSentCounter
"DMI":pdusReceivedCounter
"DMI":pdusSentCounter
"DMI":pdusRetransmittedErrorCounter
protocolErrors;**

Superseded by a more recent version

NOTIFICATIONS

"DMI":objectCreation
transportConnectionName
protocolClass-PAR
maxTPDUSize-PAR
callingTSelector-PAR
calledTSelector-PAR
callingNSAPAddress-PAR
calledNSAPAddress-PAR
respondingNSAPAddress-PAR
connectionDirection-PAR
networkConnectionIDs-PAR,

"DMI":objectDeletion
transportConnectionName
protocolClass-PAR
maxTPDUSize-PAR
callingTSelector-PAR
calledTSelector-PAR
callingNSAPAddress-PAR
calledNSAPAddress-PAR
respondingNSAPAddress-PAR
connectionDirection-PAR
networkConnectionIDs-PAR
objectDeletionCause,

-- *successfulConnectionEstablishment*

"GMI":communicationsInformation

-- *The following parameters are reported in the informationData field*

transportConnectionName
protocolClass-PAR
maxTPDUSize-PAR
callingTSelector-PAR
calledTSelector-PAR
callingNSAPAddress-PAR
calledNSAPAddress-PAR
respondingNSAPAddress-PAR
connectionDirection-PAR
networkConnectionIDs-PAR;

;;

CONDITIONAL PACKAGES

transportConnectionClass1-P

PRESENT IF

!At the initiating side, present if class 1 is requested or can be accepted following class negotiation procedures. At the responding side, present if class 1 is chosen!,

transportConnectionClass2-P

PRESENT IF

!At the initiating side, present if class 2 is requested or can be accepted following class negotiation procedures. At the responding side, present if class 2 is chosen!,

transportConnectionClass3-P

PRESENT IF

!At the initiating side, present if class 3 is requested or can be accepted following class negotiation procedures. At the responding side, present if class 3 is chosen!,

transportConnectionClass4-P

PRESENT IF

!At the initiating side, present if class 4 is requested or can be accepted following class negotiation procedures. At the responding side, present if class 4 is chosen!,

transportConnectionNCMS-P

PRESENT IF !NCMS is implemented!;

REGISTERED AS {TLM.moi transportConnection (7)};

5.8.2 Transport Connection IVMO

-- *There may be multiple instances of the transportConnectionIVMO*
-- *in a system. A transportConnectionIVMO may be used to supply initial*
-- *values for the attributes of automatically created*
-- *transportConnection MOs.*
--

Superseded by a more recent version

```
-- The values supplied in an IVMO may be overridden by values
-- supplied in an implementation-specific manner across the service
-- interface.
--
-- Its definition permits it to be created and deleted explicitly by
-- management operation.

transportConnectionIVMO MANAGED OBJECT CLASS
    DERIVED FROM "DMI":top;
    CHARACTERIZED BY transportConnectionIVMO-P PACKAGE
        BEHAVIOUR use-of-initialValues-B;
        ATTRIBUTES
            transportConnectionIVMOId GET,
            protocolClasses REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
            maxTPDUSize REPLACE-WITH-DEFAULT GET-REPLACE;
-- DEFAULT VALUE is implementation dependent
        ;;
    CONDITIONAL PACKAGES
        transportConnectionIVMOClass1-P
            PRESENT IF Transport Class 1 is implemented,
        transportConnectionIVMOClass2-P
            PRESENT IF Transport Class 2 is implemented,
        transportConnectionIVMOClass3-P
            PRESENT IF Transport Class 3 is implemented,
        transportConnectionIVMOClass4-P
            PRESENT IF Transport Class 4 is implemented;
REGISTERED AS {TLM.moi transportConnectionIVMO (6)};
```

5.8.3 Elements of management Information for transportConnection MO and transportConnection IVMO

-- Conditional Packages

```
transportConnectionIVMOClass1-P PACKAGE
    BEHAVIOUR transportConnectionIVMOClass1-P-B BEHAVIOUR
        DEFINED AS When Class 1 is implemented!;
    ATTRIBUTES
        networkExpeditedData REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        receiptConfirmation REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        reassignmentTime REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        transportExpeditedService REPLACE-WITH-DEFAULT GET-REPLACE;
-- DEFAULT VALUE is implementation dependent
REGISTERED AS {TLM.poi transportConnectionIVMOClass1-P (1)};
```

```
transportConnectionIVMOClass2-P PACKAGE
    BEHAVIOUR transportConnectionIVMOClass2-P-B BEHAVIOUR
        DEFINED AS When Class 2 is implemented!;
    ATTRIBUTES
        explicitFlowControl REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        extendedFormat REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        maximumWindow REPLACE-WITH-DEFAULT GET-REPLACE,
-- DEFAULT VALUE is implementation dependent
        transportExpeditedService REPLACE-WITH-DEFAULT GET-REPLACE;
-- DEFAULT VALUE is implementation dependent
REGISTERED AS {TLM.poi transportConnectionIVMOClass2-P (2)};
```

```
transportConnectionIVMOClass3-P PACKAGE
    BEHAVIOUR transportConnectionIVMOClass3-P-B BEHAVIOUR
        DEFINED AS When Class 3 is implemented!;
    ATTRIBUTES
        extendedFormat REPLACE-WITH-DEFAULT GET-REPLACE,
```

Superseded by a more recent version

-- *DEFAULT VALUE is implementation dependent*
 reassignmentTime REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 maximumWindow REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 transportExpeditedService REPLACE-WITH-DEFAULT GET-REPLACE;
REGISTERED AS {TLM.poi transportConnectionIVMOClass3-P (3)};

transportConnectionIVMOClass4-P PACKAGE
 BEHAVIOUR transportConnectionIVMOClass4-P-B BEHAVIOUR
 DEFINED AS When Class 4 is implemented;;
 ATTRIBUTES
 checksumNonuse REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 extendedFormat REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 inactivityTime REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 maxTransmissions REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 retransmissionTime REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 windowTimer REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 maximumWindow REPLACE-WITH-DEFAULT GET-REPLACE,
-- *DEFAULT VALUE is implementation dependent*
 transportExpeditedService REPLACE-WITH-DEFAULT GET-REPLACE;
REGISTERED AS {TLM.poi transportConnectionIVMOClass4-P (4)};

transportConnectionClass1-P PACKAGE
 BEHAVIOUR transportConnectionClass1-P-B BEHAVIOUR
 DEFINED AS When Class 1 is implemented!;
 ATTRIBUTES
 networkExpeditedData GET,
 reassignmentsAfterFailure GET,
 reassignmentTime GET,
 receiptConfirmation GET,
 transportExpeditedService GET;
REGISTERED AS {TLM.poi transportConnectionClass1-P (5)};

transportConnectionClass2-P PACKAGE
 BEHAVIOUR transportConnectionClass2-P-B BEHAVIOUR
 DEFINED AS When Class 2 is implemented!;
 ATTRIBUTES
 extendedFormat GET,
 explicitFlowControl GET,
 transportExpeditedService GET;
REGISTERED AS {TLM.poi transportConnectionClass2-P (6)};

transportConnectionClass3-P PACKAGE
 BEHAVIOUR transportConnectionClass3-P-B BEHAVIOUR
 DEFINED AS When Class 3 is implemented!;
 ATTRIBUTES
 extendedFormat GET,
 reassignmentTime GET,
 reassignmentsAfterFailure GET,
 transportExpeditedService GET;
REGISTERED AS {TLM.poi transportConnectionClass3-P (7)};

transportConnectionClass4-P PACKAGE
 BEHAVIOUR transportConnectionClass4-P-B BEHAVIOUR
 DEFINED AS When Class 4 is implemented!;
 ATTRIBUTES
 acknowledgeTime GET,
 checksumNonuse GET,
 extendedFormat GET,

Superseded by a more recent version

inactivityTime GET,
maxTransmissions GET,
retransmissionTime GET,
transportExpeditedService GET,
windowTimer GET;

REGISTERED AS {TLM.poi transportConnectionClass4-P (8)};

transportConnectionNCMS-P PACKAGE

BEHAVIOUR transportConnectionNCMS-P-B BEHAVIOUR

DEFINED AS When NCMS is implemented!;

ATTRIBUTES

relatingNCCMONames GET;

REGISTERED AS {TLM.poi transportConnectionNCMS-P(9)};

-- Behaviours

initialValues-B BEHAVIOUR

DEFINED AS

!When an instance of the transportConnection MO is created using the transportConnection-comodeTPM name binding, the initial values for some of the attributes of the transportConnection MO may be supplied by an instance of the transportConnectionIVMO MO. The means by which an instance (if any) of the transportConnectionIVMO are identified are a local matter.!

use-of-initialValues-B BEHAVIOUR

DEFINED AS

!The creation of an instance of the transportConnection MO using the transportConnection-comodeTPM name binding may reference an instance of the transportConnectionIVMO MO under the conditions specified by the transportConnection MO. When this occurs, some of the initial values of the attributes of the instance of the transportConnection MO may be supplied by the values of the attributes in the specified instance of the transportConnectionIVMO. However, any such value may be overridden by a value supplied by local means (for example across an internal interface). Where values are supplied by the IVMO, the initial value of an attribute of transportConnection MO shall be the value of the corresponding attribute in the transportConnectionIVMO (that is, which has the same attribute template label).!

connectionCreationDeletion-B BEHAVIOUR

DEFINED AS

!Managed object class imports the X.721 | 10165-2 objectCreation and objectDeletion notifications for transportConnection. The precise synchronization between these notifications and related protocol and service interactions is not defined by this Recommendation. In addition, where a connection is attempted as a result of an interaction at a single interface (i.e. either the protocol or the service), and fails before any interaction occurs at the other, it is a local matter whether a managed object is created or not, i.e. whether the creation and deletion events occur or not.

ObjectCreation – Generated whenever an instance of the managed object class is created. The sourceIndicator parameter shall be set to the value 'resourceOperation'. None of the other optional parameters are used, with the exception of the additionalInformation field which contains the following parameters:

transportConnectionName
protocolClass-PAR
maxTPDUsize-PAR
callingTselector-PAR
calledTselector-PAR
callingNSAPAddress-PAR
calledNSAPAddress-PAR
respondingNSAPAddress-PAR
connectionDirection-PAR
networkConnectionIDs-PAR.

ObjectDeletion – Generated whenever an instance of the managed object class is deleted. The sourceIndicator parameter shall be set to the value 'resourceOperation'. None of the other optional parameters are used, with the exception of the additionalInformation field which contains the following parameters:

transportConnectionName
protocolClass-PAR
maxTPDUsize-PAR
callingTselector-PAR
calledTselector-PAR
callingNSAPAddress-PAR
calledNSAPAddress-PAR

Superseded by a more recent version

respondingNSAPAddress-PAR
connectionDirection-PAR
networkConnectionIDs-PAR
objectDeletionCause.!

-- Name Bindings

transportConnection-comodeTPM NAME BINDING
SUBORDINATE OBJECT CLASS transportConnection AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS comodeTPM AND SUBCLASSES;
WITH ATTRIBUTE "GMI":connectionId;
REGISTERED AS {TLM.nboi transportConnection-comodeTPM (8)};

transportConnectionIVMO-comodeTPM NAME BINDING
SUBORDINATE OBJECT CLASS transportConnectionIVMO AND SUBCLASSES;
NAMED BY
SUPERIOR OBJECT CLASS comodeTPM AND SUBCLASSES;
WITH ATTRIBUTE transportConnectionIVMOId;
CREATE WITH-REFERENCE-OBJECT;
DELETE;
REGISTERED AS {TLM.nboi transportConnectionIVMO-comodeTPM (7)};

-- Attributes

acknowledgeTime ATTRIBUTE
DERIVED FROM "GMI":timer;
BEHAVIOUR acknowledgeTime-B BEHAVIOUR
DEFINED AS
Value of local Acknowledge Timer (as defined in ITU-T Rec. X.224 | ISO/IEC 8073) in use for the
connection. Unit is in seconds!;
REGISTERED AS {TLM.aoi acknowledgeTime (47)};

calledNSAPAddress ATTRIBUTE
WITH ATTRIBUTE SYNTAX TLM.OctetString;
MATCHES FOR EQUALITY;
BEHAVIOUR calledNSAPAddress-B BEHAVIOUR
DEFINED AS
The Called NSAP Address received at the network service interface at N-connection establishment when
operating over the CONS, or with the N-Unitdata indication that conveyed the CR TPDU when operating
over the CLNS!;
REGISTERED AS {TLM.aoi calledNSAPAddress (58)};

calledTSelector ATTRIBUTE
WITH ATTRIBUTE SYNTAX TLM.OctetString;
MATCHES FOR EQUALITY;
BEHAVIOUR calledTSelector-B BEHAVIOUR
DEFINED AS
The "Called TSAP Identifier" specified at connection establishment!;
REGISTERED AS {TLM.aoi calledTSelector (56)};

callingNSAPAddress ATTRIBUTE
WITH ATTRIBUTE SYNTAX TLM.OctetString;
MATCHES FOR EQUALITY;
BEHAVIOUR callingNSAPAddress-B BEHAVIOUR
DEFINED AS
The Calling NSAP Address specified at the network service interface at N-connection establishment when
operating over the CONS, or for each N-Unitdata.request interaction when operating over the CLNS!;
REGISTERED AS {TLM.aoi callingNSAPAddress (57)};

callingTSelector ATTRIBUTE
WITH ATTRIBUTE SYNTAX TLM.OctetString;
MATCHES FOR EQUALITY;
BEHAVIOUR callingTSelector-B BEHAVIOUR
DEFINED AS
The "Calling TSAP Identifier" specified at connection establishment!;
REGISTERED AS {TLM.aoi callingTSelector (55)};

Superseded by a more recent version

checksumNonuse ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR checksumNonuse-B BEHAVIOUR

DEFINED AS

Enables negotiation/indicates non-use of checksum. In transportConnectionIVMO, enables negotiation of checksum non-use (Class 4 only) during connection establishment. TRUE enables non-use, FALSE disables it. In transportConnection, indicates whether checksum non-use has been selected for the connection (TRUE) or not (FALSE). During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi checksumNonuse (43)};

connectionDirection ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.ConnectionDirectionSyntax;

MATCHES FOR EQUALITY;

BEHAVIOUR connectionDirection-B BEHAVIOUR

DEFINED AS

Indicates the direction of the connection. The value Incoming means that it was initiated by the remote Transport Entity, the value Outgoing means that it was initiated by the local Transport Entity!;

REGISTERED AS {TLM.aoi connectionDirection (60)};

explicitFlowControl ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR explicitFlowControl-B BEHAVIOUR

DEFINED AS

Enables negotiation/indicates use of explicit Flow Control. In transportConnectionIVMO, enables negotiation of non-use of explicit flow control (Class 2 only) during connection establishment. TRUE enables non-use, FALSE disables it. In transportConnection, indicates whether non-use of explicit flow control has been selected for the connection (TRUE) or not (FALSE). For connections not using Class 2 of the protocol, this attribute has the value False. During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi explicitFlowControl (45)};

extendedFormat ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR extendedFormat-B BEHAVIOUR

DEFINED AS

Enables negotiation/indicates use of extended TPDU format. In transportConnectionIVMO, enables negotiation of extended TPDU format (for the classes where this is appropriate) during transport connection establishment. TRUE enables use of extended format, FALSE disables it. In transportConnection, indicates whether extended TPDU format is in use (TRUE) or not (FALSE). For connections not using Class 4 of the protocol, this attribute will be False. During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi extendedFormat (41)};

inactivityTime ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR inactivityTime-B BEHAVIOUR

DEFINED AS

Value of inactivity time (as defined in ITU-T Rec. X.224 | ISO/IEC 8073) in use for the connection. Unit is in seconds!;

REGISTERED AS {TLM.aoi inactivityTime (46)};

localReference ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;

MATCHES FOR EQUALITY;

BEHAVIOUR localReference-B BEHAVIOUR

DEFINED AS

The local reference number (as defined in ITU-T Rec. X.224 | ISO/IEC 8073) in use for the connection!;

REGISTERED AS {TLM.aoi localReference (53)};

Superseded by a more recent version

maximumWindow ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;

MATCHES FOR EQUALITY,ORDERING;

BEHAVIOUR maximumWindow-B BEHAVIOUR

DEFINED AS

The maximum window permitted to be given on the connection at any time. Buffering or other implementation constraints or policies may cause a smaller value to be used!;

REGISTERED AS {TLM.aoi maximumWindow (36)};

maxTPDUSize ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;

MATCHES FOR EQUALITY,ORDERING;

BEHAVIOUR maxTPDUSize-B BEHAVIOUR

DEFINED AS

The maximum TPDU size negotiated for the connection. Implementation constraints or policies, or relating to the remote NSPA or Transport Entity, may cause a smaller value to be used as an initial value for negotiation. During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi maxTPDUSize (51)};

maxTransmissions ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;

MATCHES FOR EQUALITY,ORDERING;

BEHAVIOUR maxTransmissions-B BEHAVIOUR

DEFINED AS

The maximum number of transmissions as defined (for Class 4 only) as the parameter 'N' in ITU-T Rec. X.224 | ISO/IEC 8073!;

REGISTERED AS {TLM.aoi maxTransmissions (52)};

networkConnectionIDs ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.LocalDistinguishedNames;

MATCHES FOR SET-COMPARISON,SET-INTERSECTION;

BEHAVIOUR networkConnectionIDs-B BEHAVIOUR

DEFINED AS

The Network Connection(s) which support the Transport Connection. If the TC is running over the CLNS, this attribute has the value of the empty set!;

REGISTERED AS {TLM.aoi networkConnectionIDs (61)};

networkExpeditedData ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

MATCHES FOR EQUALITY;

BEHAVIOUR networkExpeditedData-B BEHAVIOUR

DEFINED AS

Enables negotiation/indicates use of Network Expedited in transportConnectionIVMO, enables the negotiation of use or non-use of Network Expedited Data (for Class 1 only) during transport connection establishment. TRUE enables use of Network Expedited Data, FALSE disables it. In transportConnection, indicates whether Network Expedited Data is in use (TRUE) or not (FALSE). For connections not using Class 1, the value will always be False. During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi networkExpeditedData (42)};

protocolClass ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.ProtocolClassSyntax;

MATCHES FOR EQUALITY;

BEHAVIOUR protocolClass-B BEHAVIOUR

DEFINED AS

The protocol class in use on the connection, as negotiated during connection establishment.

During connection establishment (before the connection reaches the OPEN state) this indicates what is currently preferred and not necessarily the ultimate class which will be used for the connection!;

REGISTERED AS {TLM.aoi protocolClass (40)};

Superseded by a more recent version

protocolClasses ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.ProtocolClassesSyntax;
MATCHES FOR SET-COMPARISON,SET-INTERSECTION;
BEHAVIOUR protocolClasses-B BEHAVIOUR
DEFINED AS

The preferred/alternate set of protocol classes which may be stated at connection establishment. The default value is implementation dependent, but must be consistent with the class negotiation rules of ITU-T Rec. X.224 | ISO/IEC 8073!;

REGISTERED AS {TLM.aoi protocolClasses (26)};

reassignmentsAfterFailure ATTRIBUTE

DERIVED FROM "GMI":nonWrapping64BitCounter;
BEHAVIOUR reassignmentsAfterFailure-B BEHAVIOUR
DEFINED AS

The total number of times the TC has been reassigned to NC!;

REGISTERED AS {TLM.aoi reassignmentsAfterFailure (62)};

reassignmentTime ATTRIBUTE

DERIVED FROM "GMI":timer;
BEHAVIOUR reassignmentTime-B BEHAVIOUR
DEFINED AS

The value of the Reassignment Time (as defined in ITU-T Rec. X.224 | ISO/IEC 8073) to be conveyed or established during connection establishment. Unit is in seconds!;

REGISTERED AS {TLM.aoi reassignmentTime (48)};

receiptConfirmation ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;
MATCHES FOR EQUALITY;
BEHAVIOUR receiptConfirmation-B BEHAVIOUR
DEFINED AS

Enables negotiation/indicates use of receipt confirmation. In transportConnectionIVMO, enables negotiation of use of network receipt confirmation (Class 1 only) during transport connection establishment. TRUE enables use, FALSE enables non-use. In transportConnection, indicates whether use of network receipt confirmation has been selected for the connection (TRUE) or not (FALSE). For connections not using Class 1 of the protocol, this attribute has the value False. During connection establishment, this attribute represents the desired value and not necessarily the value which will ultimately be used!;

REGISTERED AS {TLM.aoi receiptConfirmation (44)};

relatingNCCMONames ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.LocalDistinguishedNames;
MATCHES FOR SET-COMPARISON,SET-INTERSECTION;
BEHAVIOUR relatingNCCMONames-B BEHAVIOUR
DEFINED AS

This attribute indicates the NCC MO(s);;

REGISTERED AS {TLM.aoi relatingNCCMONames (66)};

remoteReference ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Integer;
MATCHES FOR EQUALITY;
BEHAVIOUR remoteReference-B BEHAVIOUR
DEFINED AS

The remote reference number (as defined in ITU-T Rec. X.224 | ISO/IEC 8073) in use for the connection!;

REGISTERED AS {TLM.aoi remoteReference (54)};

respondingNSAPAddress ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.OctetString;
MATCHES FOR EQUALITY;
BEHAVIOUR respondingNSAPAddress-B BEHAVIOUR
DEFINED AS

The Responding NSAP Address received at network service interface at N-connection establishment. The value of this attribute is only meaningful when operating over the CONS, and when the N-connection was initiated by Transport Entity. Otherwise, the value is not meaningful and no constraints are applied to the value!;

REGISTERED AS {TLM.aoi respondingNSAPAddress (59)};

Superseded by a more recent version

retransmissionTime ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR resettingTimer-B,retransmissionTime-B BEHAVIOUR

DEFINED AS

Initial or current value for the Local Retransmission Time as defined in ITU-T Rec. X.224 | ISO/IEC 8073. Another value may be adopted initially based on knowledge concerning the remote system. The current value may change during the lifetime of the connection, based on observations of traffic on the connection or other information concerning the remote Transport Entity. The value of this attribute is used in the absence of other information. Unit is in seconds!;

REGISTERED AS {TLM.aoi retransmissionTime (49)};

transportConnectionIVMOId ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.NamingString;

MATCHES FOR EQUALITY,SUBSTRINGS;

BEHAVIOUR transportConnectionIVMOId-B BEHAVIOUR

DEFINED AS The name of this instance of transportConnectionIVMO;;

REGISTERED AS {TLM.aoi transportConnectionIVMOId (25)};

transportExpeditedService ATTRIBUTE

WITH ATTRIBUTE SYNTAX TLM.Boolean;

BEHAVIOUR transportExpeditedService-B BEHAVIOUR

DEFINED AS

Indicated whether the Transport Expedited Service is provided (true) or not (False).;;

REGISTERED AS {TLM.aoi transportExpeditedService (65)};

windowTimer ATTRIBUTE

DERIVED FROM "GMI":timer;

BEHAVIOUR windowTimer-B BEHAVIOUR

DEFINED AS

Value of Window Timer as defined in ITU-T Rec. X.224 | ISO/IEC 8073. The value of this attribute is meaningful only for connections using Class 4 of the protocol. For other connections no constraint is placed on the value to be returned. Unit is in seconds;;

REGISTERED AS {TLM.aoi windowTimer (50)};

-- Parameters

calledNSAPAddress-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE calledNSAPAddress;;

calledTSelector-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE calledTSelector;;

callingNSAPAddress-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE callingNSAPAddress;;

callingTSelector-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE callingTSelector;;

connectionDirection-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE connectionDirection;;

maxTPDUSize-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE maxTPDUSize;;

networkConnectionIDs-PAR PARAMETER

CONTEXT EVENT-INFO;

ATTRIBUTE networkConnectionIDs;;

objectDeletionCause PARAMETER

CONTEXT EVENT-INFO;

WITH SYNTAX TLM.DeletionCauseSyntax;

BEHAVIOUR objectDeletionCauseB BEHAVIOUR

DEFINED AS

Reason why the Transport Connection Object is being deleted!;

REGISTERED AS {TLM.proi objectDeletionCause (6)};

Superseded by a more recent version

```
protocolClass-PAR PARAMETER
    CONTEXT EVENT-INFO;
    ATTRIBUTE protocolClass;;

respondingNSAPAddress-PAR PARAMETER
    CONTEXT EVENT-INFO;
    ATTRIBUTE respondingNSAPAddress;;

transportConnectionName PARAMETER
    CONTEXT EVENT-INFO;
    ATTRIBUTE "GMI":connectionId;;
```

6 ASN.1 Modules

```
TLM {joint-iso-ccitt transport-layer(14) management(0) tlAsn1Module(2) 0}
DEFINITIONS IMPLICIT TAGS ::= BEGIN
EXPORTS ; -- everything
IMPORTS communicationsProtocolError
FROM Attribute-ASN1Module {joint-iso-ccitt ms(9) smi(3) part2(2) asn1Module(2) 1}
```

6.1 Object Identifier Definitions

6.1.1 Abbreviations

```
tloi OBJECT IDENTIFIER ::= {joint-iso-ccitt transport-layer(14) management(0)}
sseoi OBJECT IDENTIFIER ::= {tloi standardSpecificExtension(0)}
moi OBJECT IDENTIFIER ::= {tloi objectclass(3)}
poi OBJECT IDENTIFIER ::= {tloi package(4)}
proi OBJECT IDENTIFIER ::= {tloi parameter(5)}
nboi OBJECT IDENTIFIER ::= {tloi namebinding(6)}
aoi OBJECT IDENTIFIER ::= {tloi attribute(7)}
agoi OBJECT IDENTIFIER ::= {tloi attributeGroup(8)}
acoi OBJECT IDENTIFIER ::= {tloi action(9)}
noi OBJECT IDENTIFIER ::= {tloi notification(10)}
```

6.1.2 Other Object Identifier Definitions

```
successfulConnectionEstablishment OBJECT IDENTIFIER ::= {sseoi informationtype(4)
successfulConnectionEstablishment (1)}
incomingConnectionRejectedType OBJECT IDENTIFIER ::= {sseoi informationtype(4)
incomingConnectionRejected (2)}
```

6.2 Other Definitions

```
Boolean ::= BOOLEAN

ConnectionDirectionSyntax ::= ENUMERATED {outgoing(0),incoming(1)}

clmodeTPMId-Value GraphicString ::= "CLTPM"
comodeTPMId-Value GraphicString ::= "COTPM"

DeletionCauseSyntax ::= ENUMERATED
{protocolError(0),networkServiceProvider(1),remoteCongestion(3),
localCongestion(4)}

NamingString ::= GraphicString

Integer ::= INTEGER

LocalDistinguishedName ::= CMIP-1.BaseManagedObjectId

LocalDistinguishedNames ::= SET OF localDistinguishedName

OctetString ::= OCTET STRING

ProtocolClassSyntax ::= ENUMERATED {
class0(0), class1(1), class2(2), class3(3), class4(4)}
```

Superseded by a more recent version

ProtocolClassesSyntax ::= SET OF ProtocolClassSyntax

PDUHeaderSyntax ::= OCTET STRING(SIZE(1..255))

ReasonCodeSyntax ::= INTEGER

SourceAddressSyntax::=OCTET STRING

TransportSubsystemId-Value GraphicString ::= "TransportSubsystem"

END

7 Conformance

7.1 Conformance requirements to Recommendation X.284

An implementation for which conformance to this Recommendation as a managed implementation is claimed shall:

- a) support the transportSubsystem MO;
- b) for each MO supported, support at least one name binding defined in this Recommendation, for which the MO is the subordinate;
- c) for each MO supported, support all elements of management information as defined in GDMO description for the MO.

7.2 Protocol specific conformance requirements

7.2.1 Conformance to the management operation of ITU-T Rec. X.224 | ISO/IEC 8073

An implementation claiming conformance to the management operation of ITU-T Rec. X.224 | ISO/IEC 8073 as a managed implementation shall:

- a) conform to this Recommendation as defined in 7.1;
- b) support the transportEntity MO, the comodeTPM MO, and the TSAP MO.

7.2.2 Conformance to the management operation of ITU-T Rec. X.234 | ISO/IEC 8602

An implementation claiming conformance to the management operation of ITU-T Rec. X.234 | ISO/IEC 8602 as a managed implementation shall:

- a) conform to this Recommendation as defined in 7.1;
- b) support the transportEntity MO, the clmodeTPM MO and the TSAP MO.

NOTE – Behaviour clauses defined in this Recommendation may not always be testable. Care should be exercised when defining behaviour tests suites in order not to impose additional constraints to those defined in this Recommendation for implementations.

Annex A

Allocation of Object Identifiers

(This annex forms an integral part of this Recommendation)

The following Object Identifiers have been allocated by this Recommendation. Object Identifiers which had been allocated when this Recommendation was at the draft stage have not been re-allocated. If any modification, other than a change to the behaviour clause, has been made to any template which had been allocated an Object Identifier, the new template has been allocated a new Object Identifier and the old Object Identifier [identified thus: *obsolete* (1)] shall not be re-used.

joint-iso-ccitt (2)
ms (9)
smi (3)
part2 (2)
asn1Module (2)
(1)

Superseded by a more recent version

- transport-layer (14)
 - management (0)
 - standardSpecificExtension (0)
 - informationtype (4)
 - successfulConnectionEstablishment (1)
 - incomingConnectionRejected (2)
 - tlAsn1Module (2)
 - (0)
 - objectclass (3)
 - transportSubsystem (1)
 - transportEntity (2)
 - clmodeTPM (3)
 - comodeTPM (4)
 - tSAP (5)
 - transportConnectionIVMO (6)
 - transportConnection (7)
 - package (4)
 - transportConnectionIVMOCClass1-P (1)
 - transportConnectionIVMOCClass2-P (2)
 - transportConnectionIVMOCClass3-P (3)
 - transportConnectionIVMOCClass4-P (4)
 - transportConnectionClass1-P (5)
 - transportConnectionClass2-P (6)
 - transportConnectionClass3-P (7)
 - transportConnectionClass4-P (8)
 - transportConnectionNCMS-P (9)
 - parameter (5)
 - tEProtocolErrorPDUHeader (1)
 - tEProtocolErrorSourceAddress (2)
 - tEProtocolErrorReasonCode (3)
 - clPMPDUHeader (4)
 - clPMSourceAddress (5)
 - objectDeletionCause (6)
 - rejectionCause (7)
 - namebinding (6)
 - transportSubsystem-system (1)
 - obsolete* (2)
 - clmodeTPM-transportEntity-Management (3)
 - comodeTPM-transportEntity-Management (4)
 - tSAP-transportEntity-Automatic (5)
 - tSAP-transportEntity-Management (6)
 - transportConnectionIVMO-comodeTPM (7)
 - transportConnection-comodeTPM (8)
 - clmodeTPM-transportEntity-Automatic (9)
 - comodeTPM-transportEntity-Automatic (10)
 - transportEntity-transportSubsystem-Automatic (11)
 - transportEntity-transportSubsystem-Management (12)
 - attribute (7)
 - obsolete* (1)
 - obsolete* (2)
 - targetNSAP (3)
 - actualNSAP (4)
 - undecodedNSDUs (5)
 - checksumErrorsDetected (6)
 - protocolErrors (7)
 - obsolete* (8)
 - clChecksumOption (9)
 - undeliverablePDUsCounter (10)
 - obsolete* (11)
 - openConnections (12)
 - maxConnections (13)
 - localSuccessfulConnections (14)
 - remoteSuccessfulConnections (15)
 - localUnsuccessfulConnections (16)
 - remoteUnsuccessfulConnections (17)
 - localErrorDisconnects (18)

Superseded by a more recent version

remoteErrorDisconnects (19)
unassociatedTPDUs (20)
maxOpenConnections (21)
obsolete (22)
obsolete (23)
obsolete (24)
transportConnectionIVMOId (25)
protocolClasses (26)
obsolete (27)
obsolete (28)
obsolete (29)
obsolete (30)
obsolete (31)
obsolete (32)
obsolete (33)
obsolete (34)
obsolete (35)
maximumWindow (36)
obsolete (37)
obsolete (38)
obsolete (39)
protocolClass (40)
extendedFormat (41)
networkExpeditedData (42)
checksumNonuse (43)
receiptConfirmation (44)
explicitFlowControl (45)
inactivityTime (46)
acknowledgeTime (47)
reassignmentTime (48)
retransmissionTime (49)
windowTimer (50)
maxTPDUSize (51)
maxTransmissions (52)
localReference (53)
remoteReference (54)
callingTSelector (55)
calledTSelector (56)
callingNSAPAddress (57)
calledNSAPAddress (58)
respondingNSAPAddress (59)
connectionDirection (60)
networkConnectionIDs (61)
reassignmentsAfterFailure (62)
obsolete (63)
obsolete (64)
transportExpeditedService (65)
relatingNCCMONames (66)
attributeGroup (8)
action (9)
notification (10)

END

Annex B

Shorthand Description of Managed Objects

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

The information in this annex is intended only to give a broad outline of the Transport Layer Management Specification. While the information contained herein has been derived from the GDMO text in this Recommendation, it should be treated with caution, as there may be errors.

Superseded by a more recent version

The following abbreviations are used to describe the property lists of attributes:

G	Get
R	Replace
RWD	Replace With Default
A	Add
RM	Remove

The following abbreviations are used for external label references:

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

Template types with a '*' suffix (for example ATTRIBUTE*) refer to template types defined in conditional packages. All inherited templates, except those inherited from 'top', are included in each Managed Object Class.

The inheritance hierarchy is illustrated in Figure B.1.

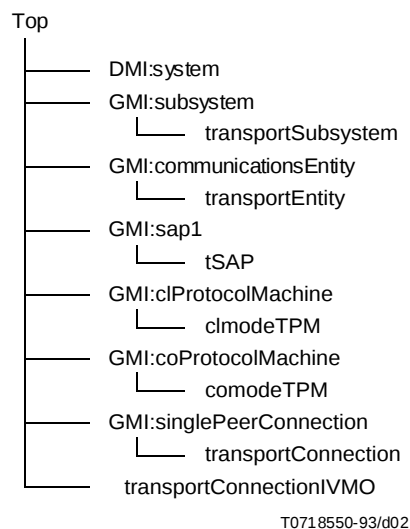


FIGURE B.1/X.284

MANAGED OBJECT CLASS transportConnectionIVMO DERIVED FROM (DMI:top) CONTAINED IN (comodeTPM)

checksumNonuse ATTRIBUTE* (G, R, RWD)

enables negotiation/indicates non-use of checksum

explicitFlowControl ATTRIBUTE* (G, R, RWD)

enables negotiation/indicates use of explicit Flow Control

extendedFormat ATTRIBUTE* (G, R, RWD)

enables negotiation/indicates use of extended TPDU Format

inactivityTime ATTRIBUTE* (G, R, RWD)

Value of inactivity time (as defined in ISO 8073)

maxTPDUSize ATTRIBUTE (G, R, RWD)

The maximum TPDU size negotiated for the connection

maxTransmissions ATTRIBUTE* (G, R, RWD)

The maximum number of transmissions

maximumWindow ATTRIBUTE* (G, R, RWD)

The maximum window permitted to be given on the connection

networkExpeditedData ATTRIBUTE* (G, R, RWD)

enables negotiation/indicates use of Network Expedited

Superseded by a more recent version

protocolClasses ATTRIBUTE (G, R, RWD)

The preferred/alternate set of protocol classes

reassignmentTime ATTRIBUTE* (G, R, RWD)

The value of the Reassignment Time

receiptConfirmation ATTRIBUTE* (G, R, RWD)

enables negotiation/indicates use of Receipt Confirmation

retransmissionTime ATTRIBUTE* (G, R, RWD)

Initial or Current value for the Local Retransmission Time

transportConnectionIVMOId ATTRIBUTE (G)

The name of this instance of the Transport Connection IVMO

transportExpeditedService ATTRIBUTE* (G, R, RWD)

Indicates whether the Transport Expedited Service is provided

windowTimer ATTRIBUTE* (G, R, RWD)

Value of Window Timer as defined in ITU-T Rec. X.224 | ISO/IEC 8073

END MANAGED OBJECT CLASS transportConnectionIVMO

MANAGED OBJECT CLASS transportConnection DERIVED FROM (GMI:singlePeerConnection) CONTAINED IN (comodeTPM)

DMI:objectCreation NOTIFICATION

DMI:objectDeletion NOTIFICATION

DMI:octetsReceivedCounter ATTRIBUTE (G)

DMI:octetsSentCounter ATTRIBUTE (G)

DMI:pdusReceivedCounter ATTRIBUTE (G)

DMI:pdusRetransmittedErrorCounter ATTRIBUTE (G)

DMI:pdusSentCounter ATTRIBUTE (G)

GMI:communicationsInformation NOTIFICATION

GMI:connectionId ATTRIBUTE (G)

GMI:supportedConnectionNames ATTRIBUTE* (G)

This attribute contains the distinguished names of managed objects that represent connections

GMI:underlyingConnectionNames ATTRIBUTE (G)

acknowledgeTime ATTRIBUTE* (G)

Value of local Acknowledge Timer

calledNSAPAddress ATTRIBUTE (G)

The Called NSAP Address received

calledTSelector ATTRIBUTE (G)

The "Called TSAP Identifier" specified

callingNSAPAddress ATTRIBUTE (G)

The Calling NSAP Address specified

callingTSelector ATTRIBUTE (G)

The "Calling TSAP Identifier" specified

checksumNonuse ATTRIBUTE* (G)

enables negotiation/indicates non-use of checksum

connectionDirection ATTRIBUTE (G)

Indicates the direction of the connection

explicitFlowControl ATTRIBUTE* (G)

enables negotiation/indicates use of explicit Flow Control

extendedFormat ATTRIBUTE* (G)

enables negotiation/indicates use of extended TPDU

inactivityTime ATTRIBUTE* (G)

Value of inactivity time (as defined in ITU-T Rec. X.224 | ISO/IEC 8073)

localReference ATTRIBUTE (G)

The local reference number (as defined in ITU-T Rec. X.224 | ISO/IEC 8073)

maxTPDUSize ATTRIBUTE (G)

The maximum TPDU size negotiated for the connection

maxTransmissions ATTRIBUTE* (G)

The maximum number of transmissions

networkConnectionIDs ATTRIBUTE (G)

The Network Connection(s) which support the Transport Connection

networkExpeditedData ATTRIBUTE* (G)

enables negotiation/indicates use of Network Expedited

protocolClass ATTRIBUTE (G)

The protocol class in use on the connection

protocolErrors ATTRIBUTE (G)

Counter associated to protocol errors

reassignmentTime ATTRIBUTE* (G)

The value of the Reassignment Time

reassignmentsAfterFailure ATTRIBUTE* (G)

The total number of times the TC has been reassigned

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receiptConfirmation ATTRIBUTE* (G)
enables negotiation/indicates use of receipt Confirmation
relatingNCCMONames ATTRIBUTE* (G)
This attribute indicates the NCC MO(s)
remoteReference ATTRIBUTE (G)
The remote reference number (as defined in ITU-T Rec. X.224 | ISO/IEC 8073)
respondingNSAPAddress ATTRIBUTE (G)
The Responding NSAP Address received
retransmissionTime ATTRIBUTE* (G)
Initial or Current value for the Local Retransmission Time
transportExpeditedService ATTRIBUTE* (G)
Indicated whether the Transport Expedited Service is provided
windowTimer ATTRIBUTE* (G)
Value of Window Timer as defined in ITU-T Rec. X.224 | ISO/IEC 8073

END MANAGED OBJECT CLASS transportConnection

MANAGED OBJECT CLASS tSAP DERIVED FROM (GMI:sap1) CONTAINED IN (transportEntity)

DMI:objectCreation NOTIFICATION
DMI:objectDeletion NOTIFICATION
GMI:sap1Address ATTRIBUTE (G)
GMI:sapId ATTRIBUTE (G)
GMI:userEntityNames ATTRIBUTE (G)

END MANAGED OBJECT CLASS tSAP

MANAGED OBJECT CLASS comodeTPM DERIVED FROM (GMI:coProtocolMachine) CONTAINED IN (transportEntity)

DMI:administrativeState ATTRIBUTE (G, R)
DMI:objectCreation NOTIFICATION
DMI:objectDeletion NOTIFICATION
DMI:octetsReceivedCounter ATTRIBUTE (G)
DMI:octetsSentCounter ATTRIBUTE (G)
DMI:operationalState ATTRIBUTE (G)
DMI:stateChange NOTIFICATION
GMI:activate ACTION
GMI:coProtocolMachineId ATTRIBUTE (G)
GMI:communicationsInformation NOTIFICATION
GMI:deactivate ACTION
localErrorDisconnects ATTRIBUTE (G)
The number of transport disconnects initiated by the local entity
localSuccessfulConnections ATTRIBUTE (G)
Number of transport connections initiated by the local entity
localUnsuccessfulConnections ATTRIBUTE (G)
The number of (local) unsuccessful transport connections
maxConnections ATTRIBUTE (G, R, RWD)
The maximum number of simultaneously open Transport connections
maxOpenConnections ATTRIBUTE (G, RWD)
The highest number of simultaneously open Transport connections
openConnections ATTRIBUTE (G)
The number of transport connections which are in the open state
remoteErrorDisconnects ATTRIBUTE (G)
The number of disconnects initiated by a peer entity
remoteSuccessfulConnections ATTRIBUTE (G)
Number of transport connections initiated by a remote entity
remoteUnsuccessfulConnections ATTRIBUTE (G)
The number of (remote) unsuccessful transport connections
unassociatedTPDUs ATTRIBUTE (G)
The number of TPDUs received which could not be associated

END MANAGED OBJECT CLASS comodeTPM

MANAGED OBJECT CLASS clmodeTPM DERIVED FROM (GMI:clProtocolMachine) CONTAINED IN (transportEntity)

DMI:administrativeState ATTRIBUTE (G, R)
DMI:communicationsAlarm NOTIFICATION
DMI:objectCreation NOTIFICATION
DMI:objectDeletion NOTIFICATION
DMI:octetsReceivedCounter ATTRIBUTE (G)
DMI:octetsSentCounter ATTRIBUTE (G)

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DMI:operationalState ATTRIBUTE (G)

DMI:pdusReceivedCounter ATTRIBUTE (G)

DMI:pdusSentCounter ATTRIBUTE (G)

DMI:stateChange NOTIFICATION

GMI:activate ACTION

GMI:clProtocolMachineId ATTRIBUTE (G)

GMI:deactivate ACTION

GMI:totalRemoteSAPs ATTRIBUTE* (G)

Counts the number of remote (N) SAPs that the containing clProtocolMachine communicated
clChecksumOption ATTRIBUTE (G, R, RWD)

Enables use of the checksum option in ITU-T Rec. X.234 | ISO/IEC 8602 PDUs

undeliverablePDUsCounter ATTRIBUTE (G)

Counter associated with the notification

END MANAGED OBJECT CLASS clmodeTPM

MANAGED OBJECT CLASS transportEntity DERIVED FROM (GMI:communicationsEntity) CONTAINED
IN (transportSubsystem)

DMI:communicationsAlarm NOTIFICATION

DMI:objectCreation NOTIFICATION

DMI:objectDeletion NOTIFICATION

DMI:operationalState ATTRIBUTE (G)

GMI:communicationsEntityId ATTRIBUTE (G)

GMI:localSapNames ATTRIBUTE (G)

actualNSAP ATTRIBUTE (G)

The actual MO name(s) of the NSAP(s)

checksumErrorsDetected ATTRIBUTE (G)

The number of PDUs received with an incorrect checksum

protocolErrors ATTRIBUTE (G)

Counter associated to protocol errors

targetNSAP ATTRIBUTE (G, R, A, RM)

The MO name(s) of the NSAP(s) to be used

undecodedNSDUs ATTRIBUTE (G)

Number of NSDUs that cannot be attributed

END MANAGED OBJECT CLASS transportEntity

MANAGED OBJECT CLASS transportSubsystem DERIVED FROM (GMI:subsystem) CONTAINED
IN (DMI:system)

GMI:subsystemId ATTRIBUTE (G)

END MANAGED OBJECT CLASS transportSubsystem

Annex C

Examples of the use of relationships

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

This annex provides examples of the use of relationship attributes, both within the Transport Layer and also between the Transport Layer and its adjoining layers. These examples are not intended to be exhaustive. Relationships for other protocol combinations may be constructed in a similar manner, and a particular implementation may be capable of supporting multiple protocols simultaneously. For example, Transport Connections over CONS at the same time as Transport Connections over CLNS. Such possibilities have only been omitted for reasons of clarity.

In order to illustrate the use of cross layer relationships it has been necessary to include diagrams which represent some of the Session and Network Layer Managed Objects in the following figures. However these are for illustrative purposes only, and the relevant layer management standards should be consulted for accurate details or complete picture of these managed objects.

The examples are as illustrated in Figures C.1 and C.2.

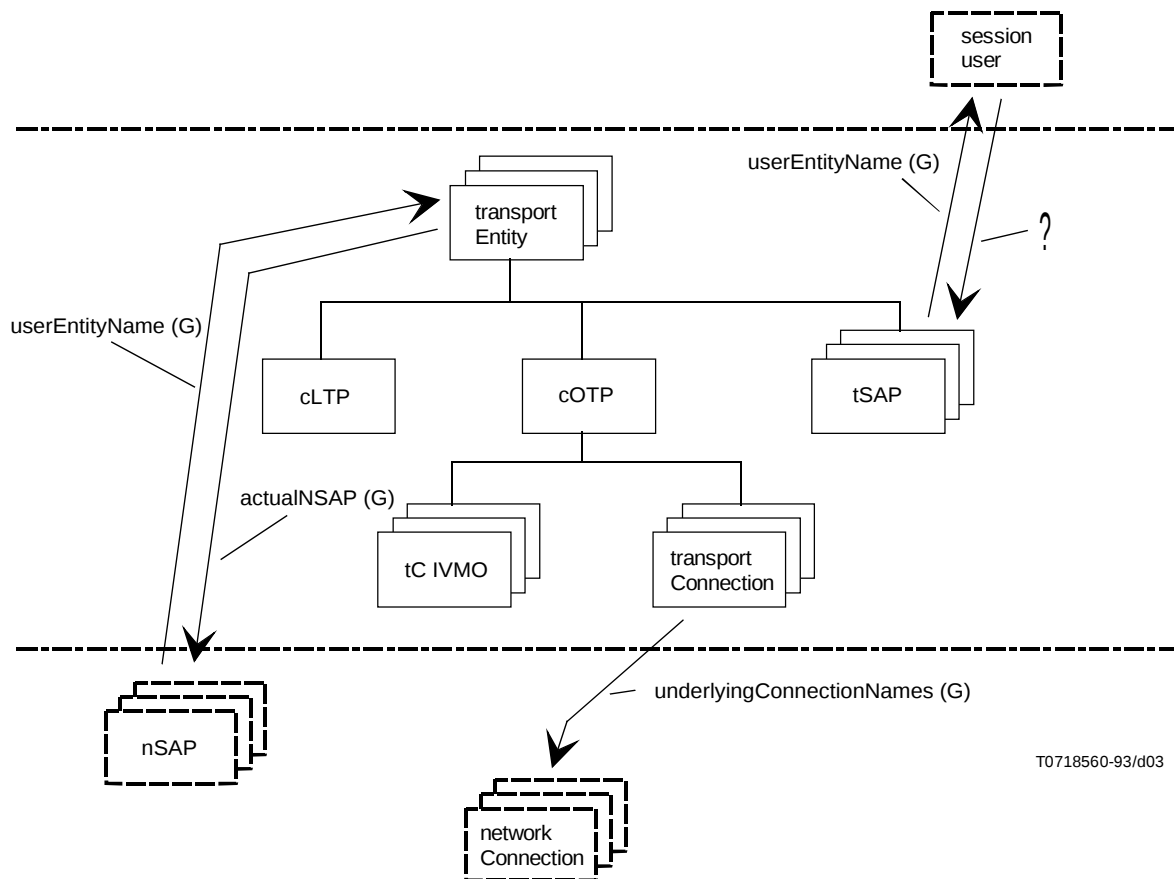


FIGURE C.1/X.284
COTP over CONS

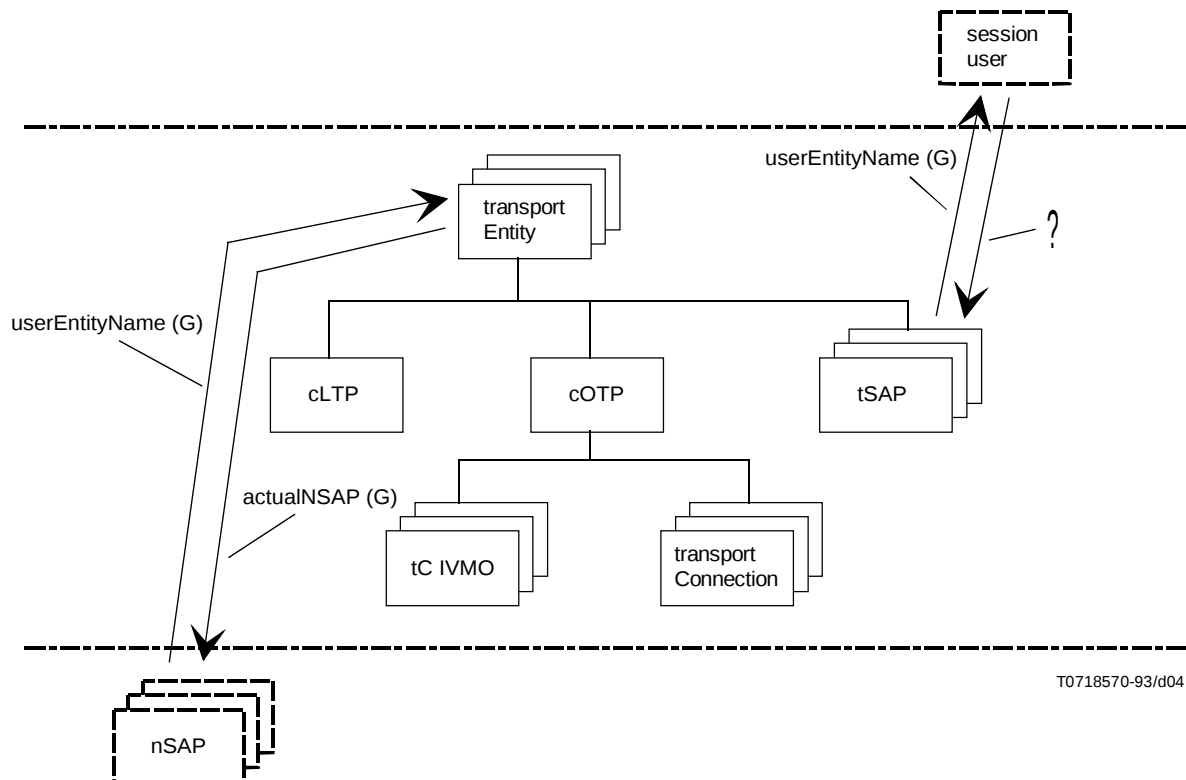


FIGURE C.2/X.284
COTP over CLNS