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# Information technology — Telecommunications and information exchange between systems — Elements of Management Information Related to OSI Transport Layer Standards

*Technologies de l'information — Télécommunications et échange d'information entre systèmes — Éléments d'information de gestion concernant les normes de la couche Transport OSI*

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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 10737 was prepared by joint Technical Committee ISO/IEC JTC 1, *Information technology,* Subcommittee 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.



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# 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 Systems Interconnection* (ISO 7498). In particular, it is concerned with the definition of Transport Layer management information.

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# Information technology — Telecommunications and information exchange between systems — Elements of Management Information Related to OSI Transport Layer Standards

## 1 Scope

This International Standard provides the specification of management information within an Open System related to those operations of the OSI Transport Layer specified by CCITT Recommendations and 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* (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 Transport Layer Managed Objects that are available to OSI Systems Management.

## 2 Normative references

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

### 2.1 Identical Recommendations | International Standards

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 (1991) | ISO/IEC 10165-5:—[1)] , *Information technology — Open Systems Interconnection — Structure of Management Information: Generic management information.*

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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 Recommendations | International Standards equivalent in technical content

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.214 (1988), *Transport service definition for Open Systems Interconnection for CCITT applications.*

ISO 8072:1994, *Information technology — Open Systems Interconnection — Transport service definition.*

CCITT Recommendation X.224 (1988), *Transport protocol specification for Open Systems Interconnection for CCITT applications.*

ISO/IEC 8073:1992, *Information technology — Telecommunications and information exchange between systems — Open Systems Interconnection — Protocol for providing the connection-mode transport service.*

CCITT Recommendation X.700 (1992), *Management Framework for Open Systems Interconnection for CCITT applications.*

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

## 2.3 Additional reference

ISO 8602:1987, *Information processing systems — Open Systems Interconnection — Protocol for providing the connectionless-mode Transport Service.*



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# 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) Transport Layer

d) Transport Protocol

e) Layer Management

f) Systems management

## 3.2 Information model

This International Standard makes use of the following terms defined in ISO/IEC 10165-1.

a) Attributes

b) Attribute type

c) Containment

d) Distinguished Name

e) Inheritance

f) Managed Object

g) Management Operations

h) Notifications

i) Object Class

j) Relative Distinguished Name

k) Subclass

l) Superclass

## 3.3 GDMO

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

a) Managed Object Class Definition

b) Template

c) Parameter

## 3.4 Management Framework

This International Standard makes use of the following term defined in ISO 7498-4.

Management Information

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# 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) I ISO/IEC 10165-2: 1992 |
| GMI | CCITT Rec X.723 I ISO/IEC 10165-5 |

This International Standard makes use of the following symbols and 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 |
| 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:

a) Transport Subsystem managed object (transportSubsystem, see 5.3)

b) Transport Entity managed object (transportEntity, see 5.4)

c) Connectionless Transport Protocol Machine managed object (clmodeTPM, see 5.5)

d) Connection-Oriented Transport Protocol Machine managed object (comodeTPM, see 5.6)

e) Transport SAP managed object (tSAP, see 5.7)

f) Transport Connection managed object (transportConnection, see 5.8.1)

g) 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.



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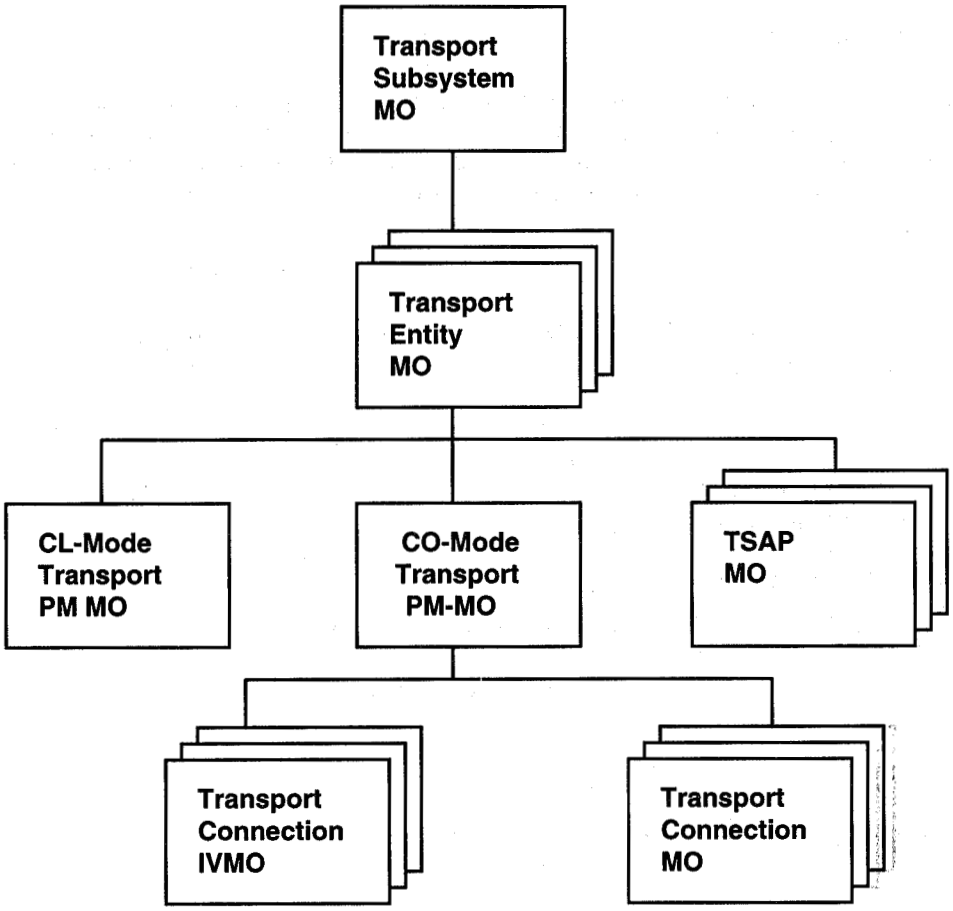


**Figure 1 - Transport Layer Containment Hierarchy**

## 5.1.2 Relationships

### 5.1.2.1 General description

The use of Relationship attributes is illustrated by examples in Annex C of this International Standard. 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).



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### 5.1.3 Minimum Event Filtering Capabilities

The transport layer management definitions embodied in this specification imply the frequent and possibly excessive generation of notifications 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 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 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 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 occured as a result of internal operation of the
    resource, the value 'resourceOperation' is used.If creation occured 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 occured as a result of internal operation of the
    resource, the value 'resourceOperation' is used. If deletion occured 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 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 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.!;
```



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```
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 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;
```



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```
    WITH ATTRIBUTE "GMI":subsystemId;
REGISTERED AS {TLM.nboi transportSubsystem-system (1)};
```

## 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
```



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```
      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.!;
```

**-- 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 Specification.!;;
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
```

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```
        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)};

-- 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.
```



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