# ISO/IEC 8073:1992 (E)
# Edition 3
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# FOR REVIEW ONLY

## Please provide your comments before
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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 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 8073 was prepared by Joint Technical Committee ISO/IEC JTC 1, Information Technology.

This third edition cancels and replaces the second edition (ISO/IEC 8073:1988) and includes technical revisions that have been published as: ISO 8073:1986/Add.1:1988, ISO/IEC 8073:1988/Add.2:1989, ISO/IEC 8073:1988/Am.3, ISO/IEC 8073/Cor.1:1990, ISO/IEC 8073:1988/Cor.2:1990, ISO/IEC 8073:1988/Cor.3:1990, ISO/IEC 8073:1988/Cor.4:1991, ISO/IEC 8073:1988/Cor.5:1991 and ISO/IEC 8073:1988/Cor.6:1992. This edition also includes ISO/IEC 8073:1988/Dam.4 and various technical revisions that have been balloted together with the Draft International Standard of this edition.

Annex A, B and C form part of this International Standard. Annexes D and E are for information only.

## Introduction

This International Standard is one of a set of International Standards produced to facilitate the interconnection of information processing systems. This set of International Standards covers the services and protocols required to achieve such interconnection.

The Transport Protocol Standard is positioned with respect to other related International Standards by the layers defined in the Reference Model for Open Systems Interconnection (ISO 7498). It is most closely related to, and lies within the field of application of the Transport Service Standard (ISO 8072). It also uses and makes reference to the Network Service Standard (ISO/IEC 8348), whose provisions it assumes in order to accomplish the transport protocol's aims. The interrelationship of these International Standards is illustrated in Figure 1.

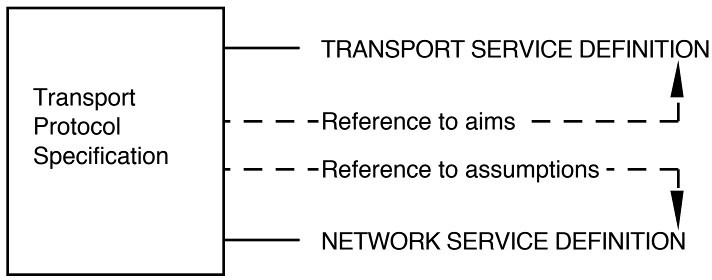



**Figure 1 – Relationship between the Transport Protocol and adjacent services**

This International Standard specifies a common encoding and a number of classes of transport protocol procedures to be used with different network qualities of service.

It is intended that the Transport Protocol should be simple but general enough to cater for the total range of Network Service qualities possible, without restricting future extensions.

The protocol is structured to give rise to classes of protocol which are designed to minimize possible incompatibilities and implementation costs.

The classes are selectable with respect to the Transport and Network Services in providing the required quality of service for the interconnection of two session entities (each class provides a different set of functions for enhancement of service qualities).

This International Standard defines mechanisms that can be used to optimize network tariffs and enhance the following qualities of service:

a) different throughput;

b) different error rates;

c) integrity of data requirements;

d) reliability requirements.

It does not require an implementation to use all of these mechanisms, nor does it define methods for measuring achieved quality of service or criteria for deciding when to release transport connections following quality of service degradation.

The primary aim of this International Standard is to provide a set of rules for communication expressed in terms of the procedures to be carried out by peer entities at the time of communication. These rules for communication are intended to provide a sound basis for development in order to serve a variety of purposes i.e.:

a) as a guide for implementors and designers;

b) for use in the testing and procurement of equipment;

c) as part of an agreement for the admittance of systems into the open systems environment;

d) as a refinement of the understanding of OSI.

As it is expected that the initial users of this International Standard will be designers and implementors of equipment this International Standard contains, in notes or in annexes, guidance on the implementation of the procedures defined herein.

It should be noted that, as the number of valid protocol sequences is very large, it is not possible with current technology to verify that an implementation will operate the protocol defined in this International Standard correctly under all circumstances. It is possible by means of testing to establish confidence that an implementation correctly operates the protocol in a representative sample of circumstances. It is, however, intended that this International Standard can be used in circumstances where two implementations fail to communicate in order to determine whether one or both have failed to operate the protocol correctly.

This International Standard contains a section on conformance of equipment claiming to implement the procedures in this International Standard. To evaluate conformance of a particular implementation, it is necessary to have a statement of which capabilities and options have been implemented for a given OSI protocol. Such a statement is called a Protocol Implementation Conformance Statement (PICS). A PICS proforma is provided in Annex C. Attention is drawn to the fact that this International Standard does not contain any tests to demonstrate this conformance.

The variations and options available within this International Standard are essential as they enable a transport service to be provided for a wide variety of applications over a variety of network qualities. Thus, a minimally conforming implementation will not be suitable for use in all possible circumstances. It is important, therefore, to qualify all references to this International Standard with statements of the options provided or required or with statements of the intended purpose of provision or use.

## Table of Contents

# Information technology — Telecommunications and information exchange between systems — Open Systems Interconnection — Protocol for providing the connection-mode transport service

## 1 Scope

This International Standard specifies

a) five classes of procedures when operating over the connection-mode network service:

1) class 0: simple class;

2) class 1: basic error recovery class;

3) class 2: multiplexing class;

4) class 3: error recovery and multiplexing class;

5) class 4: error detection and recovery class;

for the connection-mode transfer of data and control information from one transport entity to a peer transport entity;

b) one class (class 4) of procedure when operating over the connectionless-mode network service;

c) the means of negotiating the class of procedures to be used by the transport entities;

d) the structure and encoding of the transport protocol data units used for the transfer of data and control information.

The procedures are defined in terms of

a) the interactions between peer transport entities through the exchange of transport protocol data units;

b) the interactions between a transport entity and the transport service user in the same system through the exchange of transport service primitives;

c) the interactions between a transport entity and the network service provider through the exchange of network service primitives.

These procedures are defined in the main text of this International Standard supplemented by state tables in annex A.

These procedures are applicable to instances of communication between systems which support the Transport Layer of the OSI Reference Model and which wish to interconnect in an open systems environment.

This International Standard specifies, in clause 14, conformance requirements for systems implementing these procedures and provides the PICS proforma in compliance with the relevant requirements, and in accordance with the relevant guidance, given in ISO/IEC 9646-2. It does not contain tests which can be used to demonstrate this conformance.

## 2 Normative references

The following 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 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 standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 7498:1984/Add.1:1987, Information processing systems – Open Systems Interconnection – Basic Reference Model – Addendum 1: Connectionless-mode transmission.

ISO 7498-3:1989, Information processing systems – Open Systems Interconnection – Basic Reference Model – Part 3: Naming and addressing.

ISO 8072:1986, Information processing systems — Open Systems Interconnection — Transport service definition.

ISO/IEC 8348:1992, Information processing systems — Data communications — Network service definition.

ISO/IEC 9646-1:1991, OSI Conformance Testing Methodology and Framework, Part 1: General Concepts.

ISO/IEC 9646-2:1991, OSI Conformance Testing Methodology and Framework, Part 2: Abstract Test Suite Specification.

ISO/IEC 11570:1992, Information technology — Telecommunications and information exchange between systems — Open systems interconnection — Transport protocol identification mechanism.

CCITT X.224, Transport Protocol Specification for Open Systems Interconnection for CCITT Applications Version 1988.

# Section one: General

## 3 Definitions

NOTE – The definitions contained in this clause make use of abbreviations defined in clause 4.

**3.1** This International Standard is based on the concepts developed in ISO 7498 and ISO 7498/Add.1 and ISO/IEC 7498-3 and makes use of the following terms defined in it:

a) concatenation and separation;

b) segmenting and reassembling;

c) multiplexing and demultiplexing;

d) splitting and recombining;

e) flow control;

f) connectionless-mode transmission;

g) nil selector value.

**3.2** For the purposes of this International Standard, the following definitions apply:

**3.2.1 equipment:** Hardware or software or a combination of both; it need not be physically distinct within a computer system.

**3.2.2 transport service user:** An abstract representation of the totality of those entities within a single system that make use of the transport service.

**3.2.3 network service provider:** An abstract machine that models the totality of the entities providing the network service, as viewed by a transport entity.

**3.2.4 local matter:** A decision made by a system concerning its behavior in the Transport Layer that is not subject to the requirements of this protocol.

**3.2.5 initiator:** A transport entity that initiates a CR TPDU.

**3.2.6 responder:** A transport entity with whom an initiator wishes to establish a transport connection.

NOTE – Initiator and responder are defined with respect to a single transport connection. A transport entity can be both an initiator and responder simultaneously.

**3.2.7 sending transport entity:** A transport entity that sends a given TPDU.

**3.2.8 receiving transport entity:** A transport entity that receives a given TPDU.

**3.2.9 preferred class:** The protocol class that the initiator indicates in a CR TPDU as its first choice for use over the transport connection.

**3.2.10 alternative class:** A protocol class that the initiator indicates in a CR TPDU as an alternative choice for use over the transport connection.

**3.2.11 proposed class:** A preferred class or an alternative class.

**3.2.12 selected class:** The protocol class that the responder indicates in a CC TPDU that it has chosen for use over the transport connection.

**3.2.13 proposed parameter:** The value for a parameter that the initiator indicates in a CR TPDU that it wishes to use over the transport connection.

**3.2.14 selected parameter:** The value for a parameter that the responder indicates in a CC TPDU that it has chosen for use over the transport connection.

**3.2.15 error indication:** An N-RESET indication, or an N-DISCONNECT indication with a reason code indicating an error, that a transport entity receives from the NS-provider.

**3.2.16 invalid TPDU:** A TPDU that does not comply with the requirements of this International Standard for structure and encoding.

**3.2.17 protocol error:** A TPDU whose use does not comply with the procedures for the class.

**3.2.18 sequence number:**

a) the number in the TPDU-NR field of a DT TPDU that indicates the order in which the DT TPDU was transmitted by a transport entity;

b) the number in the YR-TU-NR field of an AK or RJ TPDU that indicates the sequence number of the next DT TPDU expected to be received by a transport entity.

**3.2.19 transmit window:** The set of consecutive sequence numbers which a transport entity has been authorized by its peer entity to send at a given time on a given transport connection.

**3.2.20 lower window edge:** The lowest sequence number in a transmit window.

**3.2.21 upper window edge:** The sequence number which is one greater that the highest sequence number in the transmit window.

**3.2.22 upper window edge allocated to the peer entity:** The value that a transport entity communicates to its peer entity to be interpreted as its new upper window edge.

**3.2.23 closed window:** A transmit window that contains no sequence number.

**3.2.24 window information:** Information contained in a TPDU relating to the upper and the lower window edges.

**3.2.25 frozen reference:** A reference that is not available for assignment to a connection because of the requirements of 6.18.

**3.2.26 unassigned reference:** A reference that is neither currently in use for identifying a transport connection nor which is in a frozen state.

**3.2.27 transparent (data):** TS-user data that is transferred intact between transport entities and which is unavailable for use by the transport entities.

**3.2.28 owner (of a network connection):** The transport entity that issued the N-CONNECT request leading to the creation of that network connection. Only applicable when operating over the connection-mode network service.

**3.2.29 retained TPDU:** A TPDU that is subject to the retransmission procedure or retention and acknowledgement procedure and is available for possible retransmission.

**3.3** This International Standard use the following terms defined in ISO/IEC 8348:

a) connection-mode network service

b) connectionless-mode network service

**3.4** This International Standard uses the following terms defined in ISO/IEC 9646-1:

a) PICS proforma

b) protocol implementation conformance statement (PICS)

## 4 Symbols and abbreviations

### 4.1 Data units

| | |
|---|---|
| TPDU | Transport-protocol-data-unit |
| TSDU | Transport-service-data-unit |
| NSDU | Network-service-data-unit |

### 4.2 Types of Transport Protocol data units

| | |
|---|---|
| CR TPDU | Connection request TPDU |
| CC TPDU | Connection confirm TPDU |
| DR TPDU | Disconnect request TPDU |
| DC TPDU | Disconnect confirm TPDU |
| DT TPDU | Data TPDU |
| ED TPDU | Expedited data TPDU |
| AK TPDU | Data acknowledge TPDU |
| EA TPDU | Expedited acknowledge TPDU |
| RJ TPDU | Reject TPDU |
| ER TPDU | Error TPDU |

### 4.3 TPDU Fields

| | |
|---|---|
| LI | Length indicator (field) |
| CDT | Credit (field) |
| TSAP-ID | Transport-service-access-point identifier (field) |
| DST-REF | Destination reference (field) |
| SRC-REF | Source reference (field) |
| EOT | End of TSDU mark |
| TPDU-NR | DT TPDU number (field) |
| ED-TPDU-NR | ED TPDU number (field) |
| YR-TU-NR | Sequence number response (field) |
| YR-EDTU-NR | ED TPDU number response (field) |
| ROA | Request of acknowledgement mark |

### 4.4 Times and associated variables

| | |
|---|---|
| T1 | Local retransmission time |
| N | The maximum number of transmissions |
| L | Time bound on reference and sequence number |
| I | Inactivity time |
| W | Window time |
| TTR | Time to try reassignment/resynchronization |
| TWR | Time to wait for reassignment/resynchronization |
| TS1 | Supervisory timer 1 |
| TS2 | Supervisory timer 2 |
| $M_{LR}$ | NSDU lifetime local-to-remote |
| $M_{RL}$ | NSDU lifetime remote-to-local |
| $E_{LR}$ | Expected maximum transit delay local-to-remote |
| $E_{RL}$ | Expected maximum transit delay remote-to-local |
| R | Persistence time |
| $A_L$ | Local acknowledgement time |
| $A_R$ | Remote acknowledgement time |
| $I_L$ | Local inactivity time |
| $I_R$ | Remote inactivity time |

### 4.5 Miscellaneous

| | |
|---|---|
| TS-user | Transport-service user |
| TSAP | Transport-service-access-point |
| NS-provider | Network service provider |
| AP | Network-service-access-point |
| QOS | Quality of service |
| CLNS | Connectionless-mode network service |
| CONS | Connection-mode network service |

## 5 Overview of the Transport Protocol

NOTE – This overview is not exhaustive and has been provided for guidance.

### 5.1 Service provided by the Transport Layer

The protocol specified in this International Standard supports the Transport Service defined in ISO 8072.

Information is transferred to and from the TS-user in the transport service primitives listed in Table 1.

### 5.2 Service Assumed from the Network Layer

The protocol specified in this International Standard assumes the use of the Network Service defined in ISO/IEC 8348.

When operating over CONS, information is transferred to and from the NS-provider in the network service primitives listed in Table 2a). When operating over CLNS, information is transferred to and from the NS-provider in the network service primitives listed in table 2b).

NOTES

1 The parameters listed in Table 2a) are those in the current connection-mode network service (see ISO/IEC 8348).

2 The parameters listed in table 2b) are those in the current connectionless-mode network service (see ISO/IEC 8348).

3 The way the parameters are exchanged between the transport entity and the NS-provider is a local matter.

**Table 1 – Transport Service Primitives**

| Primitives | | Parameters |
|---|---|---|
| T-CONNECT | request<br>indication | Called Address<br>Calling Address<br>Expedited data option<br>Quality of service<br>TS-user data |
| T-CONNECT | response<br>confirm | Responding address<br>Quality of service<br>Expedited data option<br>TS-user-data |
| T-DATA | request<br>indication | TS-user-data |
| T-EXPEDITED DATA | request<br>indication | TS-user-data |
| T-DISCONNECT | request | TS-user-data |
| T-DISCONNECT | indication | Disconnect reason<br>TS-user-data |

**Table 2a) – Connection-mode network service primitives**

| Primitives | | X/Y | Parameters | W/X/Y/Z |
|---|---|---|---|---|
| N-CONNECT | request | X | Called Address<br>Calling Address | X<br>X |
| | indication | X | Receipt confirmation selection<br>Expedited data selection<br>QOS parameter set<br>NS-user-data | Y<br>Y<br>X<br>Z |
| N-CONNECT | response<br>confirm | X<br>X | Responding Address<br>Receipt confirmation selection<br><br>Expedited data selection<br>QOS parameter set<br>NS-user-data | X<br>Y<br><br>Y<br>X<br>Z |
| N-DATA | request<br>indication | X<br>X | N-user-data<br>Confirmation request | X<br>Y |
| N-DATA ACKNOWLEDGE | request<br>indication | Y<br>Y | | |
| N-EXPEDITED DATA | request<br>indication | Y<br>Y | NS-user-data | Y |
| N-RESET | request<br>indication | X<br>X | Reason<br>Originator<br>Reason | W<br>W<br>W |
| N-RESET | response<br>confirm | X<br>X | —<br>— | |
| N-DISCONNECT | request | X | Reason<br>NS-user-data<br>Responding address | W<br>Z<br>Z |
| | indication | X | Originator<br>Reason<br>NS-user-data<br>Responding address | W<br>W<br>Z<br>Z |

Key:
W: The usage of this parameter is a local matter, e.g. for diagnostic or to decide whether to attempt resynchronization.
X: The Transport Protocol assumes that this facility is provide in all networks.
Y: The Transport Protocol assumes that this facility is provided in some networks and a mechanism is provided to optionally use the facility.
Z: The Transport Protocol does not use this parameter.

**Table 2b) – Connectionless-mode network service primitives**

| Primitives | | X/Y | Parameters | W/X/Y/Z |
|---|---|---|---|---|
| N-UNITDATA | request | X | Source Address<br>Destination Address<br>Quality of service<br>NS-user-data | X<br>X<br>X<br>X |
| | indication | X | Source Address<br>Destination Address<br>Quality of service<br>NS-user-data | X<br>X<br>X<br>X |

Key:
W: The usage of this parameter is a local matter, e.g. for diagnostic or to decide whether to attempt resynchronization.
X: The Transport Protocol assumes that this facility is provide in all networks.
Y: The Transport Protocol assumes that this facility is provided in some networks and a mechanism is provided to optionally use the facility.
Z: The Transport Protocol does not use this parameter.

## 5.3 Functions of the Transport Layer

### 5.3.1 Overview of Functions

The functions in the Transport Layer are those necessary to bridge the gap between the services available from the Network Layer and those to be offered to the TS-users.

The functions in the Transport Layer are concerned with the enhancement of quality of service, including aspects of cost optimization.

These functions are grouped below into those used at all times during a transport connection and those concerned with connection establishment, data transfer and release.

NOTE – This International Standard does not include the following functions which are under consideration for inclusion in future editions of this International Standard:

a) encryption;

b) accounting mechanisms;

c) status exchanges and monitoring of QOS;

d) blocking;

e) temporary release of network connections;

f) alternative checksum algorithm.

#### 5.3.1.1 Functions used at all times

The following functions, depending upon the selected class and options, are used at all times during a transport connection:

a) transmission of TPDUs (6.2 and 6.9);

b) multiplexing and demultiplexing (see 6.15): A function used only when operating over CONS to share a single network connection between two or more transport connections;

c) error detections (see 6.10, 6.13 and 6.17): A function used to detect the loss, corruption, duplication, misordering, or misdelivery of TPDUs;

d) error recovery (see 6.12, 6.14, 6.18, 6.19, 6.20, 6.21, and 6.22): A function used to recover from detected and signalled errors.

#### 5.3.1.2 Connection Establishment

The purpose of connection establishment is to establish a transport connection between two TS-users. The following functions of the transport layer during this phase match the TS-users' requested quality of service with the services offered by the network layer:

a) select the network service which best matches the requirement of the TS-user taking into account charges for various services (see 6.5);

b) decide whether to multiplex multiple transport connections onto a single network connection only when operating over CONS (see 6.5);

c) establish the optimum TPDU size (see 6.5);

d) select the functions that will be operational upon entering the data transfer phase (see 6.5);

e) map transport addresses onto network addresses;

f) provide a means to distinguish between two different transport connections (see 6.5);

g) transport of TS-user data (see 6.5);

h) exchange values of Inactivity timers (see 6.5).

#### 5.3.1.3 Data Transfer

The purpose of data transfer is to permit duplex transmission of TSDUs between the two TS-users connected by the transport connection. This purpose is achieved by means of two-way simultaneous communication and by the following functions, some of which are used or not used in accordance with the result of the selection performed in connection establishment.

a) concatenation and separation (see 6.4): a function used to collect several TPDUs into a single NSDU at the sending transport entity and to separate the TPDUs at the receiving transport entity;

b) segmenting and reassembling (see 6.3): a function used to segment a single data TSDU into multiple TPDUs at the sending transport entity and to reassemble them into their original format at the receiving transport entity;

c) splitting and recombining (see 6.23): a function allowing, only when operating over CONS, the simultaneous use of two or more network connections to support the same transport connection;

d) flow control (see 6.16): a function used to regulate the flow of TPDUs between two transport entities on one transport connection;

e) transport connection identification: a means to uniquely identify a transport connection between the pair of transport entities supporting the connection during the lifetime of the transport connection;

f) expedited data (see 6.11): a function used to bypass the flow control of normal data TPDU. Expedited data TPDU flow is controlled by separate flow control;

g) TSDU delimiting (see 6.3): a function used to determine the beginning and ending of a TSDU.

#### 5.3.1.4 Release

The purpose of release (see 6.7 and 6.8) is to provide disconnection of the transport connection, regardless of the current activity.

### 5.4 Classes and options when operating over CONS

#### 5.4.1 General

The functions of the Transport Layer have been organized into classes and options.

A class defines a set of functions. Options define those functions within a class which may or may not be used.

This International Standard defines five classes of protocol:

a) class 0: simple class;

b) class 1: basic error recovery class;

c) class 2: multiplexing class;

d) class 3: error recovery and multiplexing class;

e) class 4: error detection and recovery class.

NOTES

1 Transport connections of classes 2, 3 and 4 may be multiplexed together onto the same network connection.

2 Classes 0 to 3 do not specify mechanisms to detect unsignalled network transmission failures.

#### 5.4.2 Negotiation

The use of classes and options is negotiated during connection establishment. The choice made by the transport entities will depend upon

a) the TS-users' requirements expressed via T-CONNECT service primitives;

b) the quality of the available network services;

c) the user required service versus cost ratio acceptable to the TS-user.

#### 5.4.3 Choice of network connection

The following list classifies network services in terms of quality with respect to error behavior in relation to user requirements; its main purpose is to provide a basis for the decision regarding which class of transport protocol should be used in conjunction with given network connection:

a) Type A: Network connection with acceptable residual error rate (for example, not signalled by disconnect or reset) and acceptable rate of signalled errors.

b) Type B: Network connections with acceptable residual error rate (for example, not signalled by disconnect or reset) but unacceptable rate of signalled errors.

c) Type C: Network connections with unacceptable residual error rate.

It is assumed that each transport entity is aware of the quality of service provided by particular network connections.

#### 5.4.4 Characteristics of class 0

Class 0 provides the simplest type of transport connection and is fully compatible with the CCITT Recommendation T.70 for teletex terminals.

Class 0 has been designed to be used with type A network connections.

#### 5.4.5 Characteristics of class 1

Class 1 provides a basic transport connection with minimal overheads.

The main purpose of the class is to recover from network disconnect or reset.

Selection of this class is usually based on reliability criteria. Class 1 has been designed to be used with type B network connections.

#### 5.4.6 Characteristics of class 2

##### 5.4.6.1 General

Class 2 provides a way to multiplex several transport connections onto a single network connection. This class has been designed to be used with type A network connections.

##### 5.4.6.2 Use of explicit flow control

The objective is to provide flow control to help avoid congestion at transport-connection-end-points and on the network connection. Typical use is when traffic is heavy and continuous, or when there is intensive multiplexing. Use of flow control can optimize response times and resource utilization.

##### 5.4.6.3 Non-use of explicit flow control

The objective is to provide a basic transport connection with minimal overheads suitable when explicit disconnection of the transport connection is desirable. The option would typically be used for unsophisticated terminals, and when no multiplexing onto network connections is required. Expedited data is never available.

#### 5.4.7 Characteristics of class 3

Class 3 provides the characteristics of class 2 plus the ability to recover from network disconnect or reset. Selection of this class is usually based upon reliability criteria. Class 3 has been designed to be used with type B network connections.

#### 5.4.8 Characteristics of class 4

Class 4 provides the characteristics of class 3, plus the capability to detect and recover from errors which occur as a result of the low grade of service available from the NS-provider. The kind of errors to be detected include: TPDU loss, TPDU delivery out of sequence, TPDU duplication and TPDU corruption. These errors may affect control TPDUs as well as data TPDUs.

This class also provides for increased throughput capability and additional resilience against network failure.

Class 4 has been designed to be used with type C network connections.

### 5.5 Characteristics of class 4 transport protocol when operating over CLNS

In operation over a connectionless-mode network service the class 4 transport procotol provides flow control between communicating peer transport entities, the capability to detect and recover from errors which occur as a result of a low grade of service available from the NS-provider, and resilience from failure of the peer entity. The kinds of error to be detected include: TPDU loss, TPDU delivery out of sequence, TPDU duplication and TPDU corruption. These errors may affect control TPDUs as well as data TPDUs.

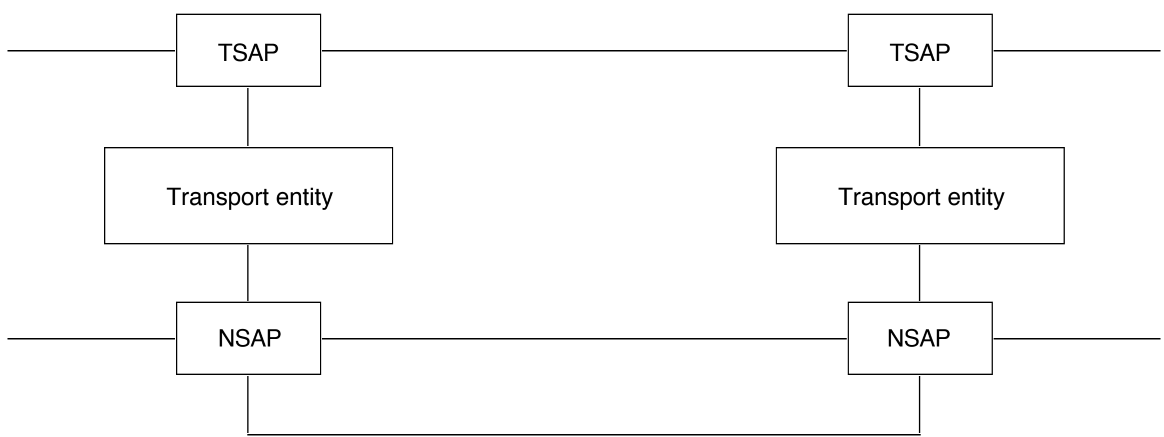
NOTE – The transport entity is incapable of distinguishing between failure of the network service and failure of the peer entity, except optionally, by some local means, in the case of the failure of the local interface to the network service (e.g., in the failure of the local transceiver on a local area network).

There is no indication given to the transport entity about the ability of the network entity to fulfill the service requirements given in the N-UNITDATA primitive. However, it can be a local matter to make transport entities aware of the availability and characteristics (QOS) of connectionless-mode network services, as the corresponding NSAP associations, exist logically by the nature of the connectionless-mode network service and may be recognized by network entities.

### 5.6 Model of the transport layer

A transport entity communicates with its TS-users through one or more TSAPs by means of the service primitives as defined by the transport service definition (see ISO 8072). Service primitives will cause or be the result of transport protocol data unit exchanges between the peer transport entities supporting a transport connection. These protocol exchanges are effected using the services of the Network Layer as defined by the network service definition (see ISO/IEC 8348) through one or more NSAPs.

Transport connection endpoints are identified in end systems by an internal, implementation dependent, mechanism so that the TS-user and the transport entity can refer to each transport connection.




NOTE – For the purposes of illustration, figure 2 shows only one TSAP and one NSAP for each transport entity. In certain instances, more than one TSAP and/or more than one NSAP may be associated with a particular transport entity.

**Figure 2 – Model of the transport layer**