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Information processing systems — Open Systems Interconnection — Protocol for providing the connectionless-mode transport service

Systèmes de traitement de l'information — Interconnexion de systèmes ouverts — Spécification du protocole pour fournir un service de transport en mode sans connexion

Reference number
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Foreword

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council. They are approved in accordance with ISO procedures requiring at least 75 % approval by the member bodies voting.

International Standard ISO 8602 was prepared by Technical Committee ISO/TC 97, *Information processing systems.*

Users should note that all International Standards undergo revision from time to time and that any reference made herein to any other International Standard implies its latest edition, unless otherwise stated.

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Information processing systems — Open Systems Interconnection — Protocol for providing the connectionless-mode transport service

0 Introduction

This International Standard is one of a set of International Standards produced to facilitate the interconnection of computer systems. The set of International Standards covers the services and protocols 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 a protocol of the Transport Layer. It is most closely related to the transport service definition (ISO 8072) and the addendum to the transport service definition covering connectionless-mode transmission (ISO 8072/Add. 1), the network service definition (ISO 8348), and the addendum to the network service definition covering connectionless-mode transmission (ISO 8348/Add. 1). The interrelationship of these International Standards is illustrated in figure 1.

The structure of this International Standard is similar to the structure of ISO 8073 in order to facilitate cross reference between the two standards.

1 Scope and field of application

This International Standard specifies

a) procedures for the connectionless-mode transmission of data and protocol control information from one transport entity to one peer transport entity;

b) the encoding of the transport-protocol-data-units used for the transmission of data and control information;

c) procedures for the correct interpretation of transport protocol control information; and

d) the functional requirements for implementations claiming conformance to this International Standard.

The procedures are defined in terms of

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

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

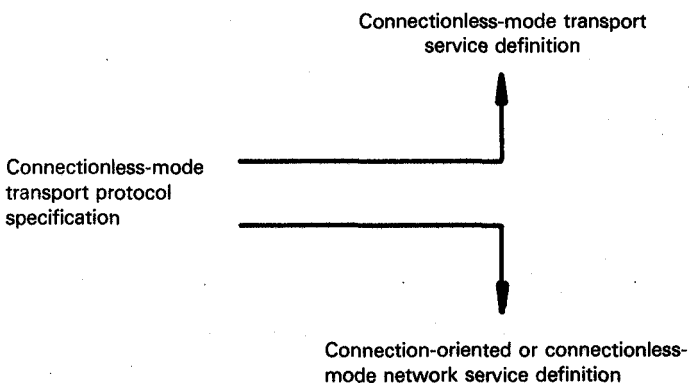

Figure 1 — Relationship between the connectionless-mode transport protocol and adjacent services

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

This International Standard specifies the connectionless-mode transport protocol. The connection oriented transport protocol is specified in ISO 8073.

2 References

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

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

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

ISO 8072/Add. 1, *Information processing systems — Open Systems Interconnection — Transport service definition — Addendum 1 : Connectionless-mode transmission.*

ISO 8073, *Information processing systems — Open Systems Interconnection — Connection oriented transport protocol specification.*

ISO 8073/Add. 1, *Information processing systems — Open Systems Interconnection — Connection oriented transport protocol specification — Addendum 1 : Network connection management subprotocol.*[1)]

ISO 8348, *Information processing systems — Data communications - Network service definition.*

ISO 8348/Add. 1, *Information processing systems — Data Communications — Network service definition — Addendum 1 : Connectionless-mode transmission.*

1) At present at the stage of draft; publication anticipated in due course.

Section one : General

3 Definitions

3.1 Reference Model definitions

This International Standard is based on the concepts developed in ISO 7498 and ISO 7498/Add. 1, and makes use of the following terms defined therein :

a) Transport Layer;

b) transport service;

c) transport-service-access-point;

d) transport-service-access-point-address;

e) transport-service-data-unit;

f) Network Layer;

g) network service;

h) *network connection;*

i) network-service-access-point;

j) transport protocol;

k) connectionless-mode transmission.

3.2 Definition from ISO 8073/Add. 1

This International Standard also uses the term below which is defined in ISO 8073/Add. 1. This reference to ISO 8073/Add. 1 does not necessarily imply that the procedures of ISO 8073/Add. 1 are required for the proper operation of the protocol specified in this International Standard.

UN TPDU

3.3 Additional definitions

For the purposes of this International Standard, the following definitions apply.

3.3.1 source-transport-address : Identifies the TSAP through which the transport service user may act as the source of data during a particular instance of transport connectionless-mode transmission.

3.3.2 destination-transport-address : Identifies the TSAP through which the transport service user may act as the sink of data during a particular instance of transport connectionless-mode transmission.

3.3.3 connection oriented transport protocol : See 3.1, "transport protocol".

3.3.4 connection oriented transport service : See 3.1, "transport service".

3.3.5 connection oriented network service : See 3.1, "network service".

3.3.6 connectionless-mode transport protocol : *Transport protocol* for providing the connectionless-mode transport service.

3.3.7 connectionless-mode transport service : Transport service providing connectionless-mode transmission.

3.3.8 connectionless-mode network service : Network service providing connectionless-mode transmission.

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

UD TPDU Unit data TPDU
UN TPDU Use of network connection TPDU

4.3 TPDU fields

LI Length indicator

4.4 Parameters

Source TSAP-ID
Destination TSAP-ID
Checksum

4.5 Miscellaneous

TS-user Transport service user
TSAP Transport-service-access-point
NSAP Network-service-access-point

5 Overview of the transport protocol

5.1 Service provided by the Transport Layer

The service provided by the protocol described herein is a connectionless-mode transport service. The connectionless-mode transport service is described in ISO 8072/Add. 1. The transport service primitives provided are summarized in table 1.

Table 1 — Transport service primitives

Primitives	Parameters
T-UNITDATA request	Source address Destination address Quality of service TS-user-data
T-UNITDATA indication	Source address Destination address Quality of service TS-user-data

5.2 Service assumed from the Network Layer

The transport protocol described in this International Standard can operate over the connection oriented network service defined in ISO 8348 and over the connectionless-mode network service defined in ISO 8348/Add. 1.

When operating over the connection oriented network service, the network service primitives given in table 2 are used.

When operating over the connectionless-mode network service, the network service primitives given in table 3 are used.

5.3 Functions of the Transport Layer

5.3.1 Connectionless-mode transfer functions

The purpose of connectionless-mode transfer is to allow the transfer of data between correspondent TS-users on a connectionless basis. This service provides for single-access data transfer for correspondent TS-users without the overhead of transport connection establishment. This purpose is achieved by using functions specific to the connectionless-mode transport protocol. The connectionless-mode transfer functions are primarily intended to benefit those applications that require a one-time, one-way transfer of data, towards one TS-user, taking advantage of mechanisms more simple than the connection oriented ones.

5.3.2 Overview of functions

The functions in the Transport Layer are at least those necessary to bridge the gap between the service available from the Network Layer and the service to be offered to the transport service users.

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

5.3.2.1 Transmission of TPDUs

5.3.2.2 Network service selection

This function selects the network service that best matches the requirements of the TS-user, taking into account charges for various services.

5.3.2.3 Address mapping

This function determines the network address that will be used as the destination address parameter in an N-UNITDATA request or as the called address parameter in an N-CONNECT request by examining the transport address specified by the destination address parameter of a T-UNITDATA request.

5.3.2.4 TSDU delimiting

This function determines the beginning and end of a TSDU.

5.3.2.5 Error detection

This function provides end-to-end error detection for correspondent TS-users utilizing the connectionless-mode transport service. The error detection mechanism is defined in 6.4.

5.4 Model of the Transport Layer

A transport entity communicates with a TS-user through one or more TSAPs by means of transport service primitives, defined in ISO 8072 and in ISO 8072/Add. 1. These transport service primitives cause or result from the exchange of TPDUs between peer transport entities engaged in connectionless-mode transmission. These protocol exchanges are effected by making use of the services of the Network Layer, as defined in ISO 8348 and ISO 8348/Add. 1.

The model of connectionless-mode transport service is presented in 9.2 of ISO 8072/Add. 1.

Table 2 — Connection oriented network service primitives

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

Key :

X : The transport protocol assumes that this facility is provided 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 facility and will ignore it when received.

Table 3 — Connectionless-mode network service primitives

Primitives	X/Y/Z	Parameters	X/Y/Z
N-UNITDATA request	X	Destination address	X
		Source address	X*
		Quality of service	X
		NS-user-data	X
N-UNITDATA indication	X	Destination address	X*
		Source address	X
		Quality of service	X
		NS-user-data	X

* This parameter may be implicitly associated with the network-service-access-point at which the primitive is issued.

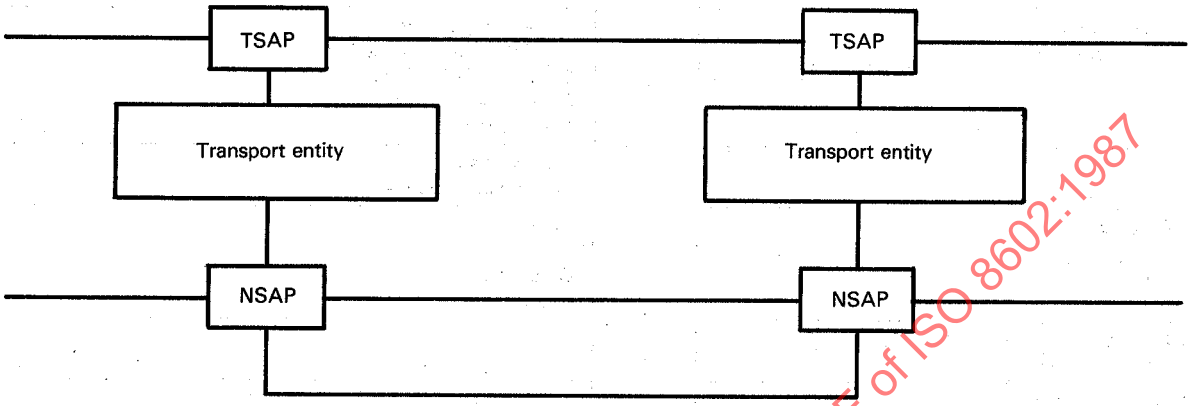

Figure 2 — Model of the Transport Layer

Section two : Connectionless-mode transport protocol specification

6 Protocol mechanisms

6.1 Transport-protocol-data-unit (TPDU) transfer

6.1.1 Purpose

The TPDU transfer procedure is used to convey transport-protocol-data-units in user data fields of network service primitives.

6.1.2 Network service primitives

The procedure uses the following network service primitives :

a) N-DATA (request, indication);

b) N-UNITDATA (request, indication).

6.1.3 TPDU used

The TPDU defined for the connectionless-mode transport protocol is the following :

UD UNITDATA

6.2 Transfer over the connectionless-mode network service

6.2.1 Purpose

The procedure of transfer over the connectionless-mode network service is used for one-time, one-way transferring of a TSDU between TS-users without confirmation of receipt, without transport connection establishment and release, and without network connection establishment and release.

6.2.2 Network service primitives

The procedure uses the following network service primitives :

N-UNITDATA (request, indication)

6.2.3 TPDU and parameters used

The procedure uses the following TPDU and parameters :

UD — Checksum;
— Source TSAP-ID;
— Destination TSAP-ID;
— User data.

6.2.4 Procedure

6.2.4.1 Sending a UD TPDU

The source and destination address parameters of the T-UNITDATA request service primitive are used to determine the source network address, source TSAP-ID, destination network address, and destination TSAP-ID.

The quality of service parameter in the T-UNITDATA request is used to determine if a checksum should be included in the unit data UD TPDU.

NOTE — If the length of the TSDU given in the T-UNITDATA request, plus the PCI of the UD TPDU exceeds the maximum NSDU size supported by the network service, then the TSDU is discarded and a local report may be made to the TS-user indicating the inability of the Transport Layer to provide the service requested.

A UD TPDU is constructed with a checksum parameter (if necessary), a source TSAP-ID, a destination TSAP-ID, and the user data field from the T-UNITDATA request.

An N-UNITDATA request service primitive is issued with the source and destination network addresses determined above, the quality of service requested and a user data field containing the UD TPDU.

6.2.4.2 Receiving a UD TPDU

The UD TPDU arrives in the user data field of an N-UNITDATA indication.

If a checksum parameter is present in the UD TPDU then a checksum verification will be made of the UD TPDU using the algorithm defined in 6.4. If the result of this verification is false, then the TPDU is discarded. If the result of this verification is true, or if the checksum mechanism is not used, then the transport entity will construct a T-UNITDATA indication and provide it to the appropriate transport service user.

The source network address from the N-UNITDATA indication and the source TSAP-ID from the UD TPDU will be used to determine the source address parameter for the T-UNITDATA indication.

The destination network address from the N-UNITDATA indication and the destination TSAP-ID from the UD TPDU will be used to determine the destination address parameter for the T-UNITDATA indication.

The user data field of the UD TPDU will be mapped to the user data parameter of the T-UNITDATA indication.

The QOS parameter is derived from the *a priori* knowledge of the QOS available from the association and whether the checksum mechanism was used.

6.2.4.3 Use of connectionless-mode network service

Each TPDU is transmitted by the use of the connectionless-mode network service over a pre-existing association between a pair of NSAPS. This association is considered by transport entities as permanently established and available.

There is no indication given to transport-entities about the ability of the network entity to fulfil 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.

6.3 Transfer over the connection oriented network service

This procedure is an optional procedure (see clause 8).

6.3.1 Purpose

The procedure of transfer over the connection oriented network service is used for one-time, one-way transferring of a TSDU between TS-users without confirmation of receipt, without transport connection establishment and release, and with network connection establishment and release.

6.3.2 Network service primitives

The procedure uses the following network service primitives :

a) N-CONNECT (request, indication, response, confirmation);

b) N-DATA (request, indication);

c) N-DISCONNECT (request, indication);

d) N-RESET (indication, response).

6.3.3 TPDUs and parameters used

The procedure uses the following TPDUs and parameters :

a) UD — Checksum,
— Source TSAP-ID,
— Destination TSAP-ID,
— User data;

b) UN — PRT-ID, defined in ISO 8073/Add. 1.

6.3.4 Procedure

6.3.4.1 Establishment and release of network connection

The source and destination address parameters of the T-UNITDATA request primitive are used to determine the source network address, source TSAP-ID, destination network address, and the destination TSAP-ID.

If a network connection to the destination network address does not already exist, or one exists but may not be used to send UD TPDU (i.e. it supports transport connections), an N-CONNECT request is issued with these parameters, together with a UN TPDU specifying that this network connection is to be used for the exchange of UD TPDUs only. The remote entity answers the N-CONNECT request by sending either an N-CONNECT response or an N-DISCONNECT request.

If an N-DISCONNECT indication is received by the sending entity, the network connection is not established.

If an N-CONNECT confirmation is received by the sending entity, the network connection is established, and both transport entities have the right to exchange UD TPDUs on the network connection, and to release the network connection by sending an N-DISCONNECT request.

If an N-RESET indication is received, the transport entity shall respond with an N-RESET response, and the procedure terminates.

6.3.4.2 Sending a UD TPDU

The quality of service parameter in the T-UNITDATA request is used to determine if a checksum mechanism should be used. If the checksum mechanism is used, a checksum parameter will be included in the UD TPDU.

If the network connection already exists or is established a UD TPDU is constructed with a checksum parameter (if necessary), a source TSAP-ID, a destination TSAP-ID, and the user data field from the T-UNITDATA request. An N-DATA request service primitive is issued with the UD TPDU contained in the user data field, and a local timer (the transaction timer) is set to ensure that the transaction takes place before the network connection is released.

If an N-DISCONNECT indication is received, the transaction timer is stopped (if it was set) and the procedure terminates.

If the transaction timer expires, it is a local decision whether or not the network connection is released.

6.3.4.3 Receiving a UD TPDU

If the checksum parameter is present in a UD TPDU then a checksum verification shall be made of the TPDU using the algorithm defined in 6.4. If the UD TPDU does not pass the checksum test it is discarded.

The source address parameter for the T-UNITDATA indication will be determined from the remote network address associated with the network connection and the source TSAP-ID from the UD TPDU. The destination address parameter for the T-UNITDATA indication will be determined from the local network address associated with the network connection and the destination TSAP-ID from the UD TPDU.

The QOS parameter is derived from the knowledge of the QOS available from the network connection and whether the checksum mechanism is used.

6.4 Checksum

6.4.1 Purpose

The checksum procedure is used to detect corruption of TPDUs by the network service provider.

6.4.2 TPDU and parameter used

The procedure uses the following TPDU and parameter :

UD — Checksum

6.4.3 Procedure

The sending transport entity shall transmit UD TPDUs with the checksum parameter set such that the following formulae are satisfied :

$$\sum_{i=1}^{L} a_i = 0 \text{ (modulo 255)}$$

$$\sum_{i=1}^{L} i a_i = 0 \text{ (modulo 255)}$$

where

i is the number (i.e. position) of an octet within the TPDU;

a_i is the value of the octet in position i;

L is the length of TPDU, in octets.

A transport entity which receives a TPDU which does not satisfy the above formulae shall discard the TPDU.

NOTES

1 An efficient algorithm for determining the checksum parameters is given in annex B.

2 The checksum proposed is easy to calculate and so will not impose a heavy burden on implementations. However, it will not detect insertion or loss of leading or trailing zeros and will not detect some octet misordering.

7 Encoding of the unit data (UD) TPDU

The procedures described in this International Standard require one TPDU. The encoding of that TPDU, unit data (UD), is described in this clause.

NOTE — The encoding of the UN TPDU is described in ISO 8073/Add. 1.

7.1 General

A UD TPDU shall contain an integral number of octets. The octets in a TPDU are numbered starting from 1 and increasing in the order they are put into an NSDU. The bits in an octet are numbered from 1 to 8, where bit 1 is the low-ordered bit.

TPDUs shall contain, in the following order

a) the header, comprising :

1) the length indicator (LI) field,

2) the fixed part,

3) the variable part, if present;

b) the data field, if present.

7.1.1 Length indicator field

This field is contained in the first octet of the TPDUs. The length is indicated by a binary number, with a maximum value of 254 (1111 1110). The length indicated shall be the header length in octets including parameters, but excluding the length indicator field and user data. The value 255 (1111 1111) is reserved for possible extensions.

7.1.2 Fixed part

This field contains the TPDU code and is contained in octet 2 of the header. The only code valid is 0100 0000, which is the code of the UD TPDU.

7.1.3 Variable part

Each parameter contained within the variable part is structured as follows :

Octets	Bits 8 7 6 5 4 3 2 1
$n + 1$	Parameter code
$n + 2$	Parameter length indication (m)
$n + 3$	Parameter value
$n + 2 + m$	

The parameter code field is coded in binary.

NOTE — Without extensions, it provides a maximum number of 255 different parameters. However, as noted below, bits 8 and 7 cannot take every possible value, so the practical maximum number of different parameters is less. Parameter code 1111 1111 is reserved for possible extension of the parameter code.

The parameter length indication indicates the length, in octets, of the parameter value field.

NOTE — The length is indicated by a binary number, m, with a theoretical maximum value of 255. The practical maximum value of m is lower. For example, in the case of a single parameter contained within the variable part, two octets are required for the parameter code and the parameter length indication itself. Thus, the value of m is limited to 248. For larger fixed parts of the header and for each succeeding parameter, the maximum value of m decreases.

The parameter value field contains the value of the parameter identified in the parameter code field.

No parameter code uses bits 8 and 7 with the value 00.

The parameters defined in the variable part may be in any order. If any parameter is duplicated then the last value shall be used. A parameter not defined in this International Standard shall be treated as a protocol error. A parameter defined in this International Standard but having an invalid value shall be treated as a protocol error.

7.1.3.1 Checksum parameter

A TPDU may contain a 16-bit checksum parameter in its variable part.

Parameter code : 1100 0011

Parameter length : 2

Parameter value : result of checksum algorithm; this algorithm is specified in 6.4.

7.1.4 Data field

This field contains transparent user data. Restrictions on its size are noted for each TPDU.

7.2 Unit data (UD) TPDU

7.2.1 Structure

1	2	3	p	$p+1$	max.
LI	UD 0100 0000	Variable part		User data	

7.2.2 LI (octet 1)

See 7.1.1.

7.2.3 Fixed part (octet 2)

This part shall contain only the unit data TPDU code : 0100 0000.

7.2.4 Variable part (octets 3 to p)

The following parameters are permitted in the variable part.

7.2.4.1 Transport-service-access-point identifier (TSAP-ID)

All UD TPDUs contain source and destination TSAP identifiers in the variable part of their header.

Parameter code : source TSAP 1100 0001
destination TSAP 1100 0010

Parameter length : not defined in this International Standard

Parameter value : identifier of the source and destination TSAP, respectively

7.2.4.2 Checksum

A UD TPDU may contain the checksum parameter in the variable part of the header.

Parameter code : 1100 0011

Parameter length : 2

Parameter value : result of the checksum algorithm

7.2.5 User data

This field contains all of the data of the TSDU being transmitted. The length of this field may be restricted to the maximum available NSDU size and is restricted to the maximum NSDU size (see ISO 8348/Add. 1) minus the size of the UD TPDU header.

8 Conformance

8.1 A system claiming to implement the procedures specified in this International Standard shall comply with the requirements in 8.2 and 8.3.

8.2 The system shall meet the elements of procedure described in 6.2 and 6.4.

8.3 The system may optionally provide the elements of procedure described in 6.3. In so doing, the system shall operate over a network connection which has been explicitly identified for this purpose by the explicit identification procedures defined in ISO 8073/Add. 1.

8.4 Claims of conformance shall state whether the option described in 6.3 is implemented.

8.5 The transport entity shall be able to transmit and receive TSDUs of a size up to and including the maximum size of the N-UNITDATA, as defined in ISO 8348/Add. 1, minus an allowance for the maximum size UD TPDU header, whether the optional procedure defined in 6.3 is utilized or not.

Annex A

State table

(This annex forms an integral part of this standard.)

This annex provides a more precise description of the protocol specified in this International Standard. In the event of a discrepancy between the description in this table and that contained in the text, the text takes precedence.

The state table is intended to describe the behaviour of the connectionless-transport entity when operating over either a connectionless-mode network service or a connection oriented network service. In the latter case, the behaviour is described with respect to a particular network connection and does not consider the actions for managing multiple network connections.

Table 4 — Predicates

Name	Description
P0	Operating over connectionless-mode network service
P1	A network connection exists and is appropriate for use
P2	T-UNITDATA objects being held for this network connection (see note 1)
P3	Local choice (see note 4)

Table 5 — Actions

Name	Description
[1]	Set timer (when last UD TPDU has been sent)
[2]	Discard any T-UNITDATA objects being held

Table 6 — Notes

Name	Description
(1)	Local option to hold T-UNITDATA objects while waiting for the network connection
(2)	A UD TPDU is formed corresponding to each T-UNITDATA object held
(3)	Acceptable UD TPDU
(4)	To allow retention of network connection in order to avoid short-term release and re-establishment of a network connection

Table 7 — State table

Event \ State	READY	NC-PENDING
T-UNITDATA req	P0 : UD; not P0 & P1 : UD [1]; not P0 & not P1 : (1) N-CON req NC-PENDING;	(1);
N-CON conf (UN in data field)		P2 : UD (2) [1] READY; not P2 & P3 : READY; not P2 & not P3 : N-DISC req READY;
N-DISC ind	P2 & P3 :; P2 & not P3 : N-CON req, NC-PENDING; not P2 :;	P2 : [2] READY;
N-RESET ind	N-RESET resp;	
Timer expires	P3 :; not P3 : N-DISC req;	
UD (3)	T-UNITDATA ind;	