INTERNATIONAL TELECOMMUNICATION UNION

ITU-T X.234

TELECOMMUNICATION
STANDARDIZATION SECTOR
OF ITU

(07/94)

DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS

OPEN SYSTEMS INTERCONNECTION – CONNECTIONLESS-MODE PROTOCOL SPECIFICATIONS

INFORMATION TECHNOLOGY – PROTOCOL FOR PROVIDING THE OSI CONNECTIONLESS-MODE TRANSPORT SERVICE

ITU-T Recommendation X.234

(Previously "CCITT Recommendation")

Foreword

ITU (International Telecommunication Union) is the United Nations Specialized Agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of the ITU. Some 179 member countries, 84 telecom operating entities, 145 scientific and industrial organizations and 38 international organizations participate in ITU-T which is the body which sets world telecommunications standards (Recommendations).

The approval of Recommendations by the Members of ITU-T is covered by the procedure laid down in WTSC Resolution No. 1 (Helsinki, 1993). In addition, the World Telecommunication Standardization Conference (WTSC), which meets every four years, approves Recommendations submitted to it and establishes the study programme for the following period.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC. The text of ITU-T Recommendation X.234 was approved on 1st July 1994. The identical text is also published as ISO/IEC International Standard 8602.

NOTE

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

ITU-T X-SERIES RECOMMENDATIONS
DATA NETWORKS AND OPEN SYSTEM COMMUNICATIONS
(FEBRUARY 1994)

ORGANIZATION OF X-SERIES RECOMMENDATIONS

Subject Area	Recommendation Series
PUBLIC DATA NETWORKS	
Services and Facilities	X.1-X.19
Interfaces	X.20-X.49
Transmission, Signalling and Switching	X.50-X.89
Network Aspects	X.90-X.149
Maintenance	X.150-X.179
Administrative Arrangements	X.180-X.199
OPEN SYSTEMS INTERCONNECTION	
Model and Notation	X.200-X.209
Service Definitions	X.210-X.219
Connection-mode Protocol Specifications	X.220-X.229
Connectionless-mode Protocol Specifications	X.230-X.239
PICS Proformas	X.240-X.259
Protocol Identification	X.260-X.269
Security Protocols	X.270-X.279
Layer Managed Objects	X.280-X.289
Conformance Testing	X.290-X.299
INTERWORKING BETWEEN NETWORKS	
General	X.300-X.349
Mobile Data Transmission Systems	X.350-X.369
Management	X.370-X.399
MESSAGE HANDLING SYSTEMS	X.400-X.499
DIRECTORY	X.500-X.599
OSI NETWORKING AND SYSTEM ASPECTS	
Networking	X.600-X.649
Naming, Addressing and Registration	X.650-X.679
Abstract Syntax Notation One (ASN.1)	X.680-X.699
OSI MANAGEMENT	X.700-X.799
SECURITY	X.800-X.849
OSI APPLICATIONS	
Commitment, Concurrency and Recovery	X.850-X.859
Transaction Processing	X.860-X.879
Remote Operations	X.880-X.899
OPEN DISTRIBUTED PROCESSING	X.900-X.999

CONTENTS

Summary

This Recommendation | International Standard specifies:

a) the 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; and

c) the functional requirements for implementations claiming conformance to this Recommendation.

Introduction

This Recommendation | International Standard is one of a set of Recommendations and International Standards produced to facilitate the interconnection of computer systems. The set of Recommendations and International Standards covers the services and protocols required to achieve such interconnection.

This Recommendation | International Standard is positioned with respect to other related Recommendations and International Standards by the layers defined in the Reference Model for Open Systems Interconnection (see ITU-T Rec. X.200 | ISO/IEC 7498-1). In particular, it is a protocol of the Transport Layer. It is most closely related to the transport service definition (see ITU-T Rec. X.214 | ISO/IEC 8072) and the network service definition (see CCITT Rec. X.213 | ISO/IEC 8348). The interrelationship between these Recommendations and International Standards is illustrated in Figure 1.

The structure of this Recommendation | International Standard is similar to the structure of ITU-T Rec. X.224 | ISO/IEC 8073 in order to facilitate cross reference between the two transport protocols.

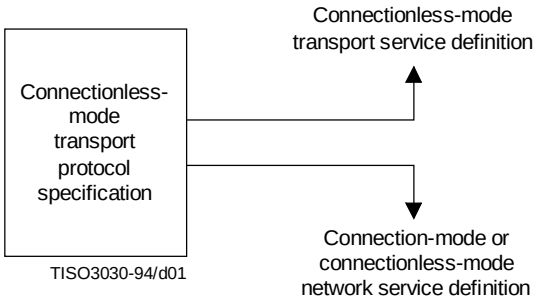

Figure 1 – Relationship between the connectionless-mode transport protocol and adjacent services

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – PROTOCOL FOR PROVIDING THE OSI CONNECTIONLESS-MODE TRANSPORT SERVICE

1 Scope

This Recommendation | 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 Recommendation | 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

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

This Recommendation | International Standard specifies the connectionless-mode transport protocol and provides the PICS Proforma in compliance with the relevant requirements, and in accordance with the relevant guideline, given in CCITT Rec. X.291 | ISO/IEC 9646-2. The protocol for providing the connection-mode transport service is specified in ITU-T Rec. X.224 | ISO/IEC 8073.

2 Normative references

The following Recommendations and International Standards contain provisions, which through references in the text, constitute provisions of this Recommendation | 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 Recommendation | International Standard are encouraged to investigate the possibility of applying the most recent edition 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.*

– CCITT Recommendation X.213 (1992) | ISO/IEC 8348:1993, *Information technology – Network service definition for Open Systems Interconnection*

– ITU-T Recommendation X.214 (1993) | ISO/IEC 8072:1994, *Information technology – Open System Interconnection – Transport service definition.*

2.2 Paired Recommendations | International Standards equivalent in technical content

– ITU-T Recommendation X.224 (1993), *Protocol for providing the OSI connection-mode transport service.*

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

– ITU-T Recommendation X.264 (1993), *Transport protocol identification mechanism.*

ISO/IEC 11570:1992, Information technology – *Telecommunications and information exchange between systems – Open Systems Interconnection – Transport protocol identification mechanism.*

– CCITT Recommendation X.290 (1992), *OSI conformance testing methodology and framework for protocol Recommendations for CCITT applications – General Concepts.*

ISO/IEC 9646-1:1991, *Information technology – Open Systems Interconnection – Conformance testing methodologies and framework – Part 1: General concepts.*

– CCITT Recommendation X.291 (1992), *OSI conformance testing methodology and framework for protocol Recommendations for CCITT applications – Abstract test suite specification.*

ISO/IEC 9646-2:1991, Information technology – *Open Systems Interconnection – Conformance testing methodologies and framework – Part 2: Abstract test suite specification.*

SECTION 1 – GENERAL

3 Definitions

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

3.1 Reference Model definitions

This Recommendation | International Standard is based on the concepts developed in ITU-T Rec. X.200 | ISO/IEC 7498-1, 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 This Recommendation | International Standard uses the following terms defined in CCITT Rec. X.290 | ISO/IEC 9646-1:

a) PICS Proforma;

b) protocol implementation conformance statement (PICS).

3.3 Additional definitions

For the purposes of this Recommendation | 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 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 (defined in ITU-T Rec. 264 | ISO/IEC 11570)

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 ITU-T Rec. X.214 | ISO/IEC 8072. 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 Recommendation | International Standard can operate over the connection oriented network service and over the connectionless-mode network service as defined in CCITT Rec. X.213 | ISO/IEC 8348.

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 one-time, one-way transfer of data, towards one TS-user, taking advantage of mechanisms more simple that 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.

Table 2 – Connection-mode 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
	confirm	X	Receipt confirmation selection	Z
			Expedited data selection	Z
			QOS parameter set	X
			NS-user-data	Z
N-DATA	request	X	N-user-data	X
	indication	X	Confirmation request	Z
N-RESET	request	X	Reason	Z
	indication	X	Originator	Z
			Reason	Z
N-RESET	response	X		
	confirm	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

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	Source address	X[a)]
			Destination address	X
			Quality of service	X
			NS-user-data	X
	indication	X	Source address	X
			Destination address	X[a)]
			Quality of service	X
			NS-user-data	X

[a)] This parameter may be implicitly associated with the network-service-access-point at which the primitive is issued.

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 ITU-T Rec. X.214 | ISO/IEC 8072. 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 CCITT Rec. X.213 | ISO/IEC 8348.

The model of connectionless-mode transport service is presented in clause 16 of ITU-T Rec. X.214 | ISO/IEC 8072.

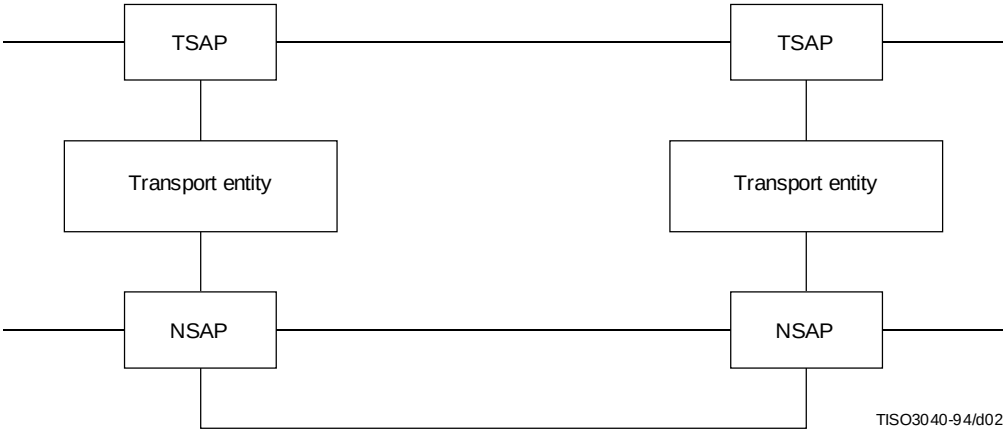

Figure 2 – Model of the Transport Layer

SECTION 2 – 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 TPDU

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 used 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 the verification is false, then the TPDU is discarded. If the result of the 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 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.

6.3 Transfer over the connection oriented network service

This procedure if 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, confirm);

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 ITU-T Rec. X.264 | ISO/IEC 11570.

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 the 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 caused 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 formulas are satisfied:

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

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

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 C.

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 Recommendation | 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 ITU-T Rec. X.264 | ISO/IEC 11570.

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 a 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 1 – Without extensions, it provides a maximum number of 255 different parameters. However, as noted below, bits 8 and 4 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 2 – 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 Recommendation | International Standard shall be treated as a protocol error. A parameter defined in this Recommendation | 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 Destination TSAP	1100 0001 1100 0010
Parameter length:	Not defined in this Recommendation | 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 the data of the TSDU being transmitted. The length of this field

a) may be restricted to the maximum available NSDU size minus the size of the UD TPDU header; and

b) is restricted to the maximum NSDU size (see CCITT Rec. X.213 | ISO/IEC 8348) minus the size of the UD TPDU header.

8 Conformance

8.1 A system claiming to implement the procedures specified in this Recommendation | 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 ITU-T Rec. X.264 | ISO/IEC 11570.

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 CCITT Rec. X.213 | ISO/IEC 8348, minus an allowance for the maximum size UD TPDU header, whether the optional procedure defined in 6.3 is utilized or not.

8.6 The supplier of a protocol implementation which is claimed to conform to this International Standard is required to complete a copy of the Protocol Implementation Conformance Statement (PICS) proforma provided in Annex B and is required to provide the information necessary to identify fully both the supplier and the implementation.

Annex A

State table

(This annex forms an integral part of this Recommendation | International Standard)

This annex provides a more precise description of the protocol specified in this Recommendation | 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 behavior 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 behavior is described with respect to a particular network connection and does not consider the actions for managing multiple network connections.

Table A.1 – Predicates

Name	Description
P1	Operating over connectionless-mode network service
P2	T-UNITDATA objects being held for this network connection (see Note 1)
P3	Local choice (see Note 4)

Table A.2 – Actions

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

Table A.3 – Notes

Name	Description
(1)	Local option to held T-UNITDATA objects while waiting for the network connection
(2)	A UD TPDU is formed corresponding to each T-UNITDATA objects 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 A.4 – State table

State / Event	READY	NC-PENDING
T-UNITDATAreq	P0:UD; not P0 & P1: UD [1]; not P0 & not P1: (1) N-CONreq NC-PENDING;	(1);
N-DISC ind	P2 & P3:; P2 & not P3: N-CONreq NC-PENDING; not P2:;	P2: [2] READY;
N-RESER ind	N-RESET resp;	
Timer expires	P3:; not P3: N-DISC req;	
UD (3)	T-UNITDATA ind;	

Annex B[1)]

PICS proforma

(This annex forms an integral part of this Recommendation | International Standard)

B.1 Introduction

The supplier of a protocol implementation which is claimed to conform to ITU-T Rec.234 | ISO/IEC 8602 shall complete the following Protocol Implementation Conformance Statement (PICS) proforma.

A completed PICS proforma is the PICS for the implementation in question. The PICS is a statement of which capabilities and options of the protocol have been implemented. The PICS can have a number of uses, including use:

- by the protocol implementor, as a check-list to reduce the risk of failure to conform to the standard through oversight;
- by the supplier and acquirer – or potential acquirer – of the implementation, as a detailed indication of the capabilities of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;
- by the user – or potential user – of the implementation, as a basis for initially checking the possibility of interworking with another implementation (note that, while interworking can never be guaranteed, failure to interwork can often be predicted from incompatible PICSs);
- by a protocol tester, as a basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

---

1) **Copyright release for PICS Proformas**

Users of this Recommendation | International Standard may freely reproduce the PICS proforma in this annex so that it can be used for its intended purpose and may further publish the completed PICS.

B.2 Abbreviations and special symbols

B.2.1 Status symbols

M mandatory

O optional

<item>: conditional-item symbol, dependent upon the support marked form <item>.

B.2.2 Support Symbols

Yes Supported

No Not Supported

N/A Not Applicable

B.3 Instructions for Completing the PICS Proforma

The main part of each PICS proforma is a fixed-format questionnaire. Answers to the questionnaire items are to be provided in the rightmost column, by marking the appropriate answer (Yes, No, N/A).

A supplier may also provide, or be required to provide, further information, categorized as either Additional Information or Exception Information. When present, each kind of further information is to be provided in a further subclause of items labelled A<i> or X<i> respectively for cross referencing purpose, where <i> is any unambiguous identification for the item (e.g. simply a numeral): there are no other restrictions on its format and presentation.

A completed PICS proforma is the Protocol Implementation Conformance Statement for the implementation in question.

Items of Additional Information allow a supplier to provide further information intended to assist the interpretation of the PICS. It is not intended or expected that a large quantity will be supplied, and a PICS can be considered complete without any such information. References to items of Addition Information may be entered next to any answer in the questionnaire, and may be included in items of Exception Information.

It may occasionally happen that a supplier will wish to answer an item with mandatory status (after any conditions have been applied) in a way that conflicts with the indicated requirement. No pre-printed answer will be found in the Support column for this: instead, the supplier shall write the missing answer into the Support column, together with an X<i> reference to an item of Exception Information, and shall provide the appropriate rationale in the Exception item itself.

B.4 Identification

B.4.1 Implementation

Supplier	
Contact point for queries about the PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification – e.g. name(s) and version(s) of machines and/or operating systems; System Name(s)	

NOTES

1 Only the first three items are required for all implementations; other information may be completed as appropriate in meeting the requirement for full identification.

2 The terms Name and Version should be interpreted appropriately to correspond with a supplier's terminology (e.g. Type, Series, Model).

B.4.2 Protocol Summary

Identification of Protocol Specification	ITU-T X.234 | ISO/IEC 8602:1994
Have any exception items been required? No[ ] Yes[ ] (the answer Yes means that the implementation does not conform to ITU-T X.234 | ISO/IEC 8602:1994	

Date of Statement	

B.5 Base Standard/Recommendation Conformance

Does the implementation claim conformance to ITU-T X.234 | ISO/IEC 8602	

B.6 General Statement of Conformance

Are all mandatory features of ITU-T X.234 | ISO/IEC 8602 implemented?	
NOTE – Answering 'No' to this question indicates non-conformance to the Recommendation | International Standard.	

B.7 PICS Proforma

B.7.1 Protocol Function Support

Item	Protocol Function	References (Subclause)	Status	Support
NS	Network service selection provided?	5.3.2.2	M	Yes
AM	Address mapping provided?	5.3.2.3	M	Yes

B.7.2 Protocol Data Unit Support

Item	Protocol Data Unit	References (Subclause)	Status	Support
UD1	Unitdata PDU supported on transmission	6.1.3	M	Yes
UD2AM	Unitdata PDU supported on reception	6.1.3	M	Yes
UN1	Use of Network connection PDU supported on transmission	6.3.3	CO:M	Yes N/A
UN2	Use of Network connection PDU supported on reception	6.3.3	CO:M	Yes N/A

B.7.2.1 Parameters of the Unitdata PDU on transmission

Item	Protocol Data Unit Parameter	References (Subclause)	Status	Support
TpTc	TPDU Unitdata Checksum	6.2.4.1, 6.3.4.2	O	Yes No
TpTs	TPDU Unitdata Source TSAP-ID	6.2.4.1, 6.3.4.2	M	Yes
TpTd	TPDU Unitdata Destination TSAP-ID	6.2.4.1 6.3.4.2	M	Yes
TpTu	TPDU Unitdata User Data	6.2.4.1, 6.3.4.2	M	Yes

B.7.2.2 Parameters of the Unitdata PDU on Reception

Item	Protocol Data Unit Parameter	References (Subclause)	Status	Support
TpRc	TPDU Unitdata Checksum	6.2.4.2, 6.3.4.3	M	Yes
TpRs	TPDU Unitdata Source TSAP-ID	6.2.4.2, 6.3.4.3	M	Yes
TpRd	TPDU Unitdata Destination TSAP-ID	6.2.4.2 6.3.4.3	M	Yes
TpRu	TPDU Unitdata User Data	6.2.4.2, 6.3.4.3	M	Yes

B.7.3 Service Support

Item	Service Name	References (Subclause)	Status	Support
CL	Connectionless-mode Network Service	6.2	M	Yes
CO	Connection-mode Network Service	6.3	O	Yes No

Annex C

Checksum algorithms

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

C.1 Symbols

The following symbols are used:

C0, C1 are variables used in the algorithms;

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

n is the number (i.e. position) of the first octet of the checksum parameter;

L is the length of the complete TPDU;

X is the value of the first octet of the checksum parameter;

Y is the value of the second octet of the checksum parameter.

C.2 Arithmetic conventions

Addition is performed in one of the two following modes:

a) modulo 255 arithmetic;

b) ones complement arithmetic in which if any of the variables has the value minus zero (i.e. 255) it shall be regarded as though it was plus zero (i.e. 0).

C.3 Algorithm for generating checksum parameters

C.3.1 Set up the complete TPDU with the value of the checksum parameter field set to zero.

C.3.2 Initialize C0 and C1 to zero.

C.3.3 Process each octet sequentially from $i = 1$ to L by

a) adding the value of the octet to C0; then

b) adding the value of C0 to C1.

C.3.4 Calculate X and Y such that

$$X = -C1 + (L - n)\,C0$$

$$Y = C1 - (L - n + 1)\,C0$$

C.3.5 Place the values X and Y in octets n and $(n + 1)$ respectively

NOTE – This algorithm calculates

$$C1 = \sum_{i=1}^{L} (L - i + 1)ai$$

which is equal to zero, if the formulae in 6.4.3 are followed, since

$$\sum_{i=1}^{L} (L - i + 1)ai = (L + 1)\sum_{i=1}^{L} ai - \sum_{i=1}^{L} iai = 0$$

C.4 Algorithm for checking checksum parameters

C.4.1 Initialize C0 and C1 to zero.

C.4.2 Process each octet of the TPDU sequentially from $i = 1$ to L by

a) adding the value of the octet to C0; then

b) adding the value of C0 to C1.

C.4.3 If, when all the octets have been processed, one or both of the parameters C0 and C1 do not have the value zero, the checksum formulae in 6.4 have not been satisfied.

NOTE – The nature of the algorithm is such that it is not necessary to compare explicitly the stored checksum bytes.