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Information technology — Protocol for providing the connectionless-mode network service: Provision of the underlying service by an X.25 subnetwork

Technologies de l'information — Protocole de fourniture du service de réseau en mode sans connexion: Fourniture du service sous-jacent par un sous-réseau X.25

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Contents

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.

International Standard ISO/IEC 8473-3 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 6, *Telecommunications and information exchange between systems*, in collaboration with ITU-T. The identical text is published as ITU-T Recommendation X.622.

ISO/IEC 8473 consists of the following parts, under the general title *Information technology — Protocol for providing the connectionless-mode network service*:

— *Part 1: Protocol specification*

— *Part 2: Provision of the underlying service by an ISO/IEC 8802 subnetwork*

— *Part 3: Provision of the underlying service by an X.25 subnetwork*

— *Part 4: Provision of the underlying service by a subnetwork that provides the OSI data link service*

Annex A forms an integral part of this part of ISO/IEC 8473.

Introduction

This is one of a set of Recommendations and International Standards produced to facilitate the interconnection of open systems. The set 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 ITU-T Rec. X.200 | ISO/IEC 7498-1. In particular, it defines the way in which an X.25 subnetwork may be used within the Network layer to provide the abstract underlying service with respect to which the protocol defined by ITU-T Rec. X.233 | ISO/IEC 8473-1 is specified.

In order to evaluate the conformance of a particular implementation of this protocol, it is necessary to have a statement of which of the protocol's capabilities and options have been implemented. Such a statement is called a Protocol Implementation Conformance Statement (PICS), as defined in CCITT Rec. X.290 | ISO/IEC 9646-1. A PICS proforma, from which a PICS may be prepared for a specific implementation, is included in this Recommendation | International Standard as normative Annex A.

INTERNATIONAL STANDARD

ITU-T RECOMMENDATION

INFORMATION TECHNOLOGY – PROTOCOL FOR PROVIDING THE CONNECTIONLESS-MODE NETWORK SERVICE: PROVISION OF THE UNDERLYING SERVICE BY AN X.25 SUBNETWORK

1 Scope

This Recommendation | International Standard specifies the way in which the underlying service assumed by the protocol defined by ITU-T Rec. X.233 | ISO/IEC 8473-1 is provided by a subnetwork that conforms to ITU-T Recommendation X.25 through the operation of a Subnetwork Dependent Convergence Function (SNDCF) as described in ISO/IEC 8648.

This Recommendation | International Standard also provides the PICS proforma for this protocol, in compliance with the relevant requirements, and in accordance with the relevant guidance, given in CCITT Rec. X.290 | ISO/IEC 9646-1.

2 Normative references

The following Recommendations and International Standards contain provisions which, through reference in this 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 editions of the Recommendations and Standards listed below. Members of IEC and ISO maintain registers of currently valid International Standards. The Telecommunication Standardization Bureau of the ITU maintains a list of currently valid ITU-T Recommendations.

2.1 Identical Recommendations | International Standards

- ITU-T Recommendation X.200 (1994) | ISO/IEC 7498-1:1994, *Information technology – Open Systems Interconnection – Basic Reference Model.*
- CCITT Recommendation X.213 (1992) | ISO/IEC 8348:1993, *Information technology – Network service definition for Open Systems Interconnection.*

2.2 Paired Recommendations | International Standards identical in technical content

- 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 methodology and framework – Part 1: General concepts.*

2.3 Additional references

- ITU-T Recommendation X.25 (1993), *Interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE) for terminals operating in the packet mode and connected to public data networks by dedicated circuit.*
- CCITT Recommendation X.121 (1992), *International numbering plan for public data networks.*
- ISO/IEC 8208:1990, *Information technology – Data communications – X.25 Packet Layer Protocol for Data Terminal Equipment.*
- ISO/IEC 8648:1988, *Information processing systems – Open Systems Interconnection – Internal organization of the network layer.*

3 Definitions

3.1 Reference model definitions

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

a) network entity;

b) Network layer;

c) service;

d) service data unit;

e) protocol control information.

3.2 Network layer architecture definitions

This Recommendation | International Standard makes use of the following terms defined in ISO/IEC 8648:

a) subnetwork;

b) subnetwork dependent convergence protocol;

c) subnetwork dependent convergence function;

d) subnetwork access protocol.

3.3 Network layer addressing definitions

This Recommendation | International Standard makes use of the following term defined in CCITT Rec. X.213 | ISO/IEC 8348:

– subnetwork point of attachment.

3.4 X.25 definitions

This Recommendation | International Standard makes use of the following terms defined in ITU-T Rec. X.25 and ISO/IEC 8208:

a) data circuit-terminating equipment;

b) data terminal equipment;

c) logical channel;

d) permanent virtual circuit;

e) virtual circuit.

4 Abbreviations

CLNP	Connectionless-mode network protocol
DCE	Data circuit-terminating equipment
DTE	Data terminal equipment
PDU	Protocol data unit
PVC	Permanent virtual circuit
QoS	Quality of service
SDU	Service data unit
SN	Subnetwork
SNDCF	Subnetwork dependent convergence function
SNDCP	Subnetwork dependent convergence protocol
SNICP	Subnetwork independent convergence protocol
SNAcP	Subnetwork access protocol
SNPA	Subnetwork point of attachment

SNCR Subnetwork connection reference

SNSDU Subnetwork service data unit

5 Subnetwork dependent convergence function

5.1 General model

The general model for providing the underlying service assumed by the protocol in conjunction with a real subnetwork that uses a connectionless subnetwork access protocol is as follows. The generation of an SN-UNITDATA Request by the CLNP results in the generation of a corresponding subnetwork-specific UNITDATA request by the subnetwork dependent convergence function. The receipt of a subnetwork-specific UNITDATA indication associated with delivery of a connectionless data unit to its destination causes the SNDCF to generate an SN-UNITDATA Indication to the CLNP.

The general model for providing the underlying service assumed by the CLNP in conjunction with a real subnetwork that uses a connection-mode subnetwork access protocol is as follows. The generation of an SN-UNITDATA Request by the CLNP causes a connection (logical channel, logical link, or the equivalent) to be made available for the transmission of SN-User-data. If a connection cannot be made available, the SN-UNITDATA Request is discarded. The receipt of subnetwork-specific PDUs containing SN-User-data causes the SNDCF to generate an SN-UNITDATA Indication to the CLNP.

Where a real subnetwork is designed to use either a connectionless-mode or a connection-mode subnetwork access protocol, the provision of the underlying service assumed by the CLNP is achieved by using the connectionless-mode alternative.

5.2 Subnetwork user data

The SN-Userdata is an ordered multiple of octets, and is transferred transparently between the specified subnetwork points of attachment.

The underlying service assumed by the CLNP is required to support a service data unit size of at least 512 octets.

If the minimum service data unit sizes supported by all of the subnetworks involved in the transmission of a particular PDU are known to be large enough that segmentation is not required, then either the full protocol or the non-segmenting protocol subset may be used.

Data received from a subnetwork with protocol identification specifying this protocol (see ITU-T Rec. X.233 | ISO/IEC 8473-1) shall be processed according to this Recommendation | International Standard.

NOTE – Data with other protocol identification should be ignored, since it may have been sent by an implementation supporting additional protocols intended for use with this protocol.

5.3 Subnetwork dependent convergence functions used with X.25 subnetworks

The connection-mode service offered by subnetworks that use the X.25 Packet Level Protocol defined in ISO/IEC 8208 or ITU-T Rec. X.25 is manipulated by the subnetwork dependent convergence function so that a virtual circuit is made available for the transmission of SN-User-data following the generation of an SN-UNITDATA Request by the CLNP. In general, no explicit subnetwork dependent convergence protocol control information is exchanged between peer network entities during the data phase of operation in order to provide this mapping of service.

The SN-Destination-Address and SN-Source-Address parameters in the SN-UNITDATA request and indication are the CCITT Rec. X.121 DTE addresses used by the X.25 subnetwork.

If the X.25 subnetwork does not provide calling DTE information, a null SN-Source-Address parameter is supplied in the SN-UNITDATA Indication. The SNDCF shall include its own DTE address in the "calling DTE" field of the X.25 Call Request packet, in the case that the subnetwork does not include this parameter but permits its inclusion by DTEs.

NOTE – Some subnetworks which use the X.25 PLP employ addressing schemes other than CCITT Rec. X.121. The use of addressing schemes other than CCITT Rec. X.121 (e.g. CCITT Recommendations E.163 and E.164) is not precluded.

The SN-User-data parameter carries user data up to a maximum size specified by the subnetwork authority. The underlying service assumed by ITU-T Rec. X.233 | ISO/IEC 8473-1 requires that a subnetwork be capable of supporting a minimum service data unit size of 512 octets.

NOTE – The M-bit may be used in cases where an X.25 subnetwork cannot directly support a minimum packet size of 512 octets as well as in situations where a service data unit size greater than the minimum is required, e.g. where the non-segmenting protocol subset is used.

5.3.1 Call setup considerations

The mechanism and timing for opening a virtual circuit prior to the transmission of SN-User-data are a local matter. The opening of a virtual circuit may be initiated by:

a) the arrival of an SNSDU to be transmitted over an X.25 subnetwork at a time when no suitable virtual circuit is available;

b) the local queue of requests waiting for an existing virtual circuit reaching a threshold size at which an additional virtual circuit shall be made available (if possible) to maintain the requested QoS; or

c) the explicit intervention of system management.

When it has been determined that a (new) virtual circuit must be made available, the calling SNDCF performs all functions associated with establishing a virtual circuit. The called SNDCF performs those operations associated with accepting a call, but generates no SN-UNITDATA indication until the call setup is completed, at which time X.25 Data packet(s) may be exchanged. In general, the receipt of X.25 Data packets containing SN-User-data causes the SNDCF to generate an SN-UNITDATA indication to the CLNP. X.25 Reset packets, if received, have no effect on the operation of the SNDCF. The necessary procedures for the correct operation of the X.25 PLP are followed.

5.3.2 Call clearing considerations

The mechanisms for determining when a virtual circuit is to be cleared following the transmission of SN-User-data by the SNDCF are local matters. Examples of circumstances which would cause the SNDCF to clear a virtual circuit are:

a) the expiration of a timeout period following the transmission of one or more PDUs (see 5.3.4);

b) the need to use a specific interface to open an alternate virtual circuit from the local network entity to a different remote network entity;

c) the explicit intervention of system management; or

d) a provider-initiated clear of a virtual circuit.

When it has been determined that a virtual circuit shall be cleared, the SNDCF performs all functions associated with clearing a call. All packets other than a Clear Confirmation or Clear Indication are ignored. The same actions apply to receipt of a Clear Indication. In these circumstances, the SNDCF will retain user data submitted via SN-UNITDATA requests while attempting to establish a new circuit; however, the SNDCF shall discard the user data if the transit delay indicated to the CLNP is likely to be exceeded.

NOTE – It is not a requirement that virtual circuits be dynamically opened or closed for the correct operation of the SNDCF herein described. The use of permanent virtual circuits (PVCs) or the maintenance of virtual circuits in a open state from system initialization is not precluded.

5.3.3 Protocol discrimination

The first octet of the call user data field of the Call Request packet shall be set to the value that indicates that the virtual circuit is to be used to provide the underlying service assumed by ITU-T Rec. X.233 | ISO/IEC 8473-1. The value is defined in ITU-T Rec. X.233 | ISO/IEC 8473-1.

5.3.4 Timeout periods

Timeout periods may be used to determine when a virtual circuit should be cleared (for example, when a virtual circuit has been idle for a long period of time) or when additional virtual circuits should be opened (for example, when there is an excessively long queue of data units waiting for the initial logical channel).

Implementations may choose to clear a virtual circuit after it has been idle for some period of time. If a timer is selected for this purpose, it is used in the following manner. When a virtual circuit is made available for the transmission of SNSDUs, a timer is initiated with a value representing the maximum period of time this virtual circuit may remain idle. Each time a data unit is transmitted by the underlying service, the timer is reset to this initial value. If no data units are queued for processing and this timer expires, the virtual circuit is cleared.

The selection of timeout values is a local matter.

NOTES

1 Additional virtual circuits may be opened when there is an excessively long queue of data units waiting for the initial logical channel. The timeout periods for determining when such additional virtual circuits are to be cleared may be shorter than the timeout period for the initial virtual circuit. (The timeout period may also be a fixed period of time.) Implementations may choose to close all additional virtual circuits if the queue of data units to be transmitted reaches some threshold (possibly zero).

2 Timeout periods are selected on the basis of economic and implementation-specific criteria. If there is no duration charge imposed by a given subnetwork authority for leaving a virtual circuit open, and if there is a charge for opening virtual circuits, then the timeout period may be selected so that the virtual circuit remains open for a long period of time. Timeout periods may also vary according to the time of day, traffic load (averaged over the recent past), or other factors.

5.3.5 Resolution of virtual circuit collisions

Two SNDCFs may simultaneously attempt to establish virtual circuits to each other. It is desirable to be able to detect this and to eliminate one virtual circuit while retaining the other, so as to avoid unnecessary call charges.

If the subnetwork supplies the DTE address of the calling DTE, it is possible to detect such a collision. A collision occurs when an incoming call is received from a DTE, while confirmation is still awaited for a previously initiated call to the same DTE.

If the calling DTE address is not supplied by the network, collisions are not detected.

A convention is established for determining which virtual circuit is to be preserved when a collision does occur. The convention is based on a comparison of the called and calling X.25 DTE addresses. The virtual circuit initiated by the SNDCF having the higher DTE address is the one which is retained.

Upon receipt of an X.25 Call Request packet while confirmation of a previously issued Call Request packet to the same DTE address is outstanding, an SNDCF shall perform the call collision resolution procedure described in the following steps:

a) The DTE address of the local SNDCF shall be compared with that of the remote SNDCF. If the addresses are of different length, the shorter is padded to the length of the longer by the addition of zero digits at the most significant (left) end of the address.

b) The comparison shall be performed, starting from the least significant (right) digit and progressing to the most (left).

c) As soon as a digit having the same position in each address has a different value, the comparison is stopped.

d) The address having the digit with the lower value (where 0 is the lowest and 9 is the highest) is regarded as being the lower address.

e) If the local SNDCF has the lower address, the SNDCF shall clear the virtual circuit which it initiated and accept the virtual circuit initiated by the remote SNDCF.

f) If the local SNDCF has the higher address, the SNDCF shall clear the virtual circuit initiated by the remote SNDCF and continue to await acceptance of the virtual circuit which it initiated.

If a request to establish a new virtual circuit is received once a virtual circuit is fully established, the new virtual circuit shall be accepted and that previously existing shall be cleared.

NOTE – This procedure is required in order to ensure rapid recovery from provider-initated clear of the virtual circuit in cases where both SNDCFs do not receive notification of this action at exactly the same time.

5.3.6 Use of multiple virtual circuits

In some circumstances, it may be desirable to use several X.25 virtual circuits between two network entities, for example, to increase throughput or resilience. In this case, each virtual circuit is separately visible to the CLNP and provides a distinct service. Each is supported by a distinct pair of independent SNDCFs. Nevertheless, it is necessary to distinguish between these independent virtual circuits in order to avoid incorrect detection of collisions.

Where multiple virtual circuits are required, they are distinguished during connection establishment by the conveyance of a two-octet subnetwork connection reference (SNCR) in the user data field of the X.25 Call Request packet. If no user data are present in the X.25 Call Indication packet (other than the protocol identifier encoded in octet 1), the receiving SNDCF shall proceed as though the SNCR had been explicitly conveyed with the value zero. When it is necessary to explicitly convey a subnetwork connection reference, the user data field of the X.25 Call Request Packet shall be set as illustrated in Table 1.

Table 1 – Subnetwork connection reference encoding

Protocol Identifier	Length Indication	SNCR version	SNCR value
Octet 1	Octet 2	Octet 3	Octet 4
0000 0000 or 1000 0001 (Note 1)	0000 0100	0000 0010	see 5.3.6