INTERNATIONAL STANDARD

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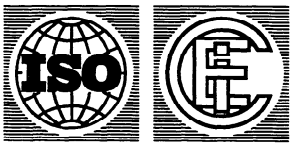
Information technology — Telecommunications and information exchange between systems — Use of X.25 to provide the OSI Connection-mode Network Service

Technologies de l'information — Télécommunications et échange d'informations entre systèmes — Utilisation du protocole X.25 pour fournir le service de réseau OSI en mode connexion



Reference number
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Foreword

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

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

International Standard ISO/IEC 8878 was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO 8878:1987), which has been technically revised. It consolidates Technical Corrigenda 1, 2 and 3, Addenda 1 and 2 and Amendment 1 as well as Technical Corrigendum 1 to Addendum 2.

NOTE — ISO/IEC DIS 8878-2 as well as defect reports 8878-012, 013, 014 and 015 have also been included in this second edition.

Annexes A, B, C and D form an integral part of this International Standard. Annexes E, F, G, H and I are for information only.

Introduction

This International Standard defines methods for providing the OSI Connection-Mode Network Service (CONS) through the use of the virtual circuit services of the X.25 Packet Layer Protocol (X.25 PLP). The method presented in the main body of this International Standard specifies a mapping between elements of the 1984 or later versions of the X.25/PLP (referred to as X.25/PLP-1984) using X.25 Virtual Call (VC) services and elements of the OSI CONS. Features associated with versions of X.25 later than 1984 are identified as to which version they relate. This International Standard is similar to CCITT Recommendation X.223; however, the two are currently published as separate documents.

Clause 13 contains the requirements for systems claiming conformance to this International Standard.

Other methods using other virtual circuit services and/or other versions of X.25 are also defined. In particular, a second method for VCs, which is presented in Annex A, defines a Subnetwork Dependent Convergence Protocol (SNDCP) that shall be used to provide the OSI CONS over subnetworks or with equipment using the 1980 or earlier versions of the X.25/PLP (referred to as X.25/PLP-1980). This SNDCP should only be used if the elements of the X.25/PLP-1984, as defined in 5.1 herein, are not available to support the OSI CONS. Annex B contains a classification of systems according to whether they implement the procedures defined in the main body of this International Standard, the procedures defined in Annex A, or both. In addition, it describes the possibilities and the rules for interworking between the classes of equipment identified.

Annexes A and B are integral parts of this International Standard. They are intended to provide a migration strategy towards the use of the 1984 version of X.25 in both subnetworks and DTEs. Because of the evolution of technology, the status of Annexes A and B will be reviewed in the future.

Annex C defines another method for providing the OSI CONS, in this case in conjunction with the PVC service of X.25.

Annex D provides the Protocol Implementation Conformance Statement (PICS) Proforma for this International Standard.

Annexes C and D are integral parts of this International Standard.

Annex E provides additional considerations on the relationship between the X.25 protocol procedures and the CONS primitives.

Annex F illustrates the use of X.25 Network Protocol Address Information (NPAI), i.e., the Address Field and the Address Extension Facilities.

Annex G illustrates the use of the X.25 transit delay facilities.

Annex H illustrates the use of the X.25 Priority Facility.

Annex I lists the differences between CCITT Rec. X.223 and ISO/IEC 8878.

Annexes E through I are not integral parts of this International Standard.

The relationship between the X.25/PLP-1984 and the OSI CONS is shown in Figure 1. This relationship is described only in terms of the Network Layer entities that provide the CONS. No discussion is given here to describe the actions of a Network Layer entity that only provides a relay function for a given network connection.

The OSI Network Service is defined in terms of

a) the primitive actions and events of the Service;

b) the parameters associated with each primitive action and event, and the form which they take;

c) the interrelationship between, and the valid sequences of, these actions and events.

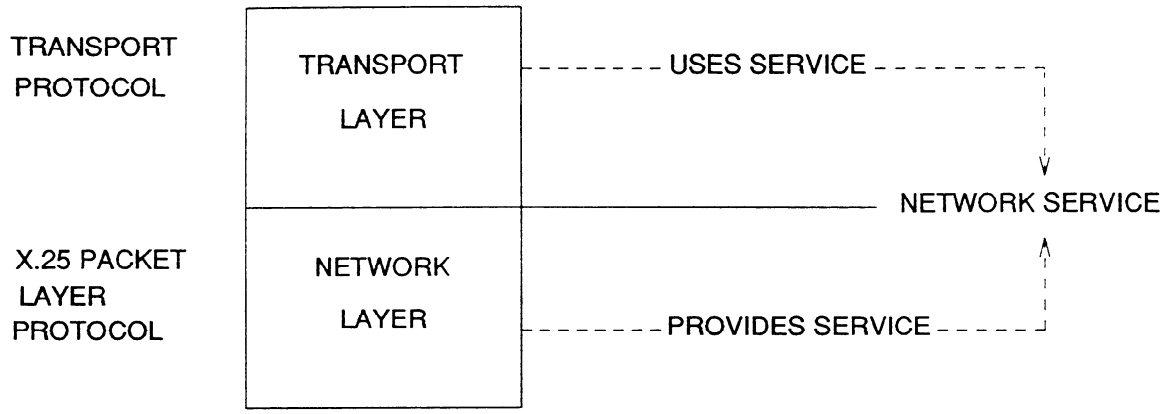


Figure 1 — Relationship of the X.25 Packet Layer Protocol to the OSI Connection-Mode Network Service

The OSI Network Service does not specify individual implementations or products nor does it constrain the implementation of entities and interfaces within a computer system.

The X.25/PLP-1984 is defined in terms of

a) procedures for Virtual Calls and Permanent Virtual Circuits;

b) formats of packets associated with these procedures;

c) procedures and formats for optional user facilities and CCITT-Specified DTE facilities.

The use of the word "Network" to name the "Network" Layer of the OSI Reference Model should be distinguished from the use of the word "network" to denote a communications network as conventionally understood. To facilitate this distinction, the term "subnetwork" is used for a collection of physical equipment, commonly called a "network" (reference CCITT Rec. X.200 | ISO 7498). Subnetworks may be either public or private networks. In the case of public networks, their properties may be determined by separate CCITT Recommendations such as CCITT Rec. X.21 for a circuit-switched network or CCITT Rec. X.25 for a packet-switched network.

Throughout the set of OSI-related Recommendations | International Standards, the term "Service" refers to the abstract capability provided by one layer of the OSI Reference Model to the layer above it. Thus, the Network Service is a conceptual architectural Service, independent of administrative divisions.

NOTE — It is important to distinguish the specialized use of the term "Service" within the set of OSI-related Recommendations | International Standards from its use elsewhere to describe the provision of a service by an organization (such as the provision of a service, as defined in CCITT Recommendations, by an Administration).

Information technology — Telecommunications and information exchange between systems — Use of X.25 to provide the OSI Connection-mode Network Service

1. Scope

The OSI Connection-mode Network Service (CONS) is defined in terms of a set of primitive actions and events and associated parameters. For a protocol to support this service, there must be a mapping between the abstract primitives and parameters of the CONS and the real elements of the protocol. For the X.25 Packet Layer Protocol (PLP), the main body of this International Standard provides such a mapping for the X.25/PLP-1984 using Virtual Calls.

This International Standard also provides a mapping of the CONS primitives and parameters to the X.25/PLP-1980 plus an SNDCP (Annex A). These mappings apply to the X.25 VC service. In addition, the method of selecting the appropriate mapping, if any, for different combinations of end systems and Network Layer relay systems implementing one or more of the mappings is defined (Annex B).

For the PVC service for both the X.25/PLP-1984 and the X.25/PLP-1980, a mapping of CONS primitives and parameters to the X.25/PLP is given in Annex C.

This International Standard specifies two sets of procedures from which three classes of implementation are described. The requirements of these procedures are applicable both to end system operation and to half the operation of a Network Layer relay. Where relay operation is concerned, the two halves of the relay may be the same or different classes of implementation.

This International Standard specifies the requirements to be met by a **System-1984** implementation. Implementations in this class are designed to operate directly and efficiently with other System-1984 implementations, including cases of operation across an X.25(1984) subnetwork.

This International Standard also specifies the procedures to be operated by a **System-1980** implementation. Implementations in this class are designed to operate directly with other System-1980 implementations, including cases of operation across any form of X.25 subnetwork, but will operate less efficiently than System-1984 implementations.

This International Standard also specifies the requirements to be met by a **Compatible** implementation. Implementations in this class are designed to operate directly with all other implementation classes, including cases of operation across any type of X.25 subnetwork. They make efficient use of X.25(1984) when placed in this environment.

The X.25/PLP is usually regarded as operating between an end system (i.e., a "Data Terminal Equipment" in X.25 terminology) and a packet-switched public data subnetwork. However, the X.25/PLP can also be used in other

environments to provide the OSI CONS. Examples of such other uses include

a) an end system connected to an X.25 packet-switched private data subnetwork;

b) an end system connected to a local area network;

c) direct connection or circuit-switched connection (including connection across a circuit-switched data subnetwork) of two end systems without an intervening packet-switched public data subnetwork;

d) an end system connected to an Integrated Services Digital Network.

2. Normative references

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

2.1 Identical Recommendations | International Standards

— CCITT Recommendation X.213 (1992) | ISO/IEC 8348:1992, *Information Technology — Network Service Definition for Open Systems Interconnection.*

2.2 Paired Recommendations | International Standards equivalent in technical content

— CCITT Recommendation X.25 (1988), *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.*

NOTE — This Recommendation is referred solely with respect to its Packet Layer Protocol description. However, this Recommendation fully specifies the behaviour of the DCE while specifying only a minimum set of requirements for the DTE. Additional guidance for the design of DTEs is available in ISO/IEC 8208.

ISO/IEC 8208:1990, *Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment.*

— CCITT Recommendation X.200 (1988), *Reference model of Open Systems Interconnection for CCITT applications.*

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

— CCITT Recommendation X.210 (1988), *Open Systems Interconnection layer service definition conventions.*

ISO/TR 8509:1987, *Information processing systems — Open Systems Interconnection — Service conventions.*

2.3 Additional references

— CCITT Recommendation X.96 (1988), *Call progress signals in Public Data Networks.*

3. Definitions

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

3.1 Reference Model definitions

The following terms, developed and defined in the OSI Reference Model (CCITT Rec. X.200 | ISO 7498), are used:

a) Network connection
b) Network Layer
c) Network Service
d) Network Service Access Point
e) Network Service Access Point address
f) Subnetwork

3.2 Service Conventions definitions

The following terms, as they apply to the Network Layer and as defined in the OSI Service Conventions (CCITT Rec. X.210 | ISO/TR 8509), are used:

a) Network Service user
b) Network Service provider
c) primitive
d) request
e) indication
f) response
g) confirm

3.3 Network Service definitions

The following terms, as defined in the Network Service (CCITT Rec. X.213 | ISO/IEC 8348), are used:

a) Calling Network Service user
b) Called Network Service user
c) Subnetwork Point of Attachment address
d) Network Protocol Address Information
e) Initial Domain Part
f) Authority and Format Identifier
g) Initial Domain Identifier
h) Domain Specific Part

3.4 X.25 definitions

The following terms, as developed in the X.25 Packet Layer Protocol (CCITT Rec. X.25 | ISO/IEC 8208), are used:

a) virtual circuit
b) Virtual Call
c) logical channel
d) Packet Layer
e) Data Terminal Equipment
f) Data Circuit-terminating Equipment
g) DXE (either a DTE or a DCE)

3.5 X.96 definitions

The following terms, as defined in CCITT Rec. X.96, are used:

a) Category C call progress signal
b) Category D call progress signal

4. Abbreviations

4.1 Network Service abbreviations

AFI	Authority and Format Identifier
CONS	Connection-Mode Network Service
DSP	Domain Specific Part
IDI	Initial Domain Identifier
IDP	Initial Domain Part
N	Network
NC	Network-connection
NL	Network Layer
NPAI	Network Protocol Address Information
NS	Network Service
NSAP	Network Service Access Point

OSI	Open Systems Interconnection
QOS	Quality of Service
SNPA	Subnetwork Point of Attachment

4.2 X.25 abbreviations

AEF	Address Extension Facility
AF	Address Field
B-MTCN	Basic Minimum Throughput Class Negotiation (Facility)
B-TCN	Basic Throughput Class Negotiation (Facility)
D-bit	Delivery Confirmation bit
DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
EDN	Expedited Data Negotiation (Facility)
EETDN	End-to-End Transit Delay Negotiation (Facility)
FPF	Facility Parameter Field
GFI	General Format Identifier
LC	Logical Channel
M-bit	More Data bit
MBS	M-bit Sequence
PLP	Packet Layer Protocol
P(R)	Packet receive sequence number
P(S)	Packet send sequence number
PVC	Permanent Virtual Circuit
Q-bit	Qualifier bit
TDSAI	Transit Delay Selection And Indication (Facility)
VC	Virtual Call

5. Overview

The Network Service (NS) provides for the transparent transfer of data between NS users. It makes invisible to these NS users the way in which supporting communications resources are utilized to achieve this transfer.

5.1 Elements of the X.25/PLP-1984 used to support the OSI CONS

The X.25/PLP-1984, as defined by CCITT Rec. X.25 | ISO/IEC 8208, provides a specific realization for the transparent transfer of data between NS users of the CONS. The elements of this protocol to be considered are

a) the virtual-circuit types;

b) the packet types and fields to be mapped to the primitives and parameters of the OSI CONS;

c) the optional user facilities and CCITT-Specified DTE facilities.

Of the two types of virtual circuits defined in CCITT Rec. X.25 | ISO/IEC 8208, the use of Virtual Calls (VCs) is mapped to the network connection (NC) establishment and release phases of the OSI CONS in clauses 6 and 7 and to the data transfer phase in clauses 8-11. (The corresponding mapping for PVCs is given in Annex C.)

Table 1 lists the X.25/PLP-1984 packets and associated fields that shall be used when supporting the OSI CONS.

In addition, the following optional user facilities and CCITT-Specified DTE facilities shall be used and/or agreed to:

a) optional user facilities:

   1) Fast Select (facility used; when operating in a DTE-to-DTE environment without an intervening packet-switched network, the use of the Fast Select Facility shall also be agreed to by the two DTEs);

   2) Fast Select Acceptance (facility agreed to if operating in a packet-switched network environment);

   3) Basic Throughput Class Negotiation (facility agreed to and used);

   4) Transit Delay Selection And Indication (facility used).

b) CCITT-Specified DTE facilities:

Table 1 — Packets and fields of the X.25/PLP-1984 used to support the OSI CONS

Packet Types[1]	Fields[2]
CALL REQUEST INCOMING CALL CALL ACCEPTED CALL CONNECTED	General Format Identifier[3], Address Field, Facility Field, Call and Called User Data Field[4]
CLEAR REQUEST CLEAR INDICATION	Clearing Cause Field, Diagnostic Code Field, Address Field, Facility Field, Clear User Data Field[4]
DATA	D-bit, M-bit, P(S)[5], P(R)[5], User Data Field[4]
INTERRUPT	Interrupt User Data Field[4]
RECEIVE READY[6] RECEIVE NOT READY[6] REJECT[6] (if agreed to)	P(R)[5]
RESET REQUEST RESET INDICATION	Resetting Cause Field, Diagnostic Code Field
RESTART INDICATION	Restarting Cause Field, Diagnostic Code Field

Notes to Table 1:

1 — The packets shown in the table are used in support of the primitives of the OSI CONS. Other packets not shown in the table (i.e., CLEAR CONFIRMATION, INTERRUPT CONFIRMATION, RESET CONFIRMATION, and RESTART CONFIRMATION packets) are essential to the use of the packets shown. Yet other packets (i.e., RESTART REQUEST, DIAGNOSTIC, REGISTRATION REQUEST, and REGISTRATION CONFIRMATION packets) have no relationship to the provision of the OSI CONS.

2 — The information in the fields shown in the table have a direct relationship to the parameters associated with the primitives of the OSI CONS. Other fields not shown in the table (e.g., the Logical Channel Identifier, the Packet Type Identifier, the Q-bit, the Address Length Fields, and the Facility Length Field) are essential to the use of the appropriate packets.

3 — Bit 7 of octet 1 of the General Format Identifier (GFI) in these packets is used to negotiate the overall availability of the Delivery Confirmation bit (D-bit) in support of the Receipt Confirmation Service. As such, this bit has no specific field-name as defined in the X.25/PLP-1984.

4 — All user data fields are octet aligned.

5 — The P(S) and P(R) fields are essential to the operation of the X.25/PLP-1984 in providing the Receipt Confirmation Service.

6 — The action implied by these packets has no relationship to the primitives of the OSI CONS. However, the P(R) field is essential to the operation of the X.25/PLP-1984 in providing the Receipt Confirmation Service.

1) Called Address Extension (facility used);

2) Calling Address Extension (facility used);

3) End-to-End Transit Delay Negotiation (facility used);

4) Expedited Data Negotiation (facility used);

5) Basic Minimum Throughput Class Negotiation (facility used);

6) Priority (facility used with 1988 or later versions of the X.25/PLP).

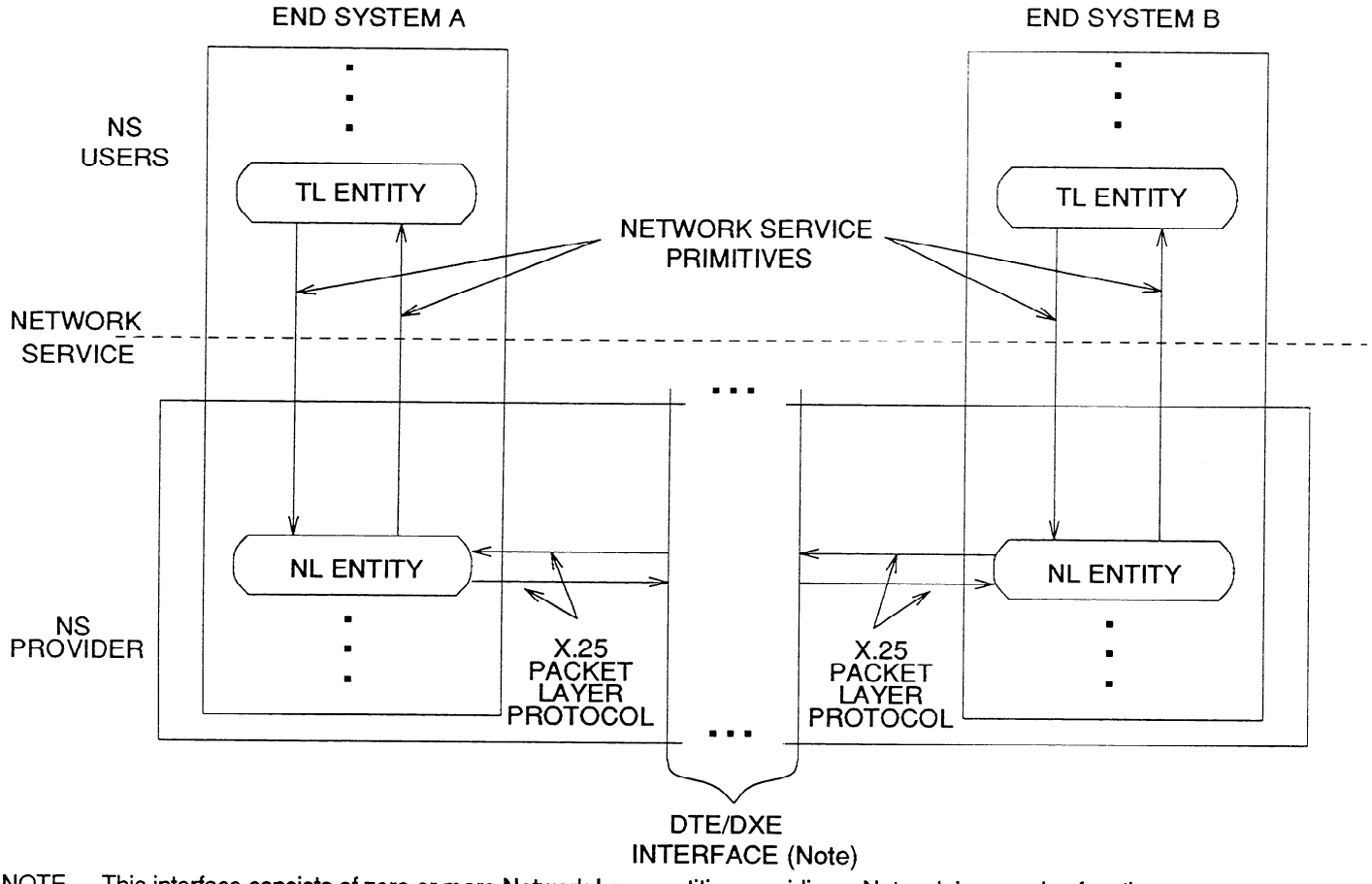
5.2 General operation of the X.25/PLP-1984 for supporting the OSI CONS

The X.25/PLP-1984 can be used to provide the OSI CONS in an end system connected to a public or private X.25 packet-switched subnetwork. It can also be used in environments where the end system is connected to a Local Area Network or where end systems are connected by a dedicated path or by a circuit-switched connection.

As shown in Figure 2, the NS provider (more particularly, the Network Layer (NL) entity in an end system) must provide a translation between

a) the primitives and parameters of the OSI CONS;

b) the packets and associated fields of the X.25/PLP-1984.



NOTE — This interface consists of zero or more Network Layer entities providing a Network Layer relay function.

Figure 2 — Operation of OSI Connection-Mode Network Service and X.25 Packet Layer Protocol (1984)

Request and response primitives are translated into packets to be transmitted across the DTE/DXE interface by the NL entity. Received packets, where appropriate, are translated by the NL entity into indication and confirm primitives.

Annex E provides additional considerations on the relationship between the X.25 protocol procedures and the CONS primitives.

NOTE — The Network Service Definition specifies valid sequences of primitives at an NC endpoint and valid parameter responses at the called NC endpoint to Receipt Confirmation negotiation, Expedited Data negotiation, and Quality of Service (QOS) parameter negotiation. The necessity for the NL entity to monitor compliance and the actions to be taken on non-compliance are a local matter, and not subject to standardization.

There is also a relationship between some local mechanism used to identify a particular NC and a Logical Channel (LC) number used to identify a particular virtual circuit. This relationship is a local matter and is not discussed here.

6. Network connection establishment phase

6.1 Primitive/Parameter and packet/field relationships

Table 2 shows the relationships between the primitives/parameters used during the NC establishment phase and the packets/fields associated with the call setup procedures.

Table 2 — CONS:X.25/PLP-1984 mapping for the NC establishment phase

CONS	X.25/PLP-1984
PRIMITIVES:	**PACKETS:**
N-CONNECT request	CALL REQUEST
N-CONNECT indication	INCOMING CALL
N-CONNECT response	CALL ACCEPTED
N-CONNECT confirm	CALL CONNECTED
PARAMETERS:	**FIELDS (INCLUDING FACILITIES):**
Called Address	Called DTE Address Field Called Address Extension Facility
Calling Address	Calling DTE Address Field Calling Address Extension Facility
Responding Address	Called DTE Address Field Called Address Extension Facility
Receipt Confirmation Selection	General Format Identifier[1)]
Expedited Data Selection	Expedited Data Negotiation Facility
QOS-Parameter Set	Basic Throughput Class Negotiation Facility[2)] Basic Minimum Throughput Class Negotiation Facility Transit Delay Selection And Indication Facility End-to-End Transit Delay Negotiation Facility Priority Facility
NS-User-Data	Call and Called User Data Field Fast Select Facility[3)]

Notes to Table 2:

1 — Bit 7 of octet 1 of the GFI in call setup packets is used to negotiate the overall availability of the D-bit in support of the Receipt Confirmation Service. As such, this bit has no specific field-name as defined in the X.25/PLP-1984.

2 — For proper operation, this optional user facility shall also be agreed to for use on the interface.

3 — For proper operation, the Fast Select Acceptance Facility shall also be agreed to on the interface when accessing a packet-switched network.

6.2 Procedures

6.2.1 Primitive/Packet mapping

When an NL entity receives an N-CONNECT request or an N-CONNECT response primitive from an NS user, it transmits a CALL REQUEST or a CALL ACCEPTED packet, respectively, across the DTE/DXE interface.

When an NL entity receives an INCOMING CALL or a CALL CONNECTED packet, it signals an N-CONNECT indication or an N-CONNECT confirm primitive, respectively, to the NS user.

6.2.2 Network addresses

Local operation determines the contents of the Network Protocol Address Information (NPAI) and whether Network Addresses, where explicitly supplied, are mapped to and from the Address Field (AF) or the Address Extension Facilities (AEF) of X.25/PLP-1984 call setup packets. Annex F describes guidelines for the methods by which the required AF contents may be derived from the Network Address. The permitted techniques for the placement of Network Addresses in either the AF or AEF are given in this clause. The encoding techniques to be employed are those specified in CCITT Rec. X.25 | ISO/IEC 8208 for the AF and AEF. The content of these fields shall be in the preferred binary encoding defined in CCITT Rec. X.213 | ISO/IEC 8348. Examples of encoding Network Addresses in the NPAI of the X.25/PLP-1984 are also given in Annex F.

6.2.2.1 Encoding of Network addresses

6.2.2.1.1 Use of the Address Field (AF)

Under certain conditions, the Network Address, as defined in CCITT Rec. X.213 | ISO/IEC 8348, may be conveyed entirely in the AF. These conditions are

a) the Network Address consists solely of the Initial Domain Part (IDP) (i.e., the Domain Specific Part (DSP) is null);

b) the Authority and Format Identifier (AFI) can be deduced from the contents of the AF (e.g., with knowledge of the subnetwork to which the DTE is attached);

c) the Initial Domain Identifier (IDI) is the same as the Subnetwork Point of Attachment (SNPA) Address.

When all of the above conditions are satisfied, the AF may be used to convey the semantics of the entire Network Address (the AFI is implied and the contents of the AF are equivalent to the IDI). In these cases, the AEF may also be used (see 6.2.2.1.2).

NOTE — The use of the preferred binary encoding results in binary-coded decimal digits in the AF, as required by CCITT Rec. X.25 | ISO/IEC 8208.

6.2.2.1.2 Use of the AEF

If any of the conditions in 6.2.2.1.1 are not satisfied, the AEF shall be used. The Network Address, complete with AFI, is placed in the AEF (bits 8 and 7 of the first octet of the Facility Parameter Field (FPF) of the AEF are both set to zero). In this case, the contents of the AF are not defined by this International Standard. Guidelines for their derivation are given in Annex F.

6.2.2.2 Decoding of Network addresses

If, after decoding the Network address as specified in the subclauses below, the Network address does not exist, then the NL entity clears the call by transmitting a CLEAR REQUEST packet across the DTE/DXE interface with a clearing cause code of "DTE Originated." It is recommended that the diagnostic code value be set to 232 (or 224), "Connection Rejection — NSAP Unreachable (Permanent Condition)." The NL entity shall not signal any primitive to the NS User.

6.2.2.2.1 Absent AEF case

If the AEF is not present, then local knowledge is required by the receiving NL entity to determine whether a Network Address is to be deduced from the content of the AF. If this local knowledge indicates that a Network Address is present, its abstract syntax is as follows:

a) the AFI is deduced from knowledge of the subnetwork from which the packet was received;

b) the IDI is the same as the contents of the AF;

c) the DSP is absent.

If insufficient local knowledge exists to derive a Network Address from a received AF-only Called Address in an INCOMING CALL packet, then the call is rejected by transmission of a CLEAR REQUEST packet across the DTE/DXE interface with a clearing cause code of "DTE Originated." The diagnostic code value is recommended to be set to 232 "Connection Rejection — NSAP Unreachable (Permanent Condition)".

6.2.2.2.2 AEF case

If the AEF is present and bits 8 and 7 of the leading octet of the FPF are both set to zero, then the Network Address is contained entirely within the AEF. The abstract syntax is as follows:

a) the AFI is contained within the first two digits of the AEF;

b) the IDI is the remainder of the IDP after any leading and trailing padding digits are discarded;

c) the DSP, if present, constitutes the remainder of the AEF content after any trailing padding digits are discarded.

If a Network Address cannot be derived from the Called AEF in an INCOMING CALL packet, then the call is rejected by transmission of a CLEAR REQUEST packet across the DTE/DXE interface with a clearing cause code of "DTE Originated." It is recommended that the diagnostic code value be set to 232 (or 224) "Connection Rejection — NSAP Unreachable (Permanent Condition)."

6.2.3 Receipt Confirmation selection

Bit 7 of octet 1 in the GFI of X.25/PLP-1984 call setup packets is mapped to/from the Receipt Confirmation Selection parameter of N-CONNECT primitives.

If the Receipt Confirmation Selection parameter of the N-CONNECT request primitive indicates "use of Receipt Confirmation," then the NL entity, if it can support the D-bit procedure as defined in 8.2.3 and 9.2.1, sets bit 7 of the GFI to 1 to indicate use of receipt confirmation during the data transfer phase. If "no use of Receipt Confirmation" is indicated or the NL entity cannot support the D-bit procedure, then bit 7 is set to 0.

When an NL entity receives an INCOMING CALL packet with bit 7 of the GFI set to 1 but it cannot support the D-bit procedure, it indicates "no use of Receipt Confirmation" in the Receipt Confirmation Selection parameter of the N-CONNECT indication primitive signaled to the Called NS user. Otherwise, if bit 7 of the GFI is set to 1 (respectively, 0), then the NL entity indicates "use (respectively, no use) of Receipt Confirmation" in the Receipt Confirmation Selection parameter of the N-CONNECT indication primitive signaled to the Called NS user.

When an NL entity receives an N-CONNECT response primitive with the Receipt Confirmation Selection parameter indicating "use (respectively, no use) of Receipt Confirmation," it sets bit 7 of the GFI in the CALL ACCEPTED packet to 1 (respectively, 0).

When an NL entity receives a CALL CONNECTED packet with bit 7 of the GFI set to 1 (respectively, 0), it indicates "use (respectively, no use) of Receipt Confirmation" in the Receipt Confirmation Selection parameter of the N-CONNECT confirm primitive signaled to the Calling NS user.

6.2.4 Expedited Data selection

The Expedited Data Negotiation (EDN) Facility of the X.25/PLP-1984 is mapped to/from the Expedited Data Selection parameter of N-CONNECT primitives.

If the Expedited Data Selection parameter of the N-CONNECT request primitive indicates "use of Expedited Data," then the NL entity, if it can support the Interrupt procedure using 32-octet INTERRUPT packets, encodes the EDN Facility in the CALL REQUEST packet to indicate use of expedited data during the data transfer phase. If "no use of Expedited Data" is indicated or the NL entity cannot support 32-octet INTERRUPT packets, then the EDN Facility shall be either encoded to indicate no use of expedited data or omitted.

When an NL entity receives an INCOMING CALL packet with no EDN Facility or with the EDN Facility indicating use of expedited data but it cannot support 32-octet INTERRUPT packets, it indicates "no use of Expedited Data" in the Expedited Data Selection parameter of the N-CONNECT indication primitive signaled to the Called NS user. Otherwise, if the EDN Facility indicates use (respectively, no use) of expedited data, then the NL entity indicates "use (respectively, no use) of Expedited Data" in the Expedited Data Selection parameter of the N-CONNECT indication primitive signaled to the Called NS user.

When an NL entity receives an N-CONNECT response primitive with the Expedited Data Selection parameter indicating "use of Expedited Data," it encodes the EDN Facility in the CALL ACCEPTED packet to indicate use of expedited data. If the Expedited Data Selection parameter indicates "no use of Expedited Data," then the EDN Facility shall be either encoded to indicate no use of expedited data or omitted.

When an NL entity receives a CALL CONNECTED packet with the EDN Facility indicating use (respectively, no use) of expedited data, it indicates "use (respectively, no use) of Expedited Data" in the Expedited Data Selection

parameter of the N-CONNECT confirm primitive signaled to the Calling NS user. If the CALL CONNECTED packet has no EDN Facility, then the NL entity indicates "no use of Expedited Data" to the Calling NS user.

6.2.5 QOS parameter set

The set of QOS parameters that are conveyed during the NC establishment phase consists of the following parameters:

a) the throughput for the direction of data transfer from the Calling NS user to the Called NS user;

b) the throughput for the direction of data transfer from the Called NS user to the Calling NS user;

c) the transit delay that applies to both directions of data transfer;

d) the priority of the data transferred on the NC (with respect to data transferred on other NCs);

e) the priority of gaining an NC;

f) the priority of keeping this NC.

For each of these parameters, a set of "subparameters" is defined as follows:

a) a "Target" value, which is the QOS value desired by the Calling NS user;

b) a "Lowest Quality Acceptable" value, which is the lowest QOS value agreeable to the Calling NS user;

c) an "Available" value, which is the QOS value the NS provider is willing to provide;

d) a "Selected" value, which is the QOS value to which the Called NS user agrees.

The set of values that can be specified for each subparameter is defined in every Network Service. This set includes the value "unspecified." It may also include a value defined to be a "default value" that is mutually understood by the NS provider and an NS user as applying in the absence of particular values.

6.2.5.1 Throughput QOS parameters

The Basic Throughput Class Negotiation (B-TCN) Facility and the Basic Minimum Throughput Class Negotiation (B-MTCN) Facility of the X.25/PLP-1984 are mapped to/from both Throughput QOS parameters of N-CONNECT primitives. The specific mapping of these X.25/PLP-1984 facilities to/from both sets of Throughput subparameters is given in Table 3.

Table 3 — Mapping of Throughput QOS subparameters to X.25/PLP-1984 Facilities

CONS		X.25/PLP-1984	
Subparameter	**Primitive**	**Facility**	**Packet**
Target	N-CONNECT request	B-TCN	CALL REQUEST
Lowest Quality Acceptable	N-CONNECT request	B-MTCN	CALL REQUEST
Available	N-CONNECT indication	B-TCN	INCOMING CALL
Lowest Quality Acceptable	N-CONNECT indication	B-MTCN	INCOMING CALL
Selected	N-CONNECT response	B-TCN	CALL ACCEPTED
Selected	N-CONNECT confirm	B-TCN	CALL CONNECTED

The set of values that can be specified for each Throughput subparameter ranges from 75 bits per second through 19 2000[1)] bits per second, inclusive. This set consists of the following discrete values: 75, 150, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, 48 000, 64 000, 128 000, and 192 000 bits per second. An NL entity supports either all of these values or a contiguous subset of them. The value "unspecified" is also allowed.

1) For the 1984 X.25/PLP, only throughputs up to 48 000 bits per second are available. For the 1988 X.25/PLP, this set is extended to 64 000 bits per second. For the 1992 X.25/PLP, this set is extended to 192 000 bits per second.

6.2.5.1.1 Processing an N-CONNECT request primitive

If an NL entity, when receiving an N-CONNECT request primitive, cannot support the Lowest Quality Acceptable throughput (i.e., the minimum throughput) when specified for either direction of data transfer, then it rejects the request. In this case, the NL entity does not transmit any X.25/PLP-1984 packet but it does signal an N-DISCONNECT indication primitive to the Calling NS user. The Originator parameter is "NS Provider." The Reason parameter is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the Lowest Quality Acceptable for either direction of data transfer.

If an NL entity, when receiving an N-CONNECT request primitive, can support the Lowest Quality Acceptable throughput when specified, for both directions of transfer, then for each direction of transfer it

a) encodes the Lowest Quality Acceptable value in the B-MTCN facility;

b) encodes the lesser of the Target value and the highest value that the NL entity is prepared to support in the B-TCN facility (as shown in Table 3).

If the Target subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the NL entity encodes the B-TCN Facility for the corresponding direction(s) of data transfer as the highest throughput rate supported by the NL entity. If the Lowest Quality Acceptable subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the NL entity encodes the B-MTCN Facility for the corresponding direction(s) of data transfer as 75 bits per second. The B-TCN and B-MTCN Facilities are transmitted across the DTE/DXE interface in a CALL REQUEST packet.

6.2.5.1.2 Processing an INCOMING CALL packet

When receiving an INCOMING CALL packet with a B-MTCN Facility, an NL entity compares the minimum throughput value specified in the B-MTCN Facility for each direction of data transfer to the available throughput value specified in the B-TCN Facility. If, for either direction, the available throughput value is less than the minimum throughput value or if the NL entity cannot support the minimum throughput value, then the NL entity clears the call (i.e., transmits a CLEAR REQUEST packet). The cause is "DTE Originated" and the diagnostic is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the lowest throughput value (these diagnostics have values 229 and 230, respectively). Otherwise, the NL entity indicates, for both directions of data transfer, the Available and Lowest Quality Acceptable throughput values in the Throughput QOS parameters of the N-CONNECT indication primitive signaled to the Called NS user. The Available and Lowest Quality Acceptable subparameters are mapped from the B-TCN and B-MTCN Facilities, respectively, as shown in Table 3.

If an NL entity receives an INCOMING CALL packet without the B-MTCN Facility, then the NL entity indicates the value "unspecified" for the Lowest Quality Acceptable subparameters of both the Throughput QOS parameters of the N-CONNECT indication primitive signaled to the Called NS user. The Available subparameters of both the Throughput QOS parameters are mapped from the B-TCN Facility.

NOTE — From a practical standpoint, the value "unspecified" can be taken to be 75 bits per second due to restrictions concerning the discrete values that can be signaled in the CALL ACCEPTED packet, as listed in 6.2.5.1.

6.2.5.1.3 Processing an N-CONNECT response primitive

When an NL entity receives an N-CONNECT response primitive, it encodes the Selected throughput values for both directions of data transfer, as given in the Throughput QOS parameters, in the B-TCN Facility returned in the CALL ACCEPTED packet.

6.2.5.1.4 Processing a CALL CONNECTED packet

When an NL entity receives a CALL CONNECTED packet, it indicates the Selected throughput values for both directions of data transfer, as given in the B-TCN Facility, in the Throughput QOS parameters of the N-CONNECT confirm primitive signaled to the Calling NS user.

6.2.5.2 Transit Delay QOS parameter

The Transit Delay Selection And Indication (TDSAI) Facility and the End-to-End Transit Delay Negotiation (EETDN) Facility of the X.25/PLP-1984 are mapped to/from the Transit Delay QOS parameter of N-CONNECT primitives.

The set of values that can be specified for each Transit Delay subparameter ranges from 1 ms through 65 534 ms, inclusive, in increments of 1 ms. An NL entity supports either all of these values or a contiguous subset of them. The value "unspecified" is also allowed.

An NL entity in an end system shall be able to determine the cumulative transit delay attributable to the NS provider in that end system. This is the transit delay of the NL entity itself, all lower-layer entities, and the effects of the access line transmission rate.

Annex G illustrates the use of the X.25 TDSAI and EETDN Facilities in support of the end-to-end negotiation of the Transit Delay QOS parameter.

6.2.5.2.1 Processing an N-CONNECT request primitive

If an NL entity, when receiving an N-CONNECT request primitive, cannot support the Lowest Quality Acceptable transit delay (i.e., the maximum transit delay) when specified, then it rejects the request. In this case, the NL entity does not transmit any X.25/PLP-1984 packet but it does signal an N-DISCONNECT indication primitive to the Calling NS user. The Originator parameter is "NS Provider." The Reason parameter is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the Lowest Quality Acceptable transit delay.

If an NL entity, when receiving an N-CONNECT request primitive, can support the Lowest Quality Acceptable transit delay (i.e., the maximum transit delay) when specified, or when the Target transit delay is specified and the Lowest Quality Acceptable transit delay is unspecified, then

a) the NL entity encodes the cumulative transit delay attributable to the NS provider in the calling end system in the "cumulative-transit-delay subfield" (i.e., octets 1 and 2) of the EETDN Facility;

b) if a Target transit delay is specified, then the NL entity encodes this value in the "target-transit-delay subfield" (i.e., octets 3 and 4) of the EETDN Facility (otherwise, this subfield is not used);

NOTE 1 — According to CCITT Rec. X.213 | ISO/IEC 8348, the case where the Target transit delay is unspecified and the Lowest Quality Acceptable transit delay has a value other than unspecified is not permitted; logically, this case can be represented by the permitted assignment where an identical value is specified for both the Target and Lowest Quality Acceptable transit delays.

c) if a Lowest Quality Acceptable transit delay is specified, then the NL entity encodes this value in the "maximum-acceptable-transit-delay subfield" (i.e., octets 5 and 6) of the EETDN Facility (otherwise, this subfield is not used);

d) if the Target transit delay is specified, then the NL entity encodes the value of the TDSAI Facility as being less than the Target transit delay minus the cumulative transit delay for the calling end system; otherwise, the TDSAI Facility is encoded with any value (i.e., it is not constrained by this International Standard).

NOTE 2 — Given a "routeing management information base," the NL entity can refine the value encoded in the TDSAI Facility. For example, the value of the TDSAI Facility could take into account whether networks other than packet-switched networks are traversed in reaching the called end system or whether the called end system is reachable directly in a point-to-point configuration.

If both the Target and Lowest Quality Acceptable transit delays are unspecified, then the NL entity shall omit the TDSAI Facility (if applicable) and encode the EETDN Facility as given in (a) above. The TDSAI (if present) and EETDN Facilities are transmitted across the DTE/DXE interface in a CALL REQUEST packet.

NOTE 3 — The value of the TDSAI Facility in a CALL REQUEST packet in a DTE/DCE environment provides a guideline to the DCE for allocating resources. The final transit-delay value applicable to the Virtual Call may be less than, equal to, or greater than the value in the CALL REQUEST packet.

6.2.5.2.2 Processing an INCOMING CALL packet

When receiving an INCOMING CALL packet, an NL entity determines whether the TDSAI Facility and the "cumulative-transit-delay subfield" (i.e., octets 1 and 2) of the EETDN Facility are present. If either is absent, then the NL entity shall derive a value to use for the missing value from its local "routeing management information base." It then computes the total NC transit delay as given below.

The total NC transit delay is determined by summing the values of

a) the TDSAI Facility;

b) the "cumulative-transit-delay subfield" (i.e., octets 1 and 2) of the EETDN Facility;

c) the transit delay attributable to the NS provider in the called end system.

NOTE — The procedure suggested here for computing the value of the total NC transit delay is the best an NL entity can do in the absence of any "external information." However, given a "routeing management information base," the NL entity can refine this value. For example, the transit delay attributable to the effects of the access line transmission rate is not included when the called end system is connected to the calling end system in a point-to-point configuration (these effects have been accounted for by the calling end system).

If the "maximum-acceptable-transit-delay subfield" (i.e., octets 5 and 6) of the EETDN Facility is present, then the NL entity compares the value in this "subfield" to the total NC transit delay computed above. If the total NC transit delay is greater than the maximum-acceptable transit delay, then the NL entity clears the call (i.e., transmits a CLEAR REQUEST packet). The cause is "DTE Originated" and the diagnostic is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the maximum-acceptable transit delay (these diagnostics have values 229 and 230, respectively). Otherwise, if either

a) the total NC transit delay is less than or equal to the maximum-acceptable transit delay, or

b) the "maximum-acceptable-transit-delay subfield" of the EETDN Facility is not present,

then the NL entity indicates the Available transit-delay value (as given by the total NC transit delay computed above) in the Transit Delay QOS parameter of the N-CONNECT indication primitive signaled to the Called NS user.

6.2.5.2.3 Processing an N-CONNECT response primitive

When an NL entity receives an N-CONNECT response primitive, it encodes the total NC transit-delay value (as computed above) in the "cumulative-transit-delay subfield" (octets 1 and 2) of the EETDN Facility returned in the CALL ACCEPTED packet.

NOTES

1 There is no Transit Delay QOS Parameter in an N-CONNECT response primitive.

2 The EETDN Facility returned in a CALL ACCEPTED packet only contains the "cumulative-transit-delay subfield."

6.2.5.2.4 Processing a CALL CONNECTED packet

When an NL entity receives a CALL CONNECTED packet, it indicates the Selected transit-delay value, as given by the "cumulative-transit-delay subfield" of the EETDN Facility, in the Transit Delay QOS parameter of the N-CONNECT confirm primitive signaled to the Calling NS user.

6.2.5.3 Priority QOS parameters

The Priority Facility of the X.25/PLP is mapped to/from the three Priority QOS parameters of N-CONNECT primitives.

The set of values that can be specified for each Priority subparameter ranges from 0 (lowest priority) to 14 (highest priority). An NL entity supports all of these values. The value "unspecified" is also allowed (encoded as 255 in the X.25/PLP).

Annex H illustrates the use of the X.25 Priority Facility in support of the end-to-end negotiation of the Priority QOS parameter.

6.2.5.3.1 Processing an N-CONNECT request primitive

An NL entity that supports a choice of priority levels shall proceed as specified in 6.2.5.3.1.1. An NL entity that does not support a choice of levels shall proceed as specified in 6.2.5.3.1.2.

6.2.5.3.1.1 Processing with choice of levels supported

If an NL entity, when receiving an N-CONNECT request primitive, cannot support the Lowest Quality Acceptable priority for any of the three Priority QOS parameters, when specified, then it rejects the request. In this case, the NL entity does not transmit any X.25/PLP packet but it does signal an N-DISCONNECT indication primitive to the Calling NS user. The Originator parameter is "NS Provider." The Reason parameter is "Connection Rejection —

QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the Lowest Quality Acceptable priority for one or more of the Priority QOS parameters.

If an NL entity, when receiving an N-CONNECT request primitive, can support the Lowest Quality Acceptable priority for all three Priority QOS parameters, when specified, or any of the Lowest Quality Acceptable Priority QOS parameters is unspecified, then the NL entity encodes the Priority Facility as follows:

a) if the Lowest Quality Acceptable of a Priority QOS parameter is specified, its value is encoded in the subfield of the X.25/PLP Priority Facility designated to contain this subparameter; otherwise, this subfield of the facility is encoded as 255 (unspecified);

b) if the Target of a Priority QOS parameter is specified, its value is encoded in the subfield of the X.25/PLP Priority Facility designated to contain this subparameter; otherwise, this subfield of the facility is encoded as 255 (unspecified).

If either the Target or the Lowest Quality Acceptable priority is specified for any of the Priority QOS parameters, then the resulting Priority Facility is transmitted across the DTE/DXE interface in a CALL REQUEST packet. Any subfield of the Priority Facility that contains the "unspecified" value (i.e., 255) may be omitted if, and only if, it is not followed by a subfield containing a value other than "unspecified." If both the Target and Lowest Quality Acceptable priority are unspecified for all Priority QOS parameters, then no Priority Facility is transmitted.

6.2.5.3.1.2 Processing with choice of levels not supported

When an NL entity receives an N-CONNECT request primitive, it shall encode the Lowest Quality Acceptable and Target priority level for each Priority QOS parameter in the X.25/PLP Priority Facility for transmission across the DTE/DXE interface in a CALL REQUEST packet, unless both values of all parameters are unspecified, in which case it shall not transmit a Priority Facility.

6.2.5.3.2 Processing an INCOMING CALL packet

An NL entity that supports a choice of priority levels shall proceed as specified in 6.2.5.3.2.1. An NL entity that does not support a choice of levels shall proceed as specified in 6.2.5.3.2.2.

6.2.5.3.2.1 Processing with choice of levels supported

When receiving an INCOMING CALL packet, an NL entity determines the Available and Lowest Quality Acceptable subparameters to be used in the N-CONNECT indication primitive for each Priority QOS parameter as follows:

a) if the packet contains no Priority Facility, then both subparameters for each Priority QOS parameter are unspecified;

b) if the subfield of the Priority Facility designated to contain the Available subparameter for a Priority QOS parameter is present, then the value of this subparameter is as given in the subfield; otherwise, the value is unspecified;

c) if the subfield of the Priority Facility designated to contain the Lowest Quality Acceptable subparameter for a Priority QOS parameter is present, then the value of this subparameter is as given in the subfield; otherwise, the value is unspecified.

If, for any of the three Priority QOS parameters, the NL entity cannot support the Lowest Quality Acceptable priority, then the NL entity clears the call (i.e., transmits a CLEAR REQUEST packet). The cause is "DTE Originated" and the diagnostic is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the Lowest Quality Acceptable priority (these diagnostics have values 229 and 230, respectively). Otherwise, the NL entity indicates, for each Priority QOS parameter, the Available and Lowest Quality Acceptable priority values in the Priority QOS parameters of the N-CONNECT indication primitive signaled to the Called NS user.

6.2.5.3.2.2 Processing with choice of levels not supported

When an NL entity receives an INCOMING CALL packet, the values of the Available and Lowest Quality Acceptable priority-level subparameters for use in the N-CONNECT indication primitive for each Priority QOS parameter shall be the values signified by the Priority Facility in the packet (if present). The absence of a subfield in the Priority Facility corresponds to the value "unspecified." If the Priority Facility is not present in the INCOMING

CALL packet, then the values of both subparameters of each Priority QOS parameter shall be "unspecified."

6.2.5.3.3 Processing an N-CONNECT response primitive

When an NL entity receives an N-CONNECT response primitive, it encodes the Selected priority value, if specified, as given for each Priority QOS parameter, in the Priority Facility returned in the CALL ACCEPTED packet. Any subfield of the Priority Facility that contains the "unspecified" value (i.e., 255) may be omitted if, and only if, it is not followed by a subfield containing a value other than "unspecified." If the Selected priority value is unspecified for all Priority QOS parameters, then no Priority Facility is returned in the CALL ACCEPTED packet.

6.2.5.3.4 Processing a CALL CONNECTED packet

When an NL entity receives a CALL CONNECTED packet, it indicates the Selected priority value, as given in the Priority Facility (if present), for each Priority QOS parameter of the N-CONNECT confirm primitive signaled to the Calling NS user. The absence of a subfield in the Priority Facility corresponds to the value "unspecified." If the Priority Facility is not present in the CALL CONNECTED packet, then the Selected value of each Priority QOS parameter shall be "unspecified."

6.2.6 NS-User-Data

The Call User Data Field of X.25/PLP-1984 CALL REQUEST and INCOMING CALL packets is used to transfer the NS-user-data of N-CONNECT request and indication primitives, respectively. The Called User Data Field of X.25/PLP-1984 CALL ACCEPTED and CALL CONNECTED packets is used to transfer the NS-user-data of N-CONNECT response and confirm primitives, respectively. In addition, the Fast Select Facility shall be indicated in the CALL REQUEST packet sent by the Calling NL entity.

7. Network connection release phase

7.1 Primitive/Parameter and packet/field relationships

Table 4 shows the relationships between the primitives/parameters used during the NC release phase and the packets/fields associated with the call clearing procedures.

Table 4 — CONS:X.25/PLP-1984 mapping for the NC release phase

CONS	X.25/PLP-1984
PRIMITIVES N-DISCONNECT request N-DISCONNECT indication	**PACKETS:** CLEAR REQUEST CLEAR INDICATION, RESTART INDICATION[1)], CLEAR REQUEST[2)]
PARAMETERS: Originator and Reason NS-User-Data Responding Address	**FIELDS (INCLUDING FACILITIES):** Cause and Diagnostic Code Fields[3)] Clear User Data Called DTE Address Field Called Address Extension Facility

Notes to Table 4:

1 — Receipt of a RESTART INDICATION packet should be treated as receipt of a CLEAR INDICATION packet for every logical channel and then mapped to an N-DISCONNECT indication primitive for every active NC associated with the Packet Layer Protocol being restarted. The Restarting Cause and Diagnostic Code Fields are then treated in the same manner as the Clearing Cause and Diagnostic Code Fields.

2 — See 7.2.1, Paragraph 2.

3 — The combination of Cause and Diagnostic Code Fields is mapped to/from the combination of Originator and Reason parameters.

7.2 Procedures

7.2.1 Primitive/Packet mapping

When an NL entity receives an N-DISCONNECT request primitive from an NS user, it transmits a CLEAR REQUEST packet across the DTE/DXE interface. If, however, the NL entity had previously transmitted a CLEAR REQUEST packet and signaled an N-DISCONNECT indication primitive to the NS user (because of a protocol error; see below), then it does not transmit another CLEAR REQUEST packet.

If an NL entity detects an error in the operation of the X.25/PLP-1984 for which its action is to clear the VC (e.g., a format error in an INCOMING CALL packet or a timeout condition), then it transmits a CLEAR REQUEST packet across the DTE/DXE interface. If the virtual circuit is associated with an NC, then it also signals an N-DISCONNECT indication primitive to the NS user.

If an NL entity, upon receipt of an INCOMING CALL packet, is to deflect the call, then it should include, in its CLEAR REQUEST packet, any necessary CCITT-Specified DTE facilities and user data that are to be present in the INCOMING CALL packet transmitted to the alternate DTE. It shall also include the Call Deflection Selection Facility.

When an NL entity receives a CLEAR INDICATION packet (or a RESTART INDICATION packet), it signals an N-DISCONNECT indication primitive to the NS user. It also transmits a CLEAR CONFIRMATION packet (or a RESTART CONFIRMATION packet) across the DTE/DXE interface. If, however, the NL entity had previously transmitted a CLEAR REQUEST packet for the NC (i.e., a clear collision), then it does not signal an N-DISCONNECT indication primitive to the NS user nor transmit a CLEAR CONFIRMATION packet.

NOTE — If the received CLEAR INDICATION packet is in response to a previously-transmitted CALL REQUEST packet, the NL entity may retry the call if the Network Connection Establishment Delay has not been exceeded rather than immediately signaling an N-DISCONNECT indication primitive to its NS user. The NL entity may also use the clearing cause code (see 7.2.2) in the CLEAR INDICATION packet to determine whether to retry the call. That is, the reattempt may be successful if the clearing cause code is classified as Category C (see CCITT Rec. X.96); on the other hand, a Category D code indicates a problem of a more permanent nature. The time interval between and number of reattempted calls is a local matter. If multiple attempts at establishing the NC are all unsuccessful, then the Originator-parameter and Reason-parameter values finally signaled in the N-DISCONNECT indication primitive are a local matter.

If either NL entity wishes to disconnect an NC, it signals an N-DISCONNECT indication primitive to its NS user and transmits a CLEAR REQUEST packet across the DTE/DXE interface. If, however, the NL entity in the calling DTE cannot, for example, support the QOS parameters specified in an N-CONNECT request primitive or does not have an LC available to set up a VC, then it signals an N-DISCONNECT indication primitive to the Calling NS user but does not transmit a CLEAR REQUEST packet across the DTE/DXE interface.

7.2.2 Originator/Reason

The combination of Originator and Reason parameters of the N-DISCONNECT primitives is mapped to/from the combination of Clearing Cause (or Restarting Cause) and Diagnostic Code Fields.

The combination of the cause code "DTE Originated" (coded as all zeros) with a diagnostic in the set 241, 242, and 244-248 corresponds to an Originator-parameter value of "NS User." In this case, there is a one-to-one relationship between the values of the Reason parameter and these diagnostic codes.

The cause code "DTE Originated" (coded as all zeros) used in combination with diagnostic codes other than those listed above corresponds to an Originator-parameter value of "NS Provider." There is a one-to-one relationship between the values of the Reason parameter and diagnostic codes 225-232 and 235.

In other cases, the Originator-parameter and Reason-parameter values depend on

a) the cause and/or diagnostic codes;

b) whether the NC is in the NC establishment phase or in the data transfer phase.

The values of the Originator and Reason parameters are derived as given below.

a) The Originator-parameter value is "NS Provider" and the Reason-parameter value is "Disconnection — Permanent Condition" when the NC is in the data transfer phase and any of the following applies:

1) cause codes "Out Of Order," "Local Procedure Error," "Remote Procedure Error," or "RPOA Out Of Order;"

2) diagnostic code 122.

b) The Originator-parameter value is "NS Provider" and the Reason-parameter value is "Disconnection — Transient Condition" when the NC is in the data transfer phase and any of the following applies:

1) cause code "Network Congestion;"

2) diagnostic codes 113 or 115;

3) cause code "DTE Originated" (coded as all zeros) with diagnostic codes 162 or 163.

c) The Originator-parameter value is "NS Provider" and the Reason-parameter value is "Connection Rejection — NSAP Address Unknown (Permanent Condition)" when the NC is in the NC establishment phase and any of the following applies:

1) cause codes "Not Obtainable" or "Ship Absent."

d) The Originator-parameter value is "NS Provider" and the Reason-parameter value is "Connection Rejection — Reason Unspecified/Permanent Condition" when the NC is in the NC establishment phase and any of the following applies:

1) cause codes "Access Barred," "Fast Select Acceptance Not Subscribed," "Incompatible Destination," "Invalid Facility Request," "Out Of Order," "Local Procedure Error," "Remote Procedure Error," "Reverse Charging Acceptance Not Subscribed," or "RPOA Out Of Order;"

2) diagnostic codes 121 or 122;

3) cause code "DTE Originated" (coded as all zeros) with diagnostic code 164.

e) The Originator-parameter value is "NS Provider" and the Reason-parameter value is "Connection Rejection — Reason Unspecified/Transient Condition" when the NC is in the NC establishment phase and any of the following applies:

1) cause codes "Network Congestion" or "Number Busy;"

2) diagnostic codes 112-120;

3) cause code "DTE Originated" (coded as all zeros) with a diagnostic code other than 162-164, 225-232, 235, 241, 242, and 244-248.

f) The Originator-parameter and Reason-parameter values are both "Undefined" for any other combination of cause and diagnostic codes.

7.2.3 NS-User-Data

The Clear User Data Field of X.25/PLP-1984 CLEAR REQUEST and CLEAR INDICATION packets is used to transfer the NS-user-data between NS users.

7.2.4 Responding address

Local operation determines the contents of the Called Address Field and whether the responding Network Address, where explicitly supplied, is mapped to/from the AF or the AEF in X.25/PLP-1984 call clearing packets. Rules for encoding and decoding the responding Network Address are given in 6.2.2.

8. Data transfer phase — Data transfer service

8.1 Primitive/Parameter and packet/field relationships

Table 5 shows the relationships between the primitives/parameters used for the data transfer service and the packets/fields associated with the data transfer procedures.

8.2 Procedures

8.2.1 Primitive/Packet mapping

When an NL entity receives an N-DATA request primitive from an NS user, it transmits a sequence of one or more DATA packets, known as an M-bit Sequence (MBS), across the DTE/DXE interface. The number of DATA

Table 5 — CONS:X.25/PLP-1984 mapping for the data transfer service

CONS	X.25/PLP-1984
PRIMITIVES: N-DATA request N-DATA indication	**PACKETS:** DATA DATA
PARAMETERS: NS-User-Data Confirmation Request	**FIELDS:** User Data, M-bit D-bit, P(S)

packets needed in an MBS depends on the amount of NS-user-data and on the maximum "packet size" (i.e., the maximum User Data Field Length of DATA packets) permitted on the DTE/DXE interface. All DATA packets but the last one of an MBS contain the maximum number of octets, have their M-bit set to 1, and have their D-bit set to 0. The last DATA packet has its M-bit set to 0. The D-bit setting of the last DATA packet is dependent on the Confirmation Request parameter (see 8.2.3 below). All DATA packets shall have the Q-bit set to zero.

When an NL entity receives an MBS with the Q-bit set to zero in each DATA packet, it signals an N-DATA indication primitive to the NS user.

8.2.2 NS-User-Data

The User Data Fields of X.25/PLP-1984 DATA packets are used to transfer NS-user-data between NS users.

8.2.3 Confirmation Request

The D-bit of the last DATA packet in an MBS is mapped to/from the Confirmation Request parameter.

If an N-DATA request primitive indicates in the Confirmation Request parameter that confirmation of receipt is requested (respectively, not requested), then the D-bit of the last DATA packet in an MBS is set to 1 (respectively, 0). In the case of confirmation of receipt being requested, the NL entity shall use a locally-defined mechanism to associate the P(S) of the last DATA packet in the MBS with the N-DATA request primitive. (This mechanism shall also provide for an association of an N-DATA request primitive with an N-DATA ACKNOWLEDGE indication primitive; see 9.2.1.)

When an NL entity signals an N-DATA indication primitive to the NS user, it indicates in the Confirmation Request parameter that confirmation of receipt is requested (respectively, not requested) if the D-bit of the last DATA packet in an MBS is set to 1 (respectively, 0). When the last DATA packet in an MBS has its D-bit set to 1, the NL entity shall not transmit a P(R) corresponding to that DATA packet across the DTE/DXE interface until it receives an N-DATA ACKNOWLEDGE request primitive from its NS user (see clause 9). In the case of the D-bit of the last DATA packet in an MBS being set to 1, the NL entity shall use a locally-defined mechanism to associate the P(S) of this packet with the N-DATA indication primitive. (This mechanism shall also provide for an association of an N-DATA indication primitive with an N-DATA ACKNOWLEDGE request primitive; see 9.2.1.)

9. Data transfer phase — Receipt confirmation service

9.1 Primitive and packet/field relationships

There is no distinct X.25/PLP-1984 packet associated with the N-DATA ACKNOWLEDGE request and N-DATA ACKNOWLEDGE indication primitives. The P(R) field of DATA, RECEIVE READY, RECEIVE NOT READY, and REJECT (if agreed to) packets is used to support the Receipt Confirmation Service.

9.2 Procedures

9.2.1 Primitive/Packet mapping

When an NL entity receives an N-DATA ACKNOWLEDGE request primitive from an NS user, it uses its locally-defined mechanism mentioned in 8.2.3 for associating an N-DATA ACKNOWLEDGE request primitive with a previously-issued N-DATA indication primitive (and, hence, a P(S)) to determine a P(R) to be transferred in the appropriate packet across the DTE/DXE interface. (Note that such acknowledgements shall be issued in the same order that the corresponding N-DATA indications were issued.)

When an NL entity receives a P(R), it shall determine whether this P(R) is inclusive of a P(S) associated with a previously-received N-DATA request primitive that requested confirmation of receipt. If such an association is made, then the NL entity signals an N-DATA ACKNOWLEDGE indication primitive to the NS user. This N-DATA ACKNOWLEDGE indication primitive is associated, by the locally-defined mechanism mentioned in 8.2.3, to the previously-received N-DATA request primitive that had requested confirmation of receipt.

9.2.2 Parameters

There are no parameters associated with the Receipt Confirmation Service.

10. Data transfer phase — Expedited data transfer service

10.1 Primitive/Parameter and packet/field relationships

Table 6 shows the relationships between the primitives/parameters used for the Expedited Data Transfer Service and the packets/fields associated with the interrupt transfer procedures.

Table 6 — CONS:X.25/PLP-1984 mapping for the Expedited Data Transfer Service

CONS	X.25/PLP-1984
PRIMITIVES: N-EXPEDITED DATA request N-EXPEDITED DATA indication	**PACKETS:** INTERRUPT INTERRUPT
PARAMETERS: NS-User-Data	**FIELDS:** Interrupt User Data

10.2 Procedures

10.2.1 Primitive/Packet mapping

When an NL entity receives an N-EXPEDITED DATA request primitive from an NS user, it transmits an INTERRUPT packet across the DTE/DXE interface. An NL entity shall not transmit a second INTERRUPT packet before an outstanding INTERRUPT packet has been confirmed by an INTERRUPT CONFIRMATION packet.

When an NL entity receives an INTERRUPT packet, it signals an N-EXPEDITED DATA indication primitive to the NS user. It also transmits an INTERRUPT CONFIRMATION packet across the DTE/DXE interface.

10.2.2 NS-User-Data

The Interrupt User Data Field of X.25/PLP-1984 INTERRUPT packets is used to transfer expedited NS-user-data between NS users.

11. Data transfer phase — Reset service

11.1 Primitive/Parameter and packet/field relationships

Table 7 shows the relationships between the primitives/parameters used for the Reset Service and the packets/fields associated with the reset procedures.

11.2 Procedures

11.2.1 Primitive/Packet mapping

When an NL entity receives an N-RESET request primitive from an NS user, it transmits a RESET REQUEST packet across the DTE/DXE interface. When the NL entity is ready to accept subsequent data, expedited data, and confirmations of receipt from the NS user, it signals an N-RESET confirm primitive. The issuing of this primitive may or may not be related to the completion of the X.25/PLP-1984 reset procedure. Any data or expedited data received from the NS user following the N-RESET confirm primitive is transmitted after completion of the X.25/PLP-1984 reset procedure.

If an NL entity detects an error in the operation of the X.25/PLP-1984 for which its action is to reset the virtual circuit (e.g., a sequence error or a timeout condition), then it transmits a RESET REQUEST packet across the

Table 7 — CONS:X.25/PLP-1984 mapping for the Reset Service

CONS	X.25/PLP-1984
PRIMITIVES:	**PACKETS:**
N-RESET request	RESET REQUEST
N-RESET indication	RESET INDICATION, RESET REQUEST[1)]
N-RESET response	none
N-RESET confirm	none
PARAMETERS:	**FIELDS:**
Originator and Reason	Cause and Diagnostic Code Fields[2)]

Notes to Table 7:

1 — See 11.2.1, Paragraph 2.

2 — The combination of Cause and Diagnostic Code Fields is mapped to/from the combination of Originator and Reason parameters.

DTE/DXE interface. When the NL entity is ready to accept subsequent data, expedited data, and confirmations of receipt from the NS user, it signals an N-RESET indication primitive. The issuing of this primitive may or may not be related to the completion of the X.25/PLP-1984 reset procedure. Any data or expedited data received from the NS user following the N-RESET response primitive is transmitted after completion of the X.25/PLP-1984 reset procedure.

When an NL entity receives a RESET INDICATION packet, it signals an N-RESET indication primitive to the NS user (except if this results in a reset collision; see below).

When an N-RESET response primitive is received from the NS user, the NL entity shall be willing to accept subsequent data, expedited data, and confirmations of receipt received from the NS user for transmission upon completion of the X.25/PLP-1984 reset procedure.

During the reset process, the following actions are taken by the NL entity with respect to the operation of the X.25/PLP-1984:

a) For DATA packets

   1) those awaiting transmission may either be transmitted prior to transmitting a reset packet or flushed from the queue of DATA packets awaiting transmission,

   2) those remaining in the transmit window when the reset procedure is completed are flushed, and

   3) those that have been received prior to receiving a reset packet but which do not constitute an entire MBS are flushed from the "MBS reassembly area."

b) The lower window edge for each direction of data transmission is set to 0 and subsequently transmitted DATA packets are numbered starting from 0.

c) Any busy condition that had existed prior to the reset is considered not to exist any longer.

d) Any outstanding INTERRUPT packet remains unconfirmed.

e) All timer and retransmission parameters relating to data and interrupt transfer are set back to their initial values.

No action is required with respect to the provision of the Network Service by an NL entity when it receives a RESET CONFIRMATION packet or a RESET INDICATION packet in response to a RESET REQUEST packet (i.e., a reset collision). However, it shall then be capable of receiving subsequent DATA and INTERRUPT packets and P(R) information.

11.2.2 Originator/Reason

The combination of Originator and Reason parameters of the N-RESET primitives is mapped to/from the combination of Resetting Cause and Diagnostic Code Fields.

The combination of the cause code "DTE Originated" (coded as all zeros) with the diagnostic "Reset — User Resynchronization" (diagnostic code 250) corresponds to an Originator-parameter value of "NS User" and a Reason-parameter value identical to the diagnostic.

All other combinations of cause codes except "DTE Originated" coded as "10000000" and diagnostic codes specified in CCITT Rec. X.25 | ISO/IEC 8208 correspond to an Originator-parameter value of "NS Provider." The value of the Reason parameter is derived as given below.

a) The Reason-parameter value is "Congestion" if any of the following applies:

   1) cause code "Network Congestion;"

   2) cause code "DTE Originated" (coded as all zeros) and diagnostic 234.

b) The Reason-parameter value is "Reason Unspecified" for any other combination of cause and diagnostic codes.

The cause code "DTE Originated" coded as "10000000" with any diagnostic code, as well as cause codes not specified in CCITT Rec. X.25 | ISO/IEC 8208 with any diagnostic code, corresponds to values of both the Originator parameter and the Reason parameter of "Undefined."

12. Response to protocol violations

An NL entity may receive a packet that is valid according to CCITT Rec. X.25 | ISO/IEC 8208 but is not valid when considered as part of the mapping specified in clauses 6 to 11. In such cases, it follows the actions given below.

a) Error Conditions:
   1) INCOMING CALL packet without a B-TCN Facility;
   2) INCOMING CALL packet without a Fast Select Facility;
   3) CALL CONNECTED packet without an EETDN Facility;
   4) CALL CONNECTED packet with a Selected QOS value, when present, that is not valid with respect to the CALL REQUEST packet (e.g., the Selected value is less than the Lowest Quality Acceptable value).

   Actions:

   The NL entity shall transmit a CLEAR REQUEST packet across the DTE/DXE interface with a clearing cause code of "DTE Originated." It is recommended that the diagnostic code be set to 228 (or 224). For conditions (1) and (2), the NL entity shall not signal any primitive to the NS User; for conditions (3) and (4), the NL entity shall signal an N-DISCONNECT indication primitive to the NS User.

b) Error Conditions:
   1) DATA packet with its Q-bit set to 1;
   2) DATA packet with its D-bit set to 1 when "no use of Receipt Confirmation" has been negotiated during NC establishment;
   3) INTERRUPT packet when "no use of Expedited Data" has been negotiated during NC establishment.

   Actions:

   The NL entity is strongly recommended to transmit either of the packets given below across the DTE/DXE interface with a cause code of "DTE Originated." The Originator parameter of the resulting primitive signaled to the NS User, in either case, shall be "NS Provider."

Packet to Transmit	Recommended Diagnostic Code	Primitive Signaled to NS User	Reason Parameter
CLEAR REQUEST	226 (or 224)	N-DISCONNECT indication	disconnection — reason unspecified (permanent condition)
RESET REQUEST	233 (or 224)	N-RESET indication	reset — reason unspecified

c) Error Conditions:
   1) zero-length MBS.

   Actions:
   The NL entity transmits either of the packets in (b) or shall otherwise ignore the zero-length MBS.

13. Conformance

13.1 Conformance requirements

A system claiming to implement the procedures specified in this International Standard shall

a) satisfy the conformance requirements of ISO/IEC 8208;

b) support all the packets and associated fields/facilities specified in Table 1 (excluding interrupt packets), Table 2 (excluding Expedited Data Negotiation), and Tables 4, 5 and 7, except that a system may support call setup packets relating to incoming calls only or to outgoing calls only;

c) support all the optional user facilities and CCITT-specified DTE facilities specified in 5.1 except the EDN Facility;

d) support the mapping of Network Service primitives to CCITT Rec. X.25 | ISO/IEC 8208 packets in clauses 6 to 11;

e) support the negotiation mechanism in 6.2.3 for the Receipt Confirmation Service;

f) if it supports the optional Receipt Confirmation Service, support:
   1) the procedures specified in clause 9;

g) support the negotiation mechanism in 6.2.4, including the case when the EDN Facility is absent, for the Expedited Data Transfer Service;

h) if it supports the optional Expedited Data Transfer Service, support:
   1) INTERRUPT packets with 32-octet User Data Fields and the procedures and mappings defined in clause 10;
   2) the EDN Facility;

i) support the conveyance of the Network Address in the X.25/PLP-1984 Called/Calling Address Extension Facilities;

j) if it supports the conditions defined in 6.2.2.1.1:
   1) recognize the Network Address when it is received in the X.25/PLP-1984 Called/Calling Address Field and the conditions of 6.2.2.1.1 are satisfied.

13.2 Optional features

Clauses 6 to 11 allow certain options for implementations. Claims of conformance shall state

a) whether Expedited Data Transfer is supported;

b) whether Receipt Confirmation is supported;

c) whether the method of conveying the Network Address in the X.25/PLP-1984 Called/Calling Address Field is supported for transmitted packets;

d) whether the conditions defined in 6.2.2.1.1 are ever supported for receipt of Network Addresses conveyed in the X.25/PLP-1984 Called/Calling Address Fields;

e) whether conformance to Annex A is also claimed;

f) whether the procedures for use with the X.25 PVC service (Annex C) are supported.

Annex A
(normative)

X.25 (1980) Subnetwork Dependent Convergence Protocol

The Subnetwork Dependent Convergence Protocol (SNDCP) defined in this annex should only be used if the elements of X.25/PLP-1984, as defined in 5.1, are not available to support provision of the OSI CONS.

A.1 Introduction

The 1984 or later versions of CCITT Recommendation X.25 contains adequate mechanisms to enable the provision of the OSI CONS over X.25 subnetworks. Until such time as all public and private packet-switched X.25 data subnetworks conform to at least the 1984 version and all existing X.25 DTEs are upgraded, there is a need for a method of providing the CONS over the X.25 (1980) subnetwork access protocol.

This annex specifies a procedure that supplies the OSI CONS, principally by the use of SNDCP parameters conveyed within X.25 User Data Fields. The parameter encodings have been aligned to the facility codes of X.25 (1984).

This procedure is intended to form part of a migration strategy towards the use of X.25 (1984) in both subnetworks and DTEs.

A.2 Scope

A.2.1 Scope of this annex

This annex specifies an SNDCP to offer the OSI CONS over an X.25 subnetwork service. The SNDCP is applicable in the following cases:

a) when the X.25 service does not support the full CONS (that is, when the X.25 service conforms to the 1980 CCITT Recommendation or earlier);

b) when the resulting service for a concatenation of X.25 subnetworks only conforms to the 1980 CCITT Recommendations, even when one or more of the subnetworks conform to later X.25 CCITT Recommendations;

c) when the X.25 subnetwork conforms to a CCITT Recommendation later than 1980, but when the calling or called DTE only implements the 1980 CCITT Recommendation.

There are two major elements of this specification: firstly, additional parameters carried as data within existing X.25 packets to provide mechanisms needed for provision of the OSI CONS; secondly, procedures specifying the use of the X.25 packets, as well as the existing and new parameters, to provide the OSI CONS.

A.2.2 Scope of the underlying X.25 subnetwork

The underlying subnetwork supports the 1980 CCITT X.25 Recommendation (the "Yellow Book") subnetwork access protocol.

Over older subnetworks not conforming to the 1980 CCITT X.25 Recommendation, the full CONS may not be achieved. In particular, delivery confirmation may not be supported.

The majority of the CONS requirements are directly supported by the X.25 protocol; the use of the SNDCP in other cases is minimal.

The X.25 (1980) datagram packets are not used. The X.25 Fast Select Facility is used if available, but it is not essential.

The use of this protocol is indicated by using a reserved ISO value for the protocol identification subfield of the Call User Data Field in a CALL REQUEST packet. This subfield is only used to identify the X.25 (1980) SNDCP and, thus, cannot be used simultaneously for other purposes (e.g., to identify a higher layer protocol).

NOTE — The solution described here is recognized as having some quality of service, cost, and feature penalties, but is seen as the best that can be achieved due to the disparity between the CONS and the X.25 (1980) protocol. In particular, there is no reasonable way to provide the optional Network expedited data service. Furthermore, NC establishment may involve extra delays in some cases if the X.25 data-transfer phase has to be used to convey parameters that cannot fit into the Call User Data

Field. Similarly, additional delay may be introduced during the NC release phase if disconnect user data has to be conveyed. Only a portion of the QOS parameters can be mapped into the elements of the X.25 protocol.

A.3 Abbreviations

The abbreviations given in the main body of this International Standard apply, with the additions listed below.

AE	Address Extension (parameter)
ID	Identifier
LI	Length Indicator
MTC	Minimum Throughput Class (parameter)
N-CC	Network Connection confirm
N-CR	Network Connection request
N-DR	Network Disconnect request
NPDU	Network Protocol Data Unit
NSDU	Network Service Data Unit
PT	Parameter Type
PV	Parameter Value
Q-bit	Qualifier Bit
SNDCP	Subnetwork Dependent Convergence Protocol

A.4 Overview of the protocol

A.4.1 Service provided by the Network Layer

The X.25 (1980) SNDCP provides the mechanism for entities in the Network Layer to interact and provide the CONS, as defined in CCITT Rec. X.213 | ISO/IEC 8348.

A.4.2 Service assumed from the X.25 subnetwork

The X.25 (1980) SNDCP assumes that the underlying X.25 subnetwork provides adequate error performance and flow control. No additional mechanisms are provided in the protocol to enhance the QOS.

A.4.2.1 Required features

The X.25 (1980) SNDCP depends on the availability of all of the following X.25 features (parenthesized references are to CCITT Recommendation X.25 (1980)):

a) procedures for Virtual Call service (4.1);

b) procedures for data transfer (4.3), except:
   1) user data field length need only be the standard length (4.3.2); however, other lengths may be supported;
   2) the D-bit is not mandatory; if it is not available, then the Receipt Confirmation Service shall not be available (4.3.3);
   3) the Interrupt procedure is not required (4.3.7);

c) procedures for flow control (4.4);

d) call setup and clearing packets (6.2);

e) DTE and DCE DATA packets (6.3.1);

f) flow control packets and reset packets (6.5);

g) coding of X.25-subnetwork-generated diagnostics in clear, reset, and restart packets (Annex E).

A.4.2.2 Features that will be used if available

It is desirable that the DTE uses and/or subscribes to the following protocol elements:

a) D-bit (4.3.3);
b) Fast Select and Fast Select Acceptance Facilities (6.8.2, 7.2.4, and 7.2.5);
c) Flow Control Parameter Negotiation Facility (7.2.2);
d) Throughput Class Negotiation Facility (7.2.3).

When there is prior knowledge that the use of any of the above X.25 features may be acceptable to the subnetwork service provider and the called DTE, then the feature shall be used for the connection. If, however, the connection is rejected because of the use of this feature, then the call shall be repeated without the use of this feature.

When there is prior knowledge that the use of a feature is not acceptable, then it shall not be used.

The following X.25 (1980) protocol elements shall be used in ways specified by the subnetwork administration:

a) procedures for restart (3.3);
b) restart packets (6.6);
c) range of logical channels (Annex A);
d) actions taken by a DCE (Annex C).

A.4.2.3 Reason Codes

This protocol assumes that a zero cause code allows the diagnostic code octet to be used to carry information relative to the reason for failure (see A.5.2). However, this is not essential, as the Alternative NC Release Procedure can carry the reason as a parameter.

A.4.2.4 QOS

Mapping of the CONS QOS parameters to the 1980 X.25 Facility Field is not a required feature. All CONS QOS parameters can either be carried as protocol parameters in the Call User Data Field or be defaulted, although the X.25 Facility Field may be used if appropriate.

A.4.2.5 Features not used

The following X.25 (1980) protocol elements are never used to directly support the CONS (these protocol elements are not precluded from use by management entities):

a) Interrupt procedures (4.3.7 and 6.3.2);
b) procedures for datagram service (5, 6.4, and 7.3);
c) D-bit Modification Facility (7.2.6).

A.4.3 Functions provided by the protocol

A.4.3.1 Network Connection establishment phase

a) NC establishment: initial establishment of the NC;

b) addressing: conveyance of the Calling and Called Network Addresses;

c) negotiation of Receipt Confirmation Service: negotiation of the use of Receipt Confirmation and other services;

d) QOS negotiation: negotiation of throughput and other QOS parameters;

e) User Data: carrying of user data during the NC establishment phase.

A.4.3.2 Network Connection release phase

a) NC release: clearing down of the NC;

b) addressing: for refusal of an NC establishment attempt, conveyance of the Responding Network Address;

c) Originator/Reason: transfer of the location and reason for failure;

d) User Data: carrying user data during the NC release phase.

A.4.3.3 Data transfer

a) data transfer: uses X.25 DATA packets for transferring data;

b) NSDU Segmentation: provides ability to transfer NSDUs larger than the maximum X.25 packet size by use of an MBS;

c) NPDU concatenation: not required;

d) error detection: the error detection capability of X.25 subnetworks is adequate to provide the CONS; no additional mechanism is provided in the protocol;

e) error recovery: the error recovery capability of X.25 subnetworks is adequate to provide the CONS; no additional mechanism is provided in the protocol;

f) sequence preservation: sequence preservation is inherent in X.25 subnetworks; no additional mechanism is provided in the protocol;

g) Receipt Confirmation: confirmation to the NS user of receipt of NSDUs;

h) Expedited Data: not provided.

A.4.3.4 Network Connection control

a) multiplexing: multiple NCs are provided by the X.25 virtual circuits;

b) splitting: parallel use of X.25 calls to support one NC is not a required facility;

c) flow control: the X.25 flow control mechanisms are adequate to provide the CONS; no additional mechanism is provided;

d) reset: the X.25 reset mechanisms are adequate to provide the CONS; no additional mechanism is provided;

e) protocol errors: if an unexpected packet, or a packet with an error in the SNDCP parameters, is received, then the protocol specifies the action to be taken.

A.5 Protocol mechanisms

The protocol mechanisms in this clause are not in themselves a complete specification of the protocol and should be read in conjunction with clauses A.6 and A.7.

A.5.1 Network Connection establishment phase

This clause describes the protocol support for the N-CONNECT primitives. Table A.1 shows the relationship between the primitives/parameters used during the Network Connection establishment phase and the packets/fields associated with the call setup procedures.

a) NC establishment:

A Fast Select X.25 CALL REQUEST packet shall be mapped, where possible, to an N-CONNECT request primitive. The N-CONNECT request parameters to be conveyed are carried as X.25 addresses or facilities wherever possible; the Call User Data Field (using SNDCP encoding) is used where this is not possible.

The N-CONNECT response primitive should be returned as a Fast Select CALL ACCEPTED packet with any required parameters encoded as X.25 parameters or Called User Data. On a multi-subnetwork call, this CALL ACCEPTED packet shall not be returned until an N-CONNECT confirm primitive is received from the following subnetwork. Alternatively, the N-CONNECT response primitive may use the Alternative NC Establishment Procedure, which is described below.

If Fast Select is not available or where 128 octets of X.25 Call User Data is not enough, then the Alternative NC Establishment Procedure shall be used.

b) Alternative NC Establishment Procedure:

If the Normal NC establishment procedure cannot be used to convey all the N-CONNECT request or response parameters, then elements of this Alternative NC Establishment Procedure shall be used.

The X.25 CALL REQUEST packet, using this alternative procedure, shall be sent with a Continuation parameter in the Call User Data Field. This indicates that the N-CONNECT request parameters will be conveyed in one or more X.25 DATA packets.

The receiver of the corresponding X.25 INCOMING CALL packet shall accept the X.25 Virtual Call and respond with a (non-Fast Select) X.25 CALL ACCEPTED packet. The receiver of a normal X.25 Fast Select INCOMING CALL packet may similarly accept the X.25 Virtual Call by responding with an X.25 CALL ACCEPTED packet containing a Continuation parameter in the Called User Data Field.

When the Virtual Call is established, any untransmitted N-CONNECT request parameters shall be conveyed in an MBS (of one or more DATA packets) that consists of an N-CR message, enabling the Called DTE to generate an N-CONNECT indication primitive.

Table A.1 — Mapping for NC establishment phase

CONS	X.25/PLP-1980
Primitive	**Packet Type**
N-CONNECT request N-CONNECT indication N-CONNECT response N-CONNECT confirm	CALL REQUEST INCOMING CALL CALL ACCEPTED CALL CONNECTED or + DATA (N-CR) DATA (N-CC) Continuation parameter
Parameters	**Fields (including Facility and Additional Parameter)**
Called Address	Called DTE Address Field Called Address Extension Parameter
Calling Address	Calling DTE Address Field Calling Address Extension Parameter
Responding Address	Called DTE Address Field Called Address Extension Parameter
Receipt Confirmation Selection	General Format Identifier (D-bit)[1)]
Expedited Data Selection	—
QOS Parameter Set	Throughput Class Negotiation Facility[1)] Minimum Throughput Class Negotiation Parameter Transit Delay Parameter
NS-user-data	NS-User-Data Parameter

Note to Table A.1:

1 — These items are not required to directly support the OSI CONS in the X.25 (1980) SNDCP.

The Alternative NC Establishment Procedure is completed by the conveyance of any N-CONNECT response parameters in an MBS (of one or more DATA packets) that consists of an N-CC message. If there are no N-CONNECT response parameters, then an X.25 DATA (N-CC) packet containing only the SNDCP message code shall be sent.

c) Addressing:

Local operation determines the contents of the NPAI and whether Network Addresses, where explicitly supplied, are mapped to and from the Address Field (AF) or the SNDCP Address Extension (AE) parameters. Annex F describes guidelines for the methods by which the required AF contents may be derived from the Network Address. The permitted techniques for the placement of Network Addresses in the AF are given in 6.2.2.1.1 and 6.2.2.2.1, and those for the AE parameters are given in A.6.4.6 of this annex. The content of these fields shall be in the preferred binary encoding defined in CCITT Rec. X.213 | ISO/IEC 8348.

NOTES

1 The use of the preferred binary encoding results in binary-coded decimal digits in the AF, as required by CCITT Rec. X.25 (1980).

2 If the Responding Address is not present in a CALL ACCEPTED/CALL CONNECTED packet, then the previous Called Network Address is assumed.

d) Receipt Confirmation Service negotiation:

The D-bit in the CALL REQUEST packet is used for negotiating the use of Receipt Confirmation.

When using the Alternative NC Establishment Procedure, the CALL ACCEPTED packet only signifies connection over the X.25 subnetwork and has no end-to-end significance. To provide end-to-end significance for multi-subnetwork calls, the D-bit in the following MBS (of one or more DATA packets) containing an N-CC message shall be used to indicate acceptance or rejection of Receipt Confirmation.

NOTE — If operating over X.25 subnetworks that do not support the D-bit negotiation, this feature is not available. If the N-CONNECT request primitive has the Receipt Confirmation Selection parameter value of "use of Receipt Confirmation," it should be returned as "no use of Receipt Confirmation." Also, the N-CONNECT indication primitive from the use of such a subnetwork should always contain "no use of Receipt Confirmation."

e) QOS negotiation:

Use is made of the TCN optional user facility (if subscribed to) when negotiating throughput QOS, although SNDCP encoding is also necessary. Transit delay is negotiated entirely by the use of SNDCP encoding.

Quality of Service is described in A.5.5. If QOS parameters are omitted or the subnetwork does not support the necessary facilities, then the QOS obtained is the default for the underlying subnetwork(s).

f) User Data:

NS-user-data shall be carried as Call User Data in a CALL REQUEST packet with the Fast Select Facility. In other cases of call requests where this field is not available, the Alternative NC Establishment Procedure shall be used.

A.5.2 Network Connection release phase

This subclause describes the protocol support for the N-DISCONNECT primitives. Table A.2 shows the relationship between the primitives/parameters used during the Network Connection release phase and the packets/fields associated with the call clearing procedures.

Table A.2 — Mapping for NC Release phase

CONS	X.25/PLP-1980
Primitive	**Packet Type**
N-DISCONNECT request	CLEAR REQUEST or + DATA(N-DR)
N-DISCONNECT indication	CLEAR INDICATION RESTART INDICATION CLEAR REQUEST or + DATA (N-DR) Continuation parameter
Parameters	**Fields (including Facility and Additional Parameter)**
Originator and Reason	Cause and Diagnostic Code Fields or Disconnect Reason Parameter Disconnect Originator Parameter
NS-user-data	NS-User-Data Parameter
Responding Address	Called DTE Address Field Called Address Extension Parameter

a) NC Release:

An N-DISCONNECT request primitive is sent as an X.25 CLEAR REQUEST packet. The CLEAR CONFIRMATION packet has no equivalent at the NS boundary. It is a management function to take

appropriate action if they are not received.

If the N-DISCONNECT primitive requires the transfer of NS-user-data during the NC release phase, then the Alternative NC Release Procedure shall be used.

b) Alternative NC Release Procedure:

When the normal disconnect or connection rejection procedure cannot be used, this alternative procedure shall be used.

The user originating the N-DISCONNECT primitive shall send an MBS (of one or more DATA packets) that consists of an N-DR message containing the appropriate NC release parameters. This acts as an invitation to clear and, on receipt of the N-DR message, the corresponding end of the NC shall issue an X.25 CLEAR REQUEST packet.

c) Originator/Reason:

For NS-user-originated disconnect requests, the X.25 cause code is "DTE Originated." The X.25 Diagnostic Code Field is used to transfer the Reason parameter, as specified in Table A.3.

For NS-provider-originated disconnect requests, the X.25 Clearing or Restarting Cause and Diagnostic Code Fields are mapped to a Reason, as specified in Table A.4.

NOTES

1 Where an NC spans several subnetworks, the X.25 clearing cause of "DTE Originated" includes the cases of network relays describing a disconnection in a distant subnetwork. The value of the Originator parameter should be deduced from the Reason, as specified in Table A.3.

2 Where the Alternative NC Release Procedure is used, the Originator parameter is carried in SNDCP encoding.

d) User Data:

NS-user-data shall be carried in the Clear User Data Field of the X.25 CLEAR REQUEST and CLEAR INDICATION packets used with the Fast Select Facility. In other cases of call clearing where this field is not available, the Alternative NC Release Procedure shall be used.

e) NC Refusal:

If the NC cannot be established, then an X.25 Fast Select CLEAR REQUEST packet should be returned. The responding address and any user data should be returned as parameters in the Clear User Data Field. For a Fast Select call, if the encoding of these parameters exceeds the maximum length of the Clear User Data Field, then the call shall first be accepted with a Fast Select CALL ACCEPTED packet containing a Continuation parameter and then immediately cleared by use of the Alternative NC Release Procedure.

For a non-Fast Select call, the call should be cleared by use of the Alternative NC Release Procedure.

f) Subnetwork-Initiated NC Release:

Receipt of X.25 RESTART INDICATION packets and X.25 CLEAR INDICATION packets with a cause that is not "DTE Originated" is indicated by NS-provider-initiated N-DISCONNECT indication primitives.

A.5.3 Data transfer phase

This subclause describes the protocol support for the N-DATA and N-DATA-ACKNOWLEDGE primitives. Table 12 shows the relationship between the primitives/parameters used for the Data Transfer Service and the packets/fields associated with the data transfer procedures.

a) Data Transfer:

NS-user-data shall be sent as an MBS of DATA packets (as defined in CCITT Rec. X.25 | ISO/IEC 8208) with the Q-bit set to zero. NSDUs, once received for transmission, shall not unduly be delayed.

b) NSDU Segmentation:

The M-bit shall be used to indicate continuation if one NSDU is sent as several X.25 DATA packets.

c) NPDU Concatenation:

NPDU concatenation is not provided. Each NPDU is sent as an X.25 DATA packet.

d) Error Detection:

The error performance of X.25 subnetworks is considered adequate and no additional protocol mechanisms are needed.

e) Error Recovery:

The error performance of X.25 subnetworks is considered adequate and no additional protocol mechanisms are needed.

f) Sequence Preservation:

An X.25 subnetwork is inherently sequence preserving. No additional protocol mechanisms are provided.

g) Receipt Confirmation:

The X.25 D-bit mechanism is used to provide the Receipt Confirmation Service. The last (or only) DATA packet of an MBS forming an NSDU that requires this service is sent with its D-bit set to 1. The entity at the far end of the X.25 subnetwork shall not acknowledge such a packet until it has received an acknowledgement from the NS user or the next stage of the NC. The receipt of the appropriate P(R) over the X.25 subnetwork thus has end-to-end significance even over multi-subnetwork connections. If a DATA packet has both its D- and M-bits set, then the D-bit has significance only over the X.25 subnetwork and may be responded to without waiting for user acknowledgement.

h) Expedited Data:

Because of the difficulties of providing an Expedited Data Service using the X.25 (1980) INTERRUPT packet, which conveys a single octet of User Data, the NS provider exercises the option not to provide this optional service.

Table A.3 — Mapping of NS Disconnect Reason to X.25 Diagnostic Code

NS Reason	NS Originator	X.25 Diagnostic Code Hex (Decimal)	Cause Value
Disconnection — Permanent Condition	NS Provider	E2 (226)	0
Disconnection — Transient Condition	NS Provider	E1 (225)	0
Connection Rejection — NSAP Address Unknown Permanent	NS Provider	E8 (232)	0
Connection Rejection — NSAP Unreachable Transient	NS Provider	E7 (231)	0
Connection Rejection — QOS Not Available Permanent	NS Provider	E6 (230)	0
Connection Rejection — QOS Not Available Transient	NS Provider	E5 (229)	0
Connection Rejection — Reason Unspecified Permanent	NS Provider	E4 (228)	0
Connection Rejection — Reason Unspecified Transient	NS Provider	E3 (227)	0
Disconnection — Normal Condition	NS User	F1 (241)	0
Disconnection — Abnormal Condition	NS User	F2 (242)	0
Connection Rejection — Permanent Condition	NS User	F5 (245)	0
Connection Rejection — Transient Condition	NS User	F4 (244)	0
Connection Rejection — QOS Not Available Permanent	NS User	F7 (247)	0
Connection Rejection — QOS Not Available Transient	NS User	F6 (246)	0
Connection Rejection — Incompatible Information In NS-user-data	NS User	F8 (248)	0

A.5.4 Network Connection control

This subclause includes a description of the protocol support for the N-RESET primitives.

a) Multiplexing:

The X.25 protocol provides support for multiple NCs.

b) Splitting:

Parallel use of X.25 calls to support one NC is not a required feature.

c) Flow Control:

The flow-control features of X.25 are considered adequate.

d) Reset:

The X.25 reset mechanisms are adequate to support the Network Service reset function. Table A.5 shows the relationship between the primitives/parameters used for the Reset Service and the packets/fields associated with the reset procedures.

For NS-user-originated reset requests, the X.25 Diagnostic Code Field is used to transfer the Reason parameter, as shown in Table A.6.

For NS-provider-originated reset requests, the X.25 Resetting Cause and Diagnostic Code Fields are mapped to a reason, as shown in Table A.7.

NOTE — Where an NC spans several subnetworks, the X.25 resetting cause of "DTE Originated" includes cases of network relays describing a reset in a distant subnetwork. The value of the Originator parameter should be deduced from the Reason.

e) Protocol Errors:

The action to be taken upon detection of errors in the X.25 protocol or packet formats is contained in CCITT Rec. X.25 | ISO/IEC 8208. If errors are detected in the SNDCP parameters of a received packet or any other error is detected for which there is no explicit event in the SNDCP state/event table, then the "Any Other Valid X.25 Event" for that state shall be taken.

A.5.5 Quality of service

a) General:

Network Service QOS parameters are mapped directly to/from the equivalent SNDCP QOS parameters.

b) Throughput:

The Throughput QOS parameters of the N-CONNECT primitives are mapped to/from the CCITT Recommendation X.25 (1980) Throughput Class Negotiation (TCN) Facility, if available, and the Minimum Throughput Class (MTC) parameter of the SNDCP. The specific mapping of this X.25 (1980) facility and SNDCP parameter to/from both sets of Throughput subparameters is given in Table A.8.

The set of values that can be specified for each Throughput subparameter ranges from 75 bits per second through 48 000 bits per second, inclusive. This set consists of the following discrete values: 75, 150, 300, 600, 1 200, 2 400, 4 800, 9 600, 19 200, and 48 000 bits per second. An NL entity supports either all of these values or a contiguous subset of them. The value "unspecified" is also allowed.

1) Processing an N-CONNECT request primitive

If an SNDCP entity, when receiving an N-CONNECT request primitive, cannot support the Lowest Quality Acceptable throughput (i.e., the minimum throughput) when specified for either direction of data transfer, then it rejects the request. In this case, the SNDCP entity does not transmit any X.25 packet but it does signal an N-DISCONNECT indication primitive to the Calling NS user. The Originator parameter is "NS Provider." The Reason parameter is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the NL entity could never support the Lowest Quality Acceptable for either direction of data transfer.

Table A.4 — Mapping of X.25 Clearing/Restarting Cause to NS Reason

X.25 Clearing or Restarting Cause	Cause Value (Hex)		NS Reason	NS Originator
Number Busy	1		Connection Rejection — NSAP Unreachable Transient	NS Provider
Out Of order	9		Connection Rejection — Reason Unspecified Permanent	NS Provider
		or	Disconnection — Permanent	NS Provider
Remote Procedure Error	11		Connection Rejection — Reason Unspecified Permanent	NS Provider
		or	Disconnection — Permanent	NS Provider
Reverse Charging Acceptance Not Subscribed	19		Connection Rejection — Reason Unspecified Permanent	NS Provider
Incompatible Destination	21		Connection Rejection — Reason Unspecified Permanent	NS Provider
Fast Select Acceptance Not Subscribed	29		Connection Rejection — Reason Unspecified Permanent	NS Provider
Invalid Facility Request	3		Connection Rejection — Reason Unspecified Permanent	NS Provider
Access Barred	B		Connection Rejection — Reason Unspecified Permanent	NS Provider
Local Procedure Error	13		Connection Rejection — Reason Unspecified Transient	NS Provider
		or	Disconnection — Transient	NS Provider
Network Congestion	5		Connection Rejection — Reason Unspecified Transient	NS Provider
		or	Disconnection — Transient	NS Provider
Not Obtainable	D		Connection Rejection — NSAP Address Unknown Permanent	NS Provider
RPOA Out Of Order	15		Connection Rejection — Reason Unspecified Permanent	NS Provider
		or	Disconnection — Permanent	NS Provider

Notes to Table A.4:

1 — The only X.25 restarting causes are "Local Procedure Error" and "Network Congestion."

2 — A "disconnect" reason should only be derived from this table if the NC has already been established. Otherwise, the "connection rejection" reason should be taken.

If an SNDCP entity, when receiving an N-CONNECT request primitive, can support the Lowest Quality Acceptable throughput (i.e., the minimum throughput) when specified for both directions of data transfer, then it encodes the Target value in the TCN Facility of X.25 (1980) if this facility is available, and the Lowest Quality Acceptable value in the MTC parameter of the SNDCP. If the Target subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the SNDCP entity encodes the TCN Facility (if it is supported) for the corresponding direction(s) of data transfer as the highest throughput rate supported by the SNDCP entity. If the Lowest Quality Acceptable

Table A.5 — Mapping for Data Transfer phase

CONS	X.25/PLP-1980
Primitive N-DATA request N-DATA indication	**Packet Type** DATA DATA
Parameters NS-user-data Confirmation Request	**Fields** User Data, M-bit D-bit[1)], P(S)
Primitive N-DATA ACKNOWLEDGE request N-DATA ACKNOWLEDGE indication	**Packet Type** DATA, RECEIVE READY, RECEIVE NOT READY, REJECT DATA, RECEIVE READY, RECEIVE NOT READY, REJECT
Parameters —	**Fields** P(R)
Primitive N-EXPEDITED DATA request N-EXPEDITED DATA indication	**Packet Type** Not Supported Not Supported
Parameters NS-user-data	**Fields** Not Supported
Primitive N-RESET request N-RESET indication N-RESET response N-RESET confirm	**Packet Type** RESET REQUEST RESET INDICATION, RESET REQUEST None None
Parameters Originator and Reason	**Fields** Cause and Diagnostic Code Fields

Note to Table A.5:

1 — This item is not required to directly support the OSI CONS in the X.25 (1980) SNDCP.

subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the SNDCP entity encodes the MTC parameter for the corresponding direction(s) of data transfer as 75 bits per second. The TCN Facility, if supported, and the MTC parameter are transmitted across the DTE/DXE interface in a CALL REQUEST packet if the Fast Select Facility is supported. If the Fast Select Facility is not supported, then the TCN Facility, if supported, is transmitted by means of the CALL REQUEST packet and the MTC parameter by means of the N-CR message.

Table A.6 — Mapping of NS Reset Reason to X.25 Diagnostic Code

NS Reason	NS Originator	X.25 Diagnostic Code Hex (Decimal)	Cause Value
Reason Unspecified	NS Provider	E9 (233)	0
Congestion	NS Provider	EA (234)	0
User Resynchronization	NS User	FA (250)	0

Table A.7 — Mapping of X.25 Reset Cause to NS Reason

X.25 Reset Cause	Cause Value	NS Reason	NS Originator
Remote Procedure Error	3	Reason Unspecified	NS Provider
Local Procedure Error	5	Reason Unspecified	NS Provider
Network Congestion	7	Congestion	NS Provider
Incompatible Destination	11	Reason Unspecified	NS Provider

Table A.8 — Mapping of Throughput QOS subparameters to X.25 (1980) facility and SNDCP parameter

CONS		X.25(1980)/SNDCP	
Subparameter	Primitive	Facility/ Parameter	Packet/ Message
Target	N-CONNECT request	TCN	CALL REQUEST[1)]
Lowest Quality Acceptable	N-CONNECT request	MTC	CALL REQUEST[2)] or DATA (N-CR)
Available	N-CONNECT indication	TCN	INCOMING CALL[1)]
Lowest Quality Acceptable	N-CONNECT indication	MTC	INCOMING CALL[2)] or DATA (N-CR)
Selected	N-CONNECT response	TCN/MTC[3)]	CALL ACCEPTED[1)] or DATA (N-CC)
Selected	N-CONNECT confirm	TCN/MTC[3)]	CALL CONNECTED[1)] or DATA (N-CC)

Notes to Table A.8:

1 — The TCN Facility is used if the underlying X.25 (1980) supports it.

2 — The MTC parameter may be conveyed in the CALL REQUEST/INCOMING CALL packet if the Fast Select Facilities are supported by the underlying X.25 (1980).

3 — Selected values are transferred in the TCN Facility if it is supported; otherwise, these values are transferred in the MTC parameter.

2) Processing an INCOMING CALL packet

If an INCOMING CALL packet is received that does not contain a TCN Facility, then the available throughput value for each direction of data transfer is taken to be the minimum of the respective default throughput classes and the equivalent values in the MTC parameter. If the INCOMING CALL packet does contain the TCN Facility, then the values in the TCN Facility represent the available throughput value for each direction of data transfer.

When receiving an INCOMING CALL packet (Fast Select supported) or an INCOMING CALL packet in combination with an N-CR message, the SNDCP entity compares the minimum throughput value specified in the MTC parameter for each direction of data transfer to the available throughput value. If, for either direction, the available throughput value is less than the minimum throughput value or if the SNDCP entity cannot support the minimum throughput value, then the SNDCP entity clears the call (i.e., transmits a CLEAR REQUEST packet). The cause is "DTE Originated" and the diagnostic is "Connection Rejection — QOS Not Available/Transient Condition," or "Connection Rejection — QOS Not Available/Permanent Condition" if the SNDCP entity could never support the lowest throughput value (these diagnostics have values 229 and 230, respectively). Otherwise, the SNDCP entity indicates, for both directions of data transfer, the Available and Lowest Quality Acceptable throughput values in the Throughput QOS parameters of the N-CONNECT indication primitive signaled to the Called NS user.

3) Processing an N-CONNECT response primitive

The SNDCP entity is passed the Selected throughput values for both directions of data transfer in the Throughput QOS parameters of the N-CONNECT response primitive. When using the Normal NC Establishment Procedure, these values are encoded in the TCN Facility returned in the CALL ACCEPTED packet. When using the Alternative NC Establishment Procedure, these values are encoded in the MTC parameter and returned either in a CALL ACCEPTED packet (if Fast Select is supported and was used in the related CALL REQUEST packet) or in an N-CC message.

4) Processing a CALL CONNECTED packet

When using the Normal NC Establishment Procedure and receiving a CALL CONNECTED packet with the TCN Facility present, the SNDCP entity indicates the Selected throughput values for both directions of data transfer, as given in the TCN Facility, in the Throughput QOS parameters of the N-CONNECT confirm primitive signaled to the Calling NS user. When using the Alternative NC Establishment Procedure, the Selected throughput values are obtained from the N-CC message.

c) Transit Delay:

The Transit Delay QOS parameter negotiation is described in 6.2.5.2 with the restrictions listed below.

1) The Transit Delay Selection And Indication (TDSAI) Facility is not available in X.25 (1980) subnetworks. The default value assumed shall be the subject of administrative agreement for a period of time with the provider of the X.25 (1980) subnetwork.

2) The End-to-End Transit Delay Negotiation (EETDN) Facility is not available in X.25 (1980) subnetworks and shall be encoded in the Transit Delay parameter of the SNDCP, as defined in A.6.4.7.

3) The reference to non-transmission of X.25/PLP-1984 packets in 6.2.5.2.1 applies in this subclause to SNDCP messages.

d) Additional QOS Parameters:

Other QOS parameters are not supported.

A.5.6 X.25 features

a) Q-bit:

The Q-bit of a DATA packet is set to 1 if it carries information coded using the SNDCP encoding.

b) M-bit:

An MBS is used if an NSDU is too large to be sent in one DATA packet, or if N-CONNECT or N-DISCONNECT parameters are too large to be sent in the Call or Clear User Data Fields, respectively.

c) D-bit:

The D-bit in a CALL REQUEST packet (i.e., bit 7 of octet 1) is set to request the optional NS-provider Receipt Confirmation Service.

The D-bit is set in a DATA packet to convey the Confirmation Request parameter.

d) Restart:

An X.25 restart will cause the release of all NCs on the interface to which it applies.

e) Flow Control:

The X.25 flow-control mechanisms can be used to provide the NS flow control and do not require any enhancement.

f) Logical Channel:

Each NC maps onto a single X.25 logical channel.

g) Diagnostic Code Field:

This field is used to transfer the value of the Reason parameter.

h) X.25 DIAGNOSTIC packet:

This is not affected. However, its receipt will cause the "Any Other Valid X.25 Event" actions in the state/event table in A.6.1.

A.5.7 Network relaying

For an NL relay between two X.25 subnetworks using the X.25 (1980) SNDCP for the NC on both sides of the relay, each received NPDU is normally passed on unaltered to the other subnetwork. However, the NPDU may be modified in the following circumstances:

a) the connected subnetworks have different permissible NPDU sizes (i.e., different DATA packet sizes), thereby requiring segmentation or reassembly;

b) the parameters, options, and addresses received in an N-CONNECT request primitive have to be analyzed and new values derived (e.g., for QOS) for the N-CONNECT request to be passed on; or

c) the relay provider can itself generate an N-DISCONNECT or N-RESET primitive.

Any parameter types or values that are not known to this particular relay provider should be passed unaltered on the basis that they will be meaningful at another stage of the call.

The relay provider may return a Fast Select CALL ACCEPTED packet followed by an MBS containing an N-CC message, if the subnetwork Call Establishment Timer is about to expire.

It is not a requirement that, for a single NC, a relay provider supports the use of the Normal NC Establishment Procedure on one X.25 subnetwork and the use of the Alternative NC Establishment Procedure on the other X.25 subnetwork. The same procedure may be used for the outgoing call that was indicated for the incoming call.

A.5.8 Timers

a) Connect Response Timer:

When either the Normal or Alternative NC Establishment Procedure is initiated, the Connect Response Timer shall be started by the caller. The timer is normally terminated when the connection establishment is complete. If the timer expires, then the connection shall be disconnected.

The use and action of the timer is shown in the state/event table in A.6.1.

The value for this timer is an implementation option. The default value should be greater than or equal to the current value of the X.25 Call Request Response Timer (T21) for the X.25 call.

b) Disconnect Response Timer:

When the Alternative NC Release Procedure is initiated, the Disconnect Response Timer shall be started by the DTE initiating the disconnection. The timer is normally terminated when the disconnection is complete. If the timer expires, then the connection shall be returned to an idle state.

The use and action of the timer is shown in the state/event table in A.6.1.

The value for this timer is an implementation option. The default value should be greater than or equal to the current value of the X.25 Clear Request Response Timer (T23) for the X.25 call.

c) Timer for Reset Procedure:

The X.25 Reset Request Response Timer (T22) is adequate to protect against loss of reset protocol messages or non-response from the corresponding DTE.

A.6 Protocol description

A.6.1 State/Event transitions

The state transition diagram for the X.25 (1980) SNDCP is shown in Figure A.1.

The operation of the X.25 (1980) SNDCP is defined by means of two state/event transition tables (Tables A.9 and A.10). These tables describe the relationship between Network Service primitives and the elements of X.25 (1980). The model that has been assumed for descriptive purposes is of the synchronous rendezvous type for a single instance of a connection. The tables are descriptive and, as such, do not contain any information that is solely concerned with details of implementation. The state/event transition tables assume that:

a) Network Service primitives are atomic actions/events;

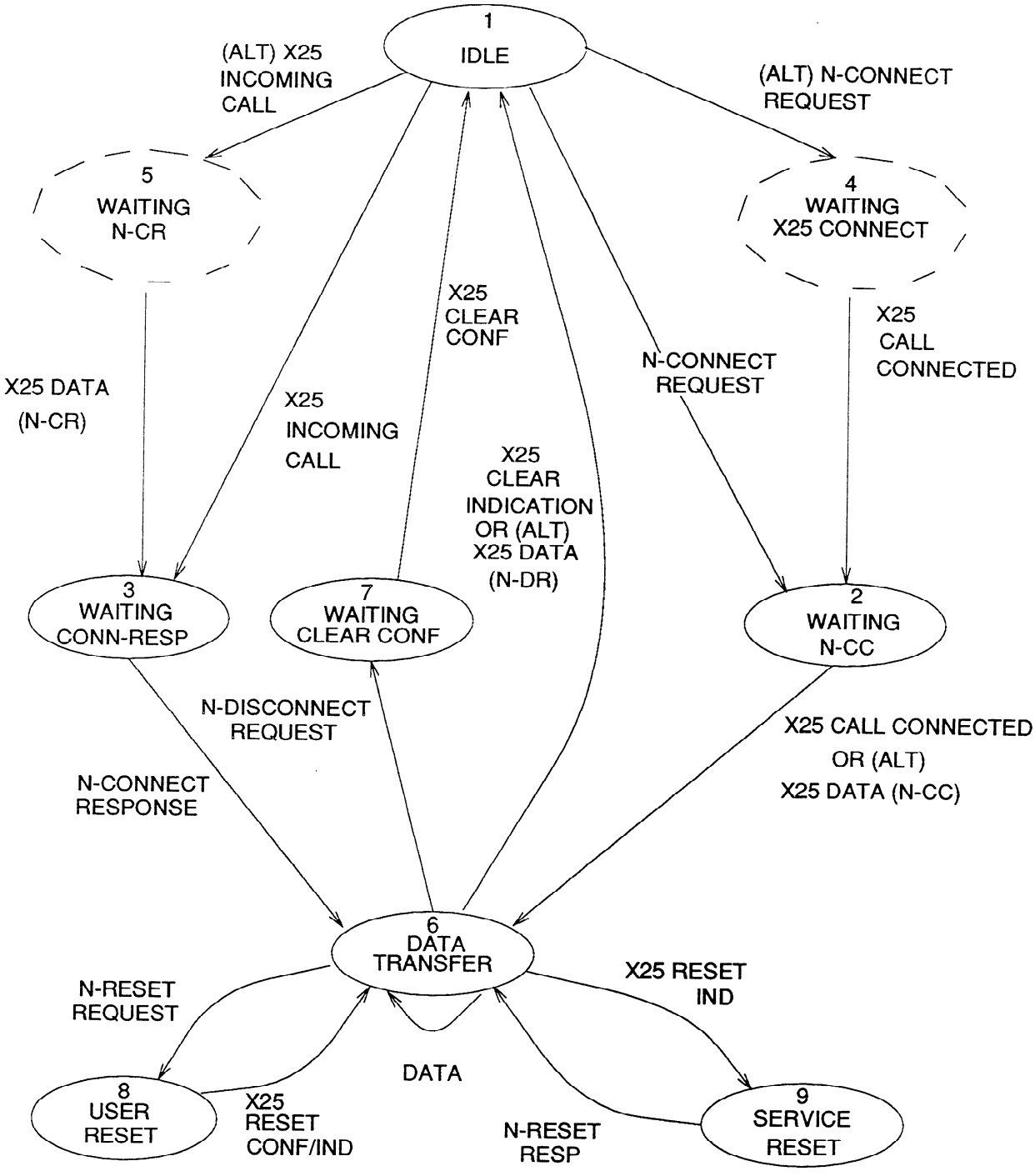
b) atomic actions/events are not queued within the SNDCP entity;

c) the Network Service user operates correctly according to the Network Service definition;

d) only correct X.25 (1980) is presented to/by the SNDCP entity;

e) all X.25 (1980) protocol elements (except RECEIVE READY, RECEIVE NOT READY, and REJECT packets) are presented to/by the SNDCP entity;

f) it is only necessary for the SNDCP to protect the N-CONNECT and the alternative N-DISCONNECT Procedures by means of its timers; the timers in X.25 (1980) are assumed to protect all other SNDCP procedures.



NOTE — This diagram is explanatory only, showing the normal sequences. The state/event tables are definitive of the actions to be taken.

Figure A.1 — State transition diagram

Table A.9 — State/Event table for NC establishment phase

STATES / EVENTS	1 IDLE	2 WAITING N-CC	3 WAITING CONN-RESP	4 WAITING X25-CONN
SERVICE PRIMITIVES	1 2 3 4 5	1 2 3 4 5 6 7	1 2 3 4 5 6 7	1 2 3 4
N-CONNECT request	x 1			
N-CONNECT response			x 1	
N-DISCONNECT request		x	x 4	x
PROTOCOL MESSAGES				
X25 Call-Conn (F-Sel)		2		
X25 Call-Conn		2		x
X25 Data (N-CC) (5)		2		
X25 Inc-Call (F-Sel)	x			
X25 Inc-Call	x			
X25 Data (N-CR) (5)				
X25 Clear-Ind		x	x	x
X25 DXE Clear-Conf	x			
X25 Data (N-DR) (5)		x	x	
TIMERS				
Connect Response Timer Expires		x		x
Disconnect Response Timer Expires				
Any Other Valid X.25 Event (excluding RECEIVE READY, RECEIVE NOT READY, and REJECT)		x	x	
ACTIONS				
SERVICE PRIMITIVES				
N-CONNECT indication	x			
N-CONNECT confirm		x x		
N-DISCONNECT indication		x x	x x	x x
PROTOCOL MESSAGES				
X25 Call-Req (F-Sel)	x			
X25 Call-Req	x			
X25 Data (N-CR)				x
X25 Call-Acc (F-Sel)			x 4	
X25 Call-Accept	x			
X25 Data (N-CC)			3 x	
X25 Clear Req		x x x	x x x	x x
X25 DTE Clear-Conf		x	x	x
X25 Data (N-DR)			4	
TIMERS				
Connect Response Timer	+ +	– – – –		– – –
Disconnect Response Timer			+	
NEXT STATE	2 3 4 5 1	6 6 2 7 1 7 7	6 6 7 1 7 7 7	2 1 1 7

Table A.9 (concluded) — State/Event table for NC establishment phase

STATES / EVENTS	5 WAITING N-CR			6 DATA TRANSFER (Note 6)					7 WAITING CLEAR-CONF			
	1	2	3	1	2	3	4	5	1	2	3	4
SERVICE PRIMITIVES												
N-CONNECT request												
N-CONNECT response												
N-DISCONNECT request					x		1					
PROTOCOL MESSAGES												
X25 Call-Conn (F-sel)												
X25 Call-Conn												
X25 Data (N-CC) (5)												
X25 Inc-Call (F-Sel)												
X25 Inc-Call												
X25 Data (N-CR) (5)	x											
X25 Clear-Ind		x			x					x		
X25 DXE Clear-Conf									x			
X25 Data (N-DR) (5)							x					x
TIMERS												
Connect Response Timer Expires												
Disconnect Response Timer Expires											x	
Any Other Valid X.25 Event (excluding RECEIVE READY, RECEIVE NOT READY, and REJECT)			x				x					x
ACTIONS												
SERVICE PRIMITIVES												
N-CONNECT indication	x											
N-CONNECT confirm												
N-DISCONNECT indication					x		x	x				
PROTOCOL MESSAGES												
X25 Call-Req (F-Sel)												
X25 Call-Req												
X25 Data (N-CR)												
X25 Call-Acc (F-Sel)												
X25 Call-Accept												
X25 Data (N-CC)												
X25 Clear Req			x	x			x	x			x	
X25 DTE Clear-Conf		x			x					x		
X25 Data (N-DR)						x						
TIMERS												
Connect Response Timer												
Disconnect Response Timer						+			–	–		
NEXT STATE	3	1	7	7	1	7	7	7	1	1	1	7

Table A.10 — State/Event table for data transfer phase

STATES / EVENTS	6 DATA TRANSFER	8 USER RESET	9 SERVICE RESET
SERVICE PRIMITIVES	6 7 8 9 A	1 2 3 4	1 2
N-DATA request	x		
N-RESET request	x		
N-RESET response			x
PROTOCOL MESSAGES			
X25 DXE-Data	x	x	
X25 Reset-Ind	x	x	
X25 DXE Reset-Conf		x	
Any Other Valid X.25 Event (excluding RECEIVE READY, RECEIVE NOT READY, and REJECT)	x	x	x
ACTIONS			
SERVICE PRIMITIVES			
N-DATA indication	x		
N-RESET indication	x		
N-RESET confirm	x		
N-DISCONNECT indication	x	x	x
PROTOCOL MESSAGES			
X25 DTE-Data	x		
X25 DTE-Reset-Request	x		
X25 DTE-Reset-Conf	3		3
X25 Clear Req	x	x	x
X25 Clear-Conf			
DISCARD DATA		x	
NEXT STATE	6 6 8 9 7	6 6 7 8	6 7

General Notes to Tables A.9 and A.10:

These state/event tables are used as explained below.

1) Find the current State.
2) Find the row containing the Event which has occurred.
3) Is there an 'x' in a column of that State? If not, the Event is an error for that State. (A number instead of an 'x' indicates a note.)
4) Follow the column down to find 'x's (or note numbers) in the Action area of the table. There may be more than one action.
5) Follow the row back to find the action.
6) Continue down the column to find the next State to be entered after the actions are performed.
7) The Action will normally result in an Event in the peer entity that will continue the cycle.
8) Remember that timers expiring are Events. A timer action can be either:
   + indicates that the timer is started or reset; or

– indicates that the timer is stopped.

9) The Message Sequence Charts, in Figure A.2, contain references to the state/event table column numbers within a State; e.g., 1.1, 1.2, 3.1, and 2.1 describe the normal NC establishment.

10) The State Diagram (Figure A.1) and Message Sequence Charts show "normal" state transitions. The state/event table contains a definitive answer for all events in a State.

11) It is assumed that the underlying X.25 system is operating correctly, so no specific precautions are needed for X.25 errors (e.g., DATA packets preceding a CALL ACCEPTED packet).

12) Only valid sequences of NS primitives occur.

13) To simplify their presentation, the state/event tables are split into two "phases:" the NC establishment phase defined by Table A.9 and the data transfer phase defined by Table A.10.

Notes for NC establishment phase (Table A.9):

1) Alternative NC Establishment/Release Procedure, not using Fast Select.

2) The system should remain in State 2 until a complete N-CC message has been received, either as a single CALL ACCEPTED packet or as a following MBS (of one or more DATA packets).

3) If the data required exceeds the limit of the Called User Data Field of the CALL ACCEPTED packet, then the CALL ACCEPTED packet shall be sent with only a Continuation parameter. The protocol parameters shall be sent in a subsequent MBS (of one or more DATA packets).

4) The Alternative NC Release Procedure is used to reject a connection request.

   If the received CALL REQUEST packet contained the Fast Select Facility and the data required exceeds the limit of the Clear User Data Field of a Fast Select CLEAR REQUEST packet, then the CALL ACCEPTED packet shall be sent with only a Continuation parameter.

   In all cases, the network parameters are then sent to the caller in an N-DR message contained in an MBS (of one or more DATA packets).

5) For received X.25 DATA packets with both the Q- and M-bits set, the X25 Data (N-CR), (N-CC), or (N-DR) event occurs when the MBS has been completely received.

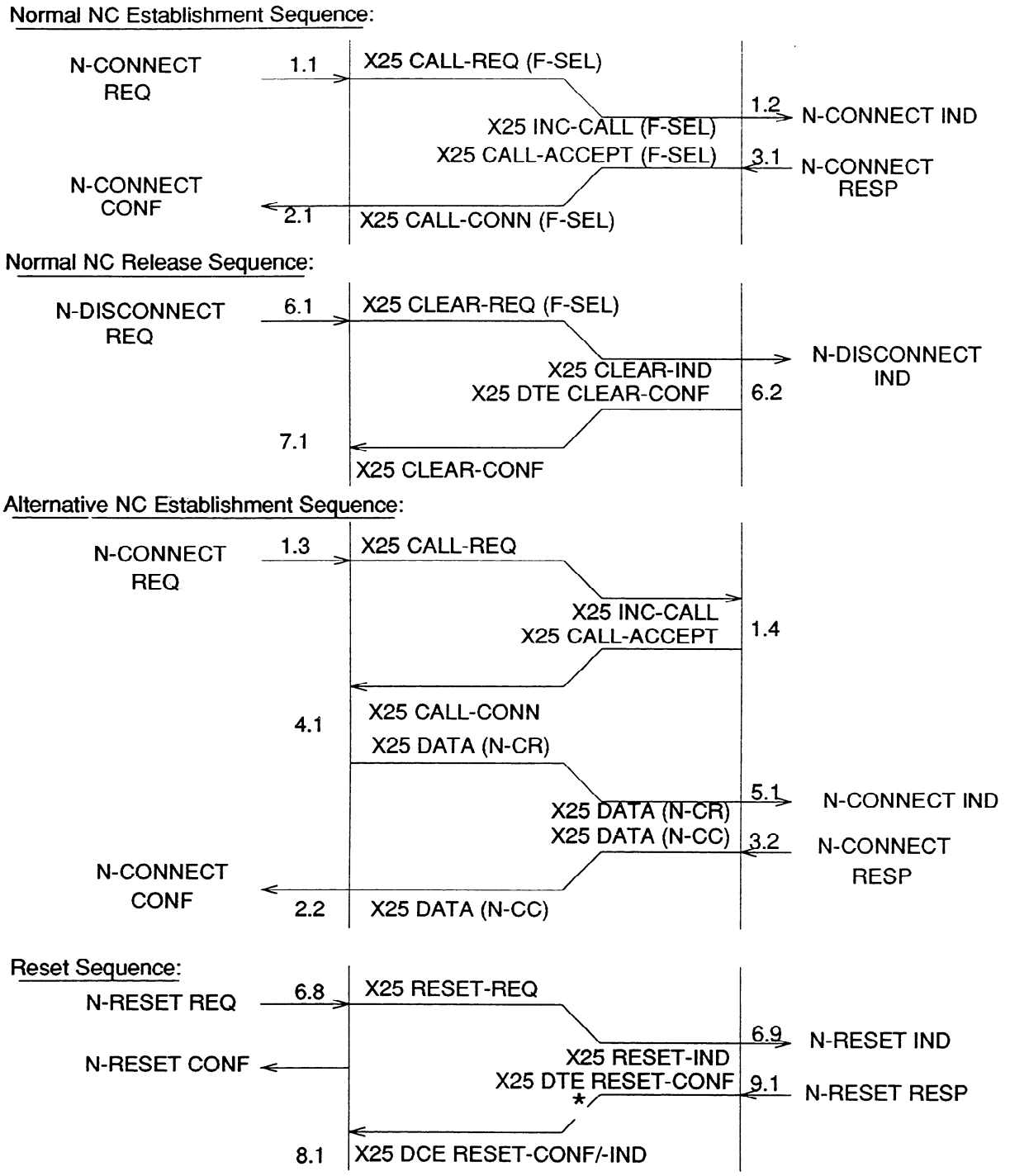
6) This state in the NC establishment phase encompasses all the states of the data transfer phase.

Notes for data transfer phase (Table A.10):

1) N-Expedited-Data is not supported.

2) N-Data-Acknowledgement request and indication primitives do not require any extra protocol messages. They are local to each end of the connection, controlling the use of the X.25 sequence number acknowledgements.

3) The sending of a RESET CONFIRMATION packet can be associated either with the receipt of the RESET INDICATION packet or with the receipt of the subsequent N-RESET response primitive.



* NOTE — Any reset procedure initiated by the Network Service provider at this time is defined to complete this reset sequence.

Figure A.2 — Message sequence charts

A.6.2 Encoding principles

The SNDCP encoding makes use of X.25 facilities wherever possible. Where it is not possible to convey the appropriate message or parameter using X.25 facilities, then SNDCP encoding is used in the Call, Called, and Clear User Data Fields or in an MBS (of one or more DATA packets) with the Q-bit set to 1.

The structure of the SNDCP encoding is shown below.

8	7	6	5	4	3	2	1
Message Code Type							
0	0	1	0	0	0	0	0
Message Code Value							
Parameter Type (PT)							
Parameter Value (PV)							
Further parameter types and values							

The encoding of the message codes and parameter types is based on the encoding used for the X.25 Facility Field. That is, bits 8 and 7 of the Parameter Type (PT) indicate the length class of the associated Parameter Value (PV) Field. Message codes (A.6.4.2) are similarly encoded.

	8	7	6	5	4	3	2	1
1-octet parameter value field	0	0	x	x	x	x	x	x
2-octet parameter value field	0	1	x	x	x	x	x	x
3-octet parameter value field	1	0	x	x	x	x	x	x
variable-length parameter value field	1	1	x	x	x	x	x	x

For the variable-length field, the octet after the PT Field is a Length Indicator (LI) defining the length of the associated PV Field.

Where there is an equivalent X.25 (1984) facility, the encoding of the PT is the same as the facility code of that facility. Otherwise, bit 6 is set to 1 to ensure that the PT value does not conflict with any currently used CCITT facility codes. Since the above encoding is based on the X.25 (1984) Facility Field, the maximum length of the X.25 facilities and encoded parameters (excluding NS-user-data) shall not exceed 109 octets.

Octets from service parameters that are defined using the terms "most significant bit" and "least significant bit" shall be transmitted on the X.25 subnetwork with the least significant bit sent first. Bit 1 corresponds to the least significant bit while bit 8 corresponds to the most significant bit of an octet.

Octets in a packet are consecutively numbered starting from 1 and are transmitted in this order.

A.6.3 Parameter type encoding

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	1	0	1	0	0A	Minimum Throughput Class
0	0	1	0	0	0	0	0	20	Message Code
0	0	1	0	1	0	0	1	29	Disconnect Originator
0	0	1	0	1	0	1	1	2B	Disconnect Reason
0	0	1	0	1	1	0	1	2D	Continuation
1	1	0	0	1	0	0	1	C9	Called Address Extension
1	1	0	0	1	0	1	0	CA	Transit Delay
1	1	0	0	1	0	1	1	CB	Calling Address Extension
1	1	1	0	0	1	0	0	E4	NS-user-data

NOTE — The order in which the SNDCP parameters appear is not important.

A.6.4 Parameter descriptions

A.6.4.1 Minimum throughput class

The one-octet PV Field contains the minimum throughput class for both directions of data transmission. The minimum throughput class for the direction of data transmission from the called DTE is indicated in bits 8, 7, 6, and 5. The minimum throughput class for the direction of data transmission from the calling DTE is indicated in bits 4, 3, 2, and 1.

The four bits indicating each throughput class are binary-coded and correspond to throughput classes as indicated below.

bit:	8	7	6	5	Throughput class
or bit:	4	3	2	1	(bits per second)
	0	0	0	0	Reserved
	0	0	0	1	Reserved
	0	0	1	0	Reserved
	0	0	1	1	75
	0	1	0	0	150
	0	1	0	1	300
	0	1	1	0	600
	0	1	1	1	1 200
	1	0	0	0	2 400
	1	0	0	1	4 800
	1	0	1	0	9 600
	1	0	1	1	19 200
	1	1	0	0	48 000
	1	1	0	1	Reserved
	1	1	1	0	Reserved
	1	1	1	1	Reserved

A.6.4.2 Message code

Message codes are used to identify the type of SNDCP message when it is carried in an MBS with the Q-bit set. Message codes appear at the start of an MBS. The one-octet PV contains the Message Code value, as shown below.

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	X.25 DATA (N-CR Message)
0	0	0	0	0	0	1	0	02	X.25 DATA (N-CC Message)
0	0	0	0	0	0	1	1	03	X.25 DATA (N-DR Message)

A.6.4.3 Disconnect originator

The encoding for the Disconnect Originator, when it is carried as a parameter, shall have the values shown below.

8	7	6	5	4	3	2	1	HEX	
0	0	0	0	0	0	0	1	01	NS User
0	0	0	0	0	0	1	0	02	NS Provider

A.6.4.4 Disconnect reason

The encoding for the Disconnect Reason, when it is carried as a parameter, shall have the same value as that of the equivalent X.25 diagnostic code, as given in Table A.3.

A.6.4.5 Continuation

This parameter denotes that more parameters follow in an MBS of DATA packets with their Q-bit set to 1. The PV Field in incoming packets is ignored. For outgoing packets, the PV Field shall be zero.

A.6.4.6 Address parameters

The Calling Address Extension parameter is used to convey the Calling Network Address. The Called Address Extension parameter is used to convey either the Called Network Address, when it is present in an X.25 CALL

REQUEST packet or in an MBS containing an N-CR message, or the Responding Network Address, when it is present in an N-CC or N-DR message.

The various formats of Network Addresses are described in CCITT Rec. X.213 | ISO/IEC 8348.

The detailed encoding rules for Network Addresses given in 6.2.2. The Address Extension Facilities are not available in X.25 (1980) for conveying Network Addresses; the Address Extension parameters in the SNDCP shall be used for this purpose.

The PV Field of an SNDCP Address Extension parameter shall be encoded as shown below.

	8	7	6	5	4	3	2	1
PV1	Address Length in semi-octets							
PV2	1-st semi-octet				2-nd semi-octet			
.								
.								
.								
PV(last)								

NOTES

1 The value of PV1 shall not exceed 40 (decimal).

2 For Network Addresses containing a decimal-based DSP, each digit of the IDP and DSP shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6, and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2, and 1 of the last octet (PV(last)) shall be ones.

3 For Network Addresses containing a binary-based DSP, each digit of the IDP shall be encoded in a semi-octet in binary-coded decimal, where bit 5 or 1 is the low-order bit of the digit. Starting from the high-order digit, the digit string is coded in octet PV2 and consecutive octets of the PV Field with two digits per octet. In each octet, the high-order digit shall be coded in bits 8, 7, 6, and 5. When the digit string consists of an odd number of digits, then bits 4, 3, 2, and 1 of the last octet containing the IDP shall be ones. The next octet of the PV Field contains the first octet of the DSP. Each octet of the DSP shall be encoded in two semi-octets, where bit 8 is the high-order bit and bit 1 is the low-order bit.

A.6.4.7 Transit delay

The octet following the PT Field indicates the length, in octets, of the following PV Field and has the value 2, 4, or 6. The PV Field follows the length and indicates the transit delay values conveyed transparently over the X.25 subnetwork.

The first and second octets of the PV Field contain the cumulative transit delay. The third and fourth octets are optional and, when present, contain the desired (i.e., Target) end-to-end transit delay. If the third and fourth octets are present, then the fifth and sixth octets are also optional. When present, these octets contain the Lowest Quality Acceptable end-to-end transit delay. The absence of the optional octets in the CALL REQUEST and INCOMING CALL packets (or in N-CR messages) indicates that any transit delay is acceptable for the NC. The optional octets are not present in the CALL ACCEPTED and CALL CONNECTED packets (or in N-CC messages).

Transit delay is expressed in milliseconds and is binary-coded, with bit 8 of the first of a pair of octets being the high-order bit and bit 1 of the second of a pair of octets being the low-order bit.

The value of all ones for cumulative transit delay indicates that the cumulative transit delay is unknown or exceeds 65 534 ms.

A.6.4.8 NS-User-Data

NS-user-data is encoded as a string of octets.

A.7 Protocol encoding in X.25 packets

A.7.1 CALL REQUEST and INCOMING CALL packets (only for Fast Select)

8	7	6	5	4	3	2	1
General Format Identifier (Note 1)				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	0	1	1
Calling DTE Addr Length				Called DTE Addr Length			
DTE Addresses							
				0	0	0	0
0	0	Facility Length					
Facilities							
		Protocol ID					
1	0	0	0	0	1	0	0
"Network" Parameters (Note 2)							

NOTES

1 Bit 7 is used to request the D-bit procedure, which is necessary to support the Receipt Confirmation Service.

2 Allowed parameters, which may be in any order, are

Called Address Extension	PT=C9 (+LI,PV)
Calling Address Extension	PT=CB (+LI,PV)
QOS Parameters:	
— Minimum Throughput Class	PT=0A (+PV)
— Transit Delay	PT=CA (+LI,PV)
NS-user-data	PT=E4 (+LI,PV)

A.7.2 CALL ACCEPTED and CALL CONNECTED packets (only for Fast Select)

8	7	6	5	4	3	2	1
General Format Identifier (Note 1)				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	1	1	1
Calling DTE Addr Length				Called DTE Addr Length			
DTE Addresses							
				0	0	0	0
0	0	Facility Length					
Facilities							
		Protocol ID					
1	0	0	0	0	1	0	0
"Network" Parameters (Note 2)							

NOTES

1 Bit 7 is used to indicate acceptance of the D-bit Procedure.

2 Allowed parameters, which may be in any order, are

Called Address Extension	PT=C9 (+LI,PV)
QOS Parameters:	
— Minimum Throughput Class	PT=0A (+PV)
— Transit Delay	PT=CA, LI=2 (+PV)
NS-user-data	PT=E4 (+LI,PV)

A.7.3 CLEAR REQUEST and CLEAR INDICATION packets

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	1	0	0	1	1
Clearing Cause							
Diagnostic Code							
Calling DTE Addr Length				Called DTE Addr Length			
DTE Addresses							
				0	0	0	0
0	0	Facility Length					
Facilities							
"Network" Parameters (Note 1)							

NOTES

1 If the packet is used to convey an NC rejection in response to a Fast Select CALL REQUEST packet, then the Address Length Fields and the Facility Length Field contain zeros (the addresses and facilities are not present). Allowed parameters, which may be in any order, are

Called Address Extension	PT=C9 (+LI,PV)
NS-user-data	PT=E4 (+LI,PV)

2 In all other cases, the Address and Facility Fields, their length fields, and the "Network" parameters are not present.

A.7.4 DTE and DCE DATA packets

Normal DATA (Q=0) Packets

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
0	D	0	1				
Logical Channel Number							
P(R)			M	P(S)			0
User Data							

A.7.5 RESET REQUEST and RESET INDICATION packets

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	1	1	0	1	1
Resetting Cause							
Diagnostic Code							

A.7.6 RESET CONFIRMATION packet

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	1	1	1	1	1

A.7.7 Alternative Network Connection establishment packets

a. CALL REQUEST and INCOMING CALL packets

8	7	6	5	4	3	2	1
General Format Identifier (Note 1)				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	0	1	0	1	1
Calling DTE Addr Length				Called DTE Addr Length			
DTE Addresses							
				0	0	0	0
0	0	Facility Length					
Facilities							
		Protocol ID					
1	0	0	0	0	1	0	0
"Network" Parameters (Note 2)							

NOTES

1 Bit 7 is used to request the the D-bit Procedure, which is necessary to support the Receipt Confirmation Service.

2 The only parameter, which is mandatory, is

Continuation PT=2D

b. CALL ACCEPTED and CALL CONNECTED packets

	8	7	6	5	4	3	2	1
	General Format Identifier (Note 1)				Logical Channel Group			
	Logical Channel Number							
	Packet Type Identifier							
	0	0	0	0	1	1	1	1
	Calling DTE Addr Length				Called DTE Addr Length			
	DTE Addresses							
					0	0	0	0
	0	0	Facility Length					
Note 3	Facilities							
			Protocol ID					
	1	0	0	0	0	1	0	0
	"Network" Parameters (Note 2)							

NOTES

1 Bit 7 is used to indicate provisional support of the Receipt Confirmation Service.

2 Parameters are only permitted if the CALL ACCEPTED packet is in response to an INCOMING CALL packet with the Fast Select Facility. In this case, the Continuation parameter alone is mandatory.

Continuation PT=2D

3 For a non-Fast Select INCOMING CALL packet, the CALL ACCEPTED and CALL CONNECTED packets will not contain parameters. The Address and Facilities Fields may not be present.

c. DATA packets: N-CR message

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
1	0	0	1				
Logical Channel Number							
P(R)			M	P(S)			0
Message Code Type (Note 1)							
0	0	1	0	0	0	0	0
Message Code Value							
0	0	0	0	0	0	0	1
"Network" Parameters (Note 2)							

NOTES

1 If the N-CR message spans an MBS of more than one DATA packet, then the Message Code parameter (i.e., the Message Code Type and the Message Code Value) is present only in the first DATA packet of the MBS.

2 Allowed parameters, which may be in any order, are

Called Address Extension PT=C9 (+LI,PV)
Calling Address Extension PT=CB (+LI,PV)

QOS Parameters:
— Minimum Throughput Class PT=0A (+PV)

— Transit Delay	PT=CA (+LI,PV)
NS-user-data	PT=E4 (+LI,PV)

If the N-CR message spans more than one DATA packet, then all but the last DATA packet shall be full. If necessary, parameters shall be fragmented to fill packets, with the first part completing one DATA packet and the remainder occupying the start of the User Data Field of the next DATA packet in the MBS.

d. DATA packets: N-CC message

8	7	6	5	4	3	2	1
General Format Identifier (Note 1)				Logical Channel Group			
Logical Channel Number							
P(R)			M	P(S)			0
Message Code Type (Note 2)							
0	0	1	0	0	0	0	0
Message Code Value							
0	0	0	0	0	0	1	0
"Network" Parameters (Note 3)							

NOTES

1 If use of the Receipt Confirmation Service has been provisionally accepted, then bit 7 of the single X.25 DATA packet, or bit 7 of the last DATA packet in an MBS, containing the N-CC message carries the D-bit set to 1 to denote final acceptance to use this service. The Q-bit, bit 8, is set to 1.

2 If the N-CC message spans an MBS of more than one DATA packet, then the Message Code parameter (i.e., the Message Code Type and the Message Code Value) is present only in the first DATA packet of the MBS.

3 Allowed parameters, which may be in any order, are

Called Address Extension	PT=C9 (+LI,PV)
QOS Parameters:	
— Minimum Throughput Class	PT=0A (+PV)
— Transit Delay	PT=CA, LI=2 (+PV)
NS-user-data	PT=E4 (+LI,PV)

If the N-CC message spans more than one DATA packet, then all but the last DATA packet shall be full. If necessary, parameters shall be fragmented to fill packets, with the first part completing one DATA packet and the remainder occupying the start of the User Data Field of the next DATA packet in the MBS.

A.7.8 Alternative Network Connection release packets

a. DATA packets: N-DR message

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
1	0	0	1				
Logical Channel Number							
P(R)			M	P(S)			0
Message Code Type (Note 1)							
0	0	1	0	0	0	0	0
Message Code Value							
0	0	0	0	0	0	1	1
"Network" Parameters (Note 2)							

NOTES

1 If the N-DR message spans an MBS of more than one DATA packet, then the Message Code parameter (i.e., the Message Code Type and the Message Code Value) is present only in the first DATA packet of the MBS.

2 Allowed parameters, which may be in any order, are

Called Address Extension	PT=C9 (+LI,PV)
Disconnect Originator	PT=29 (+PV)
Disconnect Reason	PT=2B (+PV)
NS-user-data	PT=E4 (+LI,PV)

If the N-DR message spans more than one DATA packet, then all but the last DATA packet shall be full. If necessary, parameters shall be fragmented to fill packets, with the first part completing one DATA packet and the remainder occupying the start of the User Data Field of the next DATA packet in the MBS.

b. CLEAR REQUEST and CLEAR INDICATION Packets

8	7	6	5	4	3	2	1
General Format Identifier				Logical Channel Group			
Logical Channel Number							
Packet Type Identifier							
0	0	0	1	0	0	1	1
Clearing Cause							
Diagnostic Code							

NOTE — In a CLEAR REQUEST packet, the clearing cause shall always be "DTE Originated" and the diagnostic code shall always be "No Additional Information" (zero). For a CLEAR INDICATION packet used with the Alternative NC Release Procedure, the Clearing Cause and Diagnostic Code Fields should be ignored.

Annex B
(normative)

Classification

B.1 Classification of systems

Three classes of implementation are identified below.

SYSTEM-1984	The system conforms to this International Standard as "A system providing the OSI Network Service using only X.25/PLP-1984 (including later versions) procedures."
SYSTEM-1980	The system conforms to this International Standard as "A system providing the OSI Network Service using only X.25/PLP-1980 (including earlier versions) procedures."
COMPATIBLE	The system conforms to this International Standard as "A system providing the OSI Network Service using either X.25/PLP-1984 or X.25/PLP-1980 procedures."

B.2 Functionality of classes

The functionality of an implementation claiming to belong to one of these classes is given below.

	SYSTEM -1984	SYSTEM -1980	COMPATIBLE
Fast Select used by DTE	Supported	Optional	Supported
X.25/PLP-1984 DTE procedures (see Note 1)	Supported	Optional	Supported
1984 CONS procedures (see Note 2)	Supported	Optional	Supported
X.25/PLP-1980 Fast Select procedures (see Note 3)	Optional	Optional	Supported
X.25/PLP-1980 Alternative Procedures (see Note 4)	Optional	Supported	Supported

NOTES

1 "X.25/PLP-1984 DTE procedures" are the Packet Layer procedures of CCITT Rec. X.25 | ISO/IEC 8208 and include a DTE acting as a DCE for the necessary procedures (e.g., resolution of call collision); these are fully compatible with the requirements of CCITT Recommendation X.25 (1984) for a DTE.

2 "1984 CONS procedures" are procedures to be followed by an NL entity to provide the CONS using X.25/PLP-1984 without the use of special parameter encodings. They are defined in the main body of this International Standard.

3 "X.25/PLP-1980 Fast Select procedures" are the procedures in Annex A but where the Alternative NC Establishment Procedure of Annex A is only used if the encoded parameters of an N-CONNECT request primitive exceed 128 octets.

4 "X.25/PLP-1980 Alternative Procedures" are the procedures in Annex A but where NC establishment is always by use of the Alternative NC Establishment Procedure of Annex A.

B.3 Scenarios

A System-1984 implementation can operate over a 1984 X.25 subnetwork, as well as other non-packet-switched subnetwork environments, and can directly communicate only with another System-1984 implementation or with a Compatible implementation.

A System-1980 implementation can operate over either a 1984 or 1980 X.25 subnetwork, as well as other non-packet-switched subnetwork environments, and can directly communicate only with another System-1980 implementation or with a Compatible implementation.

A System-1984 implementation and a System-1980 implementation can communicate over interconnected 1980 X.25 and 1984 X.25 subnetworks or over the same 1984 X.25 subnetwork, but the communication requires the use of one or more relays. The relay must implement, in one half, at least a System-1984 implementation and, in the other half, at least a System-1980 implementation.

A Compatible implementation can operate over either a 1984 or 1980 X.25 subnetwork and can communicate directly with any conforming implementation. Compatible implementations are particularly suitable for the provision of relay functions.

B.4 Procedures for selecting class of operation

The use of the X.25/PLP-1984 requires a DTE to use the CCITT-Specified DTE Facility Marker in the Facility Field of the CALL REQUEST packet. If all subnetworks and the called DTE do not recognize this marker as being valid, then the X.25/PLP-1980 with SNDCP is used to provide the CONS. The details are shown in Figure B.1.

NOTE — An attempt to establish an NC may fail because of use of incompatible protocol options (e.g., use of the CCITT-Specified DTE Facility Marker). If the DTE is capable of retrying the call with different protocol options (e.g., a Compatible DTE), then it need not report the receipt of a CLEAR INDICATION packet as an N-DISCONNECT indication primitive to the NS user. Instead, it may retry establishing the NC by transmitting a CALL REQUEST packet with the different options.

If a DTE receives an INCOMING CALL packet with the CCITT-Specified DTE Facility Marker, then it should use the X.25/PLP-1984 procedures for the CONS. If the marker is not present in the INCOMING CALL packet, then the X.25/PLP-1980 with SNDCP procedures should be used.

B.5 Interworking by relay system

The procedure outlined in B.4 accomplishes interworking by having the DTE implement additional procedures. It is also possible to accomplish interworking by providing a relay system to provide the mapping between the X.25/PLP-1984 and X.25/PLP-1980 with SNDCP. The operation of the relay system is depicted in Figure B.2.

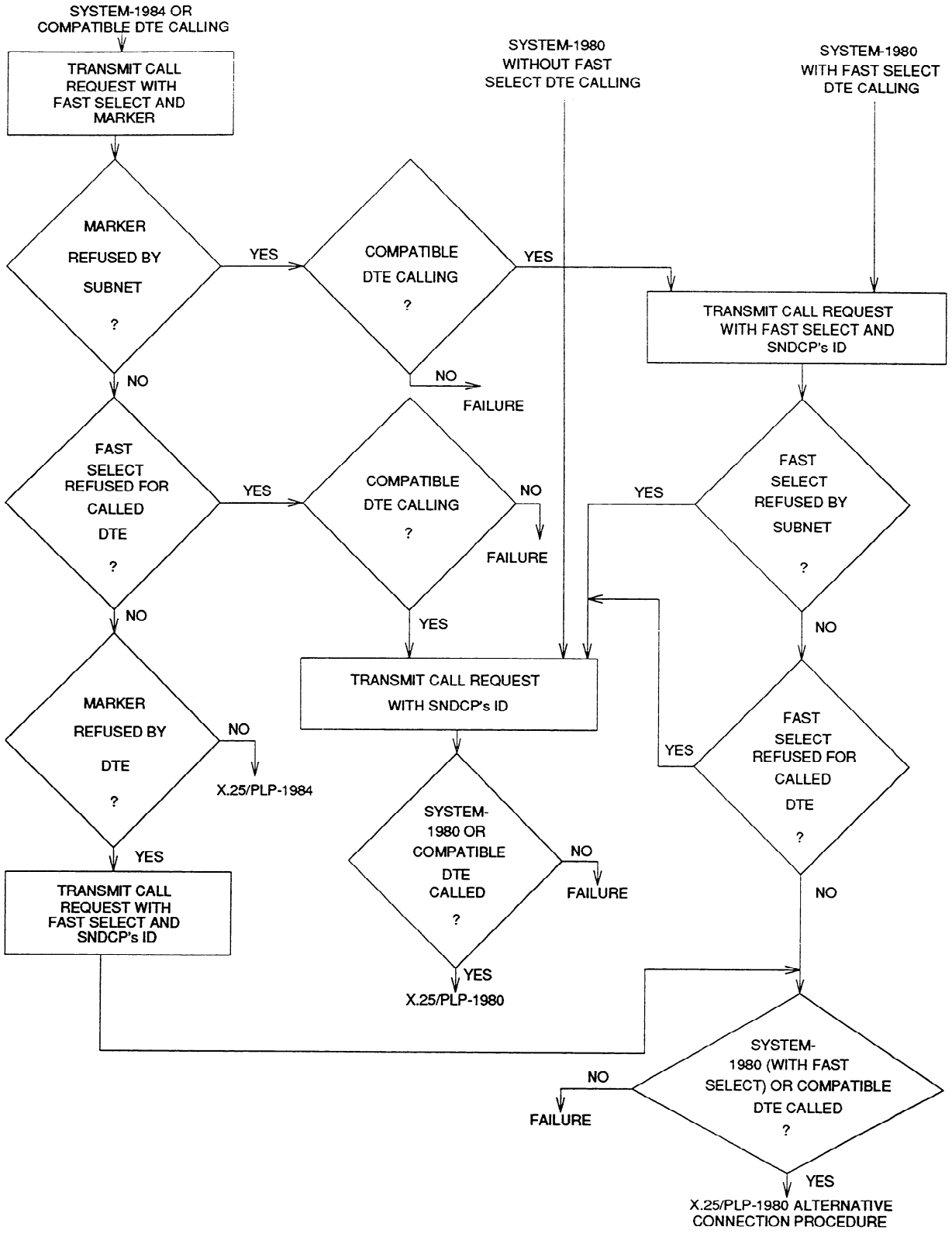


Figure B.1 — Procedure for selecting class of operation

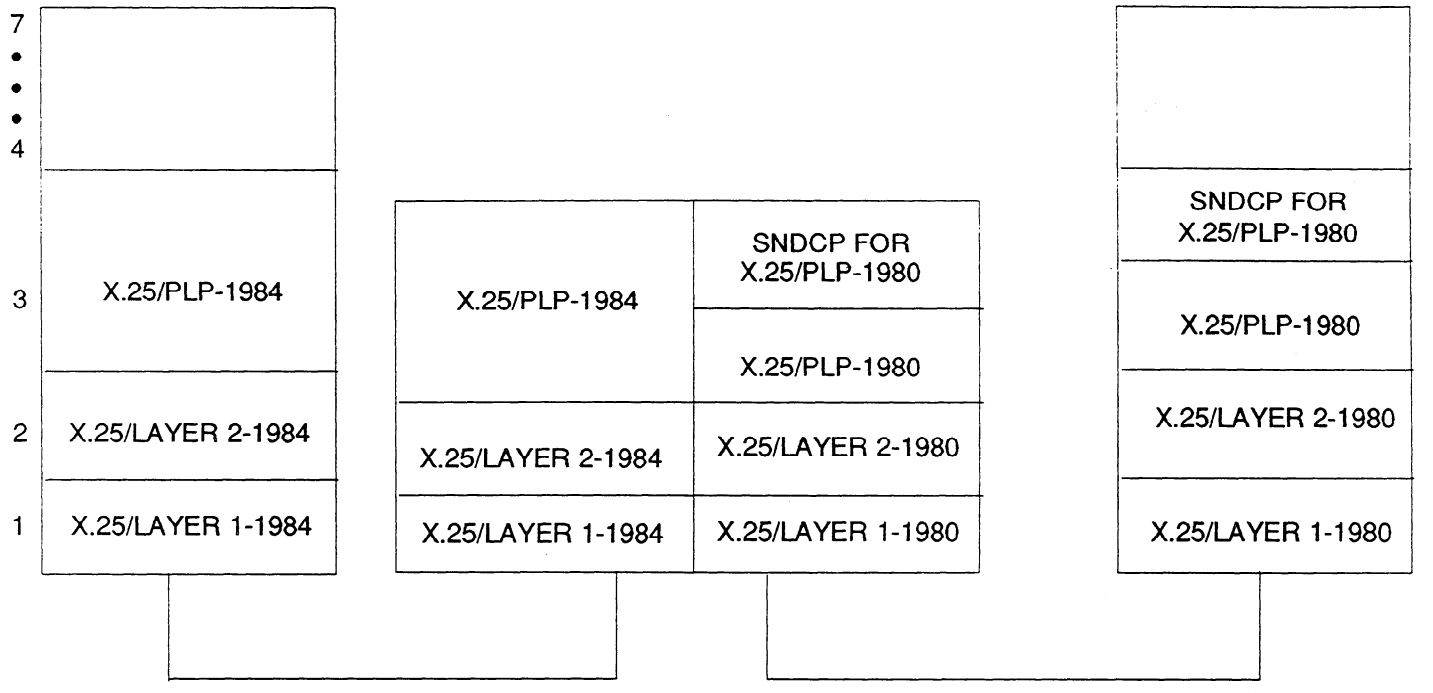


Figure B.2 — Operation of a relay system mapping between the X.25/PLP-1984 and the X.25/PLP-1980 with SNDCP

Annex C
(normative)

Subnetwork Convergence Protocol for Use With X.25 Permanent Virtual Circuits

C.1 Introduction and scope

This annex defines a set of SNDCP procedures for use with X.25 Permanent Virtual Circuit (PVC) service for X.25-1980 and later versions. These procedures provide

a) a mechanism for transferring data during the "connection establishment" and "connection release" phases of a Network Connection;

b) a method for transferring Network Addresses;

c) association of QOS characteristics with the PVC;

d) a method for selecting use of the Receipt Confirmation and Expedited Data Services.

With the use of the procedures in this annex, a PVC can be used to provide the CONS for different NCs, with the same or different parameter values, at different times. However, use of the Expedited Data Service is not supported over X.25-1980 PVCs.

This annex specifies the procedures for use by an End System: the PVC can connect the End System either to another End System or to an Intermediate System. This annex allows for the possibility of using a PVC in support of other protocols, but not simultaneously with the procedures of this annex (apart from transient collision cases, which do not fail unnecessarily).

C.2 Overview

The procedures defined in this annex provide a mechanism for using X.25 PVC service in support of the OSI CONS. These procedures make up for the lack of dynamic mechanisms visible to the NS user for NC establishment and release. No special procedures are defined here for the data transfer phase.

The procedures in this annex make use of the packets, packet fields, and states associated with the X.25 Virtual Call (VC) service. The "images" of these packets (i.e., "packet images") are encoded within X.25 DATA packets. The states associated with the VC service are considered as substates within state d1.

Two timers and one retransmission counter are specified for the SNDCP procedures: the Connect Response Timer, the Disconnect Response Timer, and the Disconnect Retransmission Counter. The procedures for use, and the default values, of these are the same as those for T21, T23, and R23, respectively, in CCITT Rec. X.25 | ISO/IEC 8208.

C.3 Abbreviations

The abbreviations given in the main body of this International Standard apply, with the following additions:

Q-bit	Qualifier bit
SNDCP	Subnetwork Dependent Convergence Protocol

C.4 Protocol mechanisms

C.4.1 NC establishment procedure

The mapping of primitives/parameters used during the NC establishment phase to packet-images/fields is given below.

a) An N-CONNECT request primitive and the associated parameters are mapped to a CALL REQUEST packet-image and the associated fields, as specified in clause 6 (except that the value of the TDSAI Facility shall be the transit delay associated with the PVC). For X.25-1980, the EDN Facility shall be encoded by the NL entity as "no use of Expedited Data" in the CALL REQUEST packet-image; alternatively, the EDN Facility may be omitted.

NOTE — The NL entity considers the QOS aspects (e.g., throughput) that were associated with the PVC, when it was established, in relation to the QOS parameters of the N-CONNECT request primitive (see 6.2.5). For example, if the Lowest Quality Acceptable Throughput of an N-CONNECT request primitive is greater than the throughput class of a particular PVC, then that PVC shall not be used for the associated NC.

b) This CALL REQUEST packet-image is sent to the remote NL entity in an M-bit Sequence (MBS) of one or more DATA packets. The Q-bit in all DATA packets of the MBS shall be set to 1. The Connect Response Timer shall be started. The timer is normally terminated when the connection establishment is completed. If the timer expires, then the connection shall be disconnected (see C.4.2).

c) An MBS of one or more DATA packets with its(their) Q-bit set to 1 and recognized as an INCOMING CALL packet-image is mapped to an N-CONNECT indication primitive and the associated parameters, as described in clause 6.

d) The equivalent procedure is applied to an N-CONNECT response primitive and CALL ACCEPTED packet-image, and to an N-CONNECT confirm primitive and CALL CONNECTED packet-image.

The roles of "DCE" and "DTE" for resolution of call collision procedures shall be established a priori. That is, in the event of a collision between a CALL REQUEST packet-image and an INCOMING CALL packet-image, the procedures of CCITT Rec. X.25 | ISO/IEC 8208 for resolving call collision shall be followed by applying the roles of "DTE" and "DCE" to the two ends of the PVC.

If the PVC is not in state d1 (flow control ready), the N-CONNECT request primitive shall be answered with an N-DISCONNECT indication primitive, where the Originator-parameter value is "NS Provider," and the Reason-parameter value is "Connection Rejection — Reason Unspecified/Transient Condition."

C.4.2 NC release procedure

C.4.2.1 Invocation of NC release

An N-DISCONNECT request primitive and associated parameters are mapped to a CLEAR REQUEST packet-image and associated fields, as specified in clause 7.

Invocation of NC release by the NL entity, resulting in an N-DISCONNECT indication primitive to the NS user, also results in a CLEAR REQUEST packet-image. The Cause and Diagnostic Code Fields map to the Originator and Reason parameters of the primitive, as specified in 7.2.2.

In either case, the CLEAR REQUEST packet image shall be sent in an MBS of one or more DATA packets. The Q-bit set in all DATA packets of the MBS shall be set to 1. The Disconnect Response Timer is started. If the logical channel is in state f2 (DXE receive not ready), the NL entity shall reset the logical channel before transmitting the CLEAR REQUEST packet-image.

On receipt of a CLEAR CONFIRMATION or CLEAR INDICATION packet-image, the NL entity shall stop the Disconnect Response Timer and the NC release is complete.

If the Disconnect Response Timer expires, the CLEAR REQUEST packet-image shall be retransmitted and the Disconnect Response Timer shall be restarted. The maximum number of such retransmissions is determined by the value of the Disconnect Retransmission Counter.

C.4.2.2 Response to NC release

A received CLEAR INDICATION packet-image and associated fields are mapped to an N-DISCONNECT indication primitive and associated parameters, as specified in clause 7. On receiving such a packet-image, the NL entity shall send a CLEAR CONFIRMATION packet-image in a DATA packet with the M-bit set to 0 and the Q-bit set to 1. The NC release is then complete at the NL entity. If the logical channel is in state f2 (DXE receive not ready), the NL entity shall reset the logical channel before transmitting the CLEAR CONFIRMATION packet-image.

C.4.3 Procedures for X.25 reset during NC establishment or release

If, during the NC establishment procedure, the NL entity receives a RESET INDICATION packet, it shall

a) respond to the reset by transmitting a RESET CONFIRMATION packet;

b) then, invoke the NC release procedure, as specified in C.4.2.1.

If, during the NC release procedure, the NL entity receives a RESET INDICATION packet, then the NL entity shall confirm the RESET INDICATION packet but shall otherwise ignore the packet with respect to the effects on the NC

release procedure.

C.4.4 Data transfer phase of the NC

The data transfer phase is carried out as described in clauses 8 to 11. In particular, the Q-bit of DATA packets used for data transfer is set to 0.

If a RESET REQUEST packet is transmitted but not confirmed after R22 retransmissions, the NL entity shall signal an N-DISCONNECT indication primitive to the NS User. The Originator parameter is "NS Provider" and the Reason parameter is "Disconnection — Transient Condition."

C.4.5 Protocol violations

C.4.5.1 SNDCP violations

If an MBS of one or more DATA packets is received with the Q-bit set to 1 and is not formatted as a valid packet-image for a call setup or call clearing packet appropriate to the state of the NC (if any), then

a) if there is an NC present (i.e., in the NC establishment phase or the data transfer phase), then the NL entity shall invoke the release of the NC as specified in C.4.2.1;

b) if no NC is present and the Disconnect Response Timer is not running, then the NL entity shall act as specified in C.4.2.1 for invocation of NC release except that no N-DISCONNECT indication primitive is generated;

c) otherwise, if no NC is present and the Disconnect Response Timer is running, the received MBS shall be discarded.

C.4.5.2 Unexpected packets received

When the Disconnect Response Timer is running following rejection of an incoming NC establishment attempt or following release of an established NC, any INTERRUPT packet received and any DATA packet received with the Q-bit set to 0 shall be discarded. At other times when no NC is in the data transfer phase, such packets shall be ignored as being outside the scope of this annex.

NOTE — The procedures specified above permit co-existence of the SNDCP specified in this annex with other protocols, provided that such other protocols do not set the Q-bit to 1 in the first DATA packet of an instance of communication. Such co-existence applies to successive, not simultaneous, use of the protocols.

C.4.5.3 Other protocol violations

Other protocol violations during an NC shall be dealt with as specified in clause 12.

C.5 Protocol encoding for NC establishment and release

The encoding of packet-images used during the NC establishment and release phases is exemplified in Figure C.1.

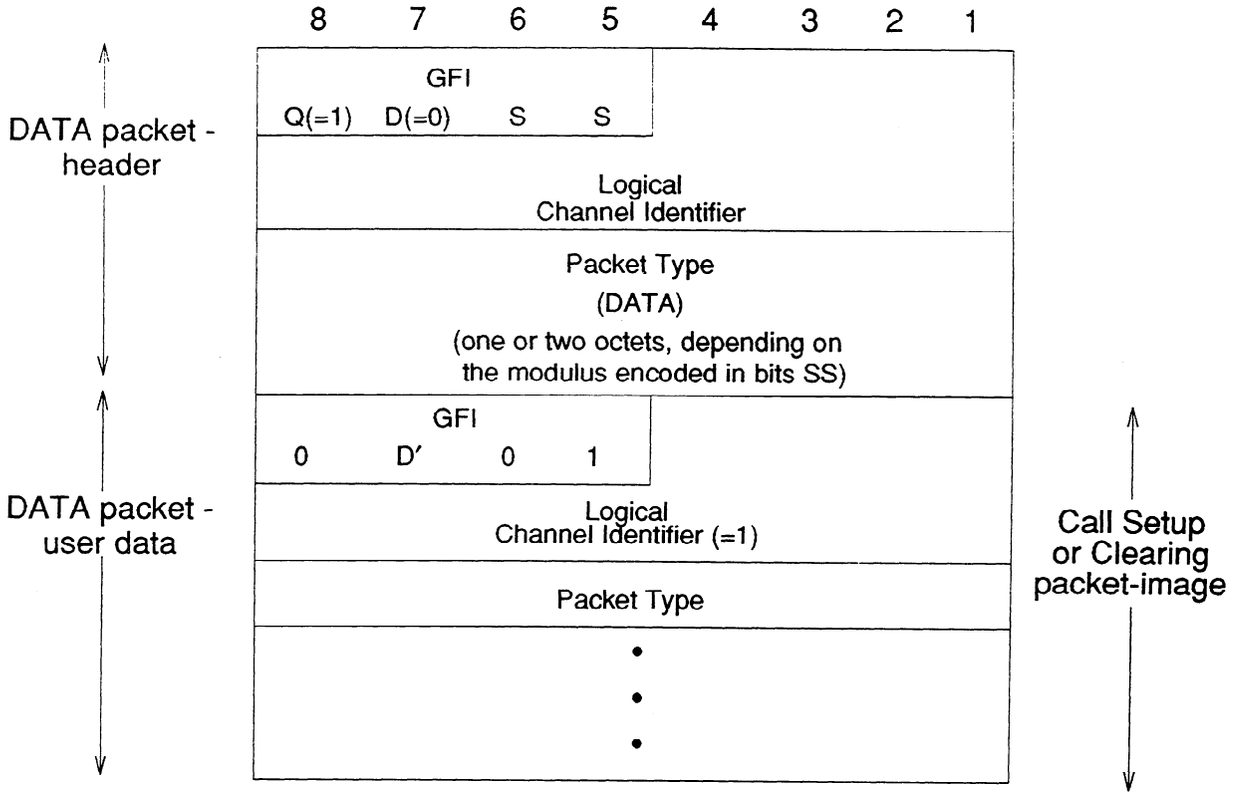


Figure C.1 — Call setup/clearing encoding

The following shall apply to Figure C.1:

a) an MBS of one or more DATA packets shall be used to embed the call setup/clearing packet-image;

b) bit D′ shall be used for the Receipt Confirmation Selection parameter (see 6.2.3);

c) the GFI field in the packet-image shall always be encoded as though for modulo 8 packet sequence numbering, regardless of the modulus used for the PVC and encoded in bits SS;

d) the Logical Channel Identifier of a call setup or clearing packet-image shall be encoded as 1;

e) the Packet Type field of a call setup or clearing packet-image shall be encoded to identify the appropriate packet (e.g., CALL REQUEST);

f) the Address Length fields of call setup or clearing packet-images shall be encoded as 0;

g) other fields shall be used as appropriate for the packet type (i.e., the Cause, Diagnostic Code, Facility Length, Facility, and User Data Fields shall be used as described in Tables 2 and 4).

NOTE — If the Facility Field is to be used to carry facilities other than those needed in support of the OSI CONS (e.g., the Closed User Group Selection Facility), then the NL entity should be aware of whether the remote NL entity at the other end of the PVC is in an end system or in an intermediate system. Receipt of certain facilities in an INCOMING CALL packet by an NL entity in an end system is a protocol violation of CCITT Rec. X.25 | ISO/IEC 8208.

Annex D
(normative)

Protocol Implementation Conformance Statement Proforma

D.1 Introduction

The supplier of a protocol implementation which is claimed to conform to International Standard shall complete the following Protocol Implementation Conformance Statement (PICS) proforma in D.6 and D.7 of this annex.

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

a) by the protocol implementor, as a check-list to reduce the risk of failure to conform to the standard through oversight;

b) by the supplier and acquirer – or potential acquirer – of the implementation, stated relative to the common basis for understanding provided by the standard PICS proforma;

c) 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);

d) by a protocol tester, as the basis for selecting appropriate tests against which to assess the claim for conformance of the implementation.

D.2 Scope

This annex defines the PICS proforma for the detailed expression of the conformance requirements for this International Standard.

This PICS proforma is in compliance with the relevant requirements for a PICS proforma given in CCITT Rec. X.291 | ISO/IEC 9646-2. Detail of the use of this proforma is provided in this annex. Implementations claiming conformance to this International Standard shall complete the proforma as part of the conformance requirements.

D.3 Normative references

The references given in the main body of this International Standard apply, with the additions listed below.

D.3.1 International Standards

— ISO/IEC 8208:1990/Amd.3:1991, *Information technology — Data communications — X.25 Packet Layer Protocol for Data Terminal Equipment — Amendment 3: Conformance requirements.*

D.3.2 Paired Recommendations | International Standards equivalent 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.*

— 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 methodology and framework — Part 2: Abstract test suite specification.*

D.4 Definitions

The definitions given in the main body of this International Standard apply, with the additions listed below.

a) Protocol Implementation Conformance Statement (PICS)

b) PICS proforma

D.5 Abbreviations

The abbreviations given in the main body of this International Standard apply, with the additions listed above.

AEP Address Extension Parameter
PICS Protocol Implementation Conformance Statement
RC Receipt Confirmation

D.6 Protocol Implementation Conformance Statement Proforma[2)]

D.6.1 Notations

M	mandatory
O	optional
O.<n>	optional, but support of at least one of the group of options labeled by the same numeral <n> is required
X	prohibited
N/A	not applicable
<pred>:	conditional-item symbol, including predicate identification (see D.6.2.4.2)
¬	Logical negation, applied to a conditional item's predicate (see D.6.2.4.2)

D.6.2 Instructions for completing the PICS proforma

D.6.2.1 General structure of the PICS proforma

The first part of the PICS proforma — Implementation Identification and Protocol Summary — is to be completed as indicated with the information necessary to identify fully both the supplier and the implementation.

The main part of the PICS proforma is a fixed-format questionnaire. Answers to the questionnaire items are to be provided in the rightmost column by simply marking an answer to indicate a restricted choice (usually Yes or No). (Note that there may be items where two or more choices from a set of possible answers can apply; all relevant choices are to be marked.)

Each item is identified by an item reference in the first column; the second column contains the question to be answered; the third column the reference or references to the material that specifies the item in this International Standard. The remaining columns record the status of the item — whether support is mandatory, optional, prohibited or conditional — and provide the space for the answers; see also D.6.2.2 below. (Status is sometimes indicated by other means than a separate Status column: for example, where the same status applies to a whole group of items, as in D.6.2.4.2.)

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 labeled A<i> or X<i>, respectively, for cross-referencing purposes, 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, including any Additional Information and Exception Information, is the Protocol Implementation Conformance Statement for the implementation in question.

NOTE — Where an implementation is capable of being configured in more than one way, a single PICS may be able to describe all such configurations. However, the supplier has the choice of providing more than one PICS, each covering some subset of the implementation's configuration capabilities, in case this makes for easier and clearer presentation of the information.

D.6.2.2 Additional information

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. Examples might be an outline of the ways in which a (single) implementation can be set up to operate in a variety of environments and configurations or a brief rationale — based perhaps upon specific applications needs — for the exclusion of features which, although optional, are nonetheless commonly present in implementations of this International Standard.

References to items of Additional Information may be entered next to any answer in the questionnaire and may be included in items of Exception Information.

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2) **Copyright release for PICS proformas**

Users of this International Standard may freely reproduce the PICS proforma in clauses D.6 and D.7 of this annex so that it can be used for the intended purpose and may further publish the completed PICS.

D.6.2.3 Exception information

It may occasionally happen that a supplier will wish to answer an item with mandatory or prohibited 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 is required to write into the Support column an X<i> reference to an item of Exception Information and to provide the appropriate rationale in the Exception item itself.

An implementation for which an Exception item is required in this way does not conform to this International Standard.

NOTE — A possible reason for the situation described above is that a defect in the standard has been reported, a correction for which is expected to change the requirement not met by the implementation.

D.6.2.4 Conditional status

D.6.2.4.1 Conditional items

The PICS proforma contains a number of conditional items. These are items for which the status — mandatory, optional or prohibited — that applies is dependent upon whether or not certain other items are supported or upon the values supported for other items.

In many cases, whether or not the item applies at all is conditional in this way, as well as the status when the item does apply.

Where a group of items is subject to the same condition for applicability, a separate preliminary question about the condition appears at the head of the group, with an instruction to skip to a later point in the questionnaire if the "Not Applicable" answer is selected. Otherwise, individual conditional items are indicated by one or more conditional symbols (on separate lines) in the Status column.

A conditional symbol is of the form "<pred>: <s>" where "<pred>" is a predicate as described in D.6.2.4.2 below, and "<s>" is one of the status symbols M, O, O.<n>, X or N/A.

If the value of the predicate in any line of a conditional item is true (see D.6.2.4.2), the conditional item is applicable, and its status is that indicated by the status symbol following the predicate: the answer column is to be marked in the usual way. If the value of a predicate is false, the Not Applicable (N/A) answer is to be marked in the relevant line. (Each line in a multi-line conditional item is to be marked: at most one line will require an answer other than N/A.)

D.6.2.4.2 Predicates

A predicate is one of the following:

a) an item-reference for an item in the PICS proforma: the value of the predicate is true if the item is marked as supported, and is false otherwise; or

b) a predicate name, for a predicate defined elsewhere in the PICS proforma (usually in the Major Capabilities section or at the end of the section containing the conditional item): see below; or

c) the logical negation symbol "¬" prefixed to an item-reference or predicate name: the value of the predicate is true if the value of the predicate formed by omitting the "¬" symbol is false, and vice versa.

The definition for a predicate name is one of the following:

i) an item-reference, evaluated as at (a) above; or

ii) a relation containing a comparison operator (=, <, etc.) with at least one of its operands being an item-reference for an item taking numerical values as its answer: the predicate is true if the relation holds when each item-reference is replaced by the value entered in the Support column as the answer to the item referred to; or

iii) a boolean expression constructed by combining simple predicates, as at (i) and (ii), using the boolean operators AND, OR and NOT, and parentheses, in the usual way: the value of such a predicate is true if the boolean expression evaluates to true when the simple predicates are interpreted as described above.

Each item whose reference is used in a predicate or predicate definition is indicated by an asterisk in the Item column.

D.6.3 Implementation identification

Supplier	
Contact point for queries about this PICS	
Implementation Name(s) and Version(s)	
Other information necessary for full identification (e.g., Name(s) and Version(s) for 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 (using, e.g., Type, Series, Model).

D.6.4 Protocol summary: ISO/IEC 8878:1992

Identification of Protocol Specification	ISO/IEC 8878:1992	
Identification of Amendments and Corrigenda to this PICS proforma which have been completed as part of this PICS.	ISO/IEC 8878:1992 Am. : Am. : Am. : Am. :	 Corr. : Corr. : Corr. : Corr. :
Have any Exception items been required No □ Yes □ (The answer Yes means that the implementation does not conform to ISO/IEC 8878:1992)		

Date of Statement	

D.6.5 Major capabilities

Item	Protocol Feature	References	Status	Support		
*SY1	X.25/PLP-1984 VC Procedures	Clauses 0-12	O.1		Yes □	No □
*SY2	X.25/PLP-1980 VC Procedures	Annex A	O.1		Yes □	No □
SY3	Selection of Class of Operation	Annex B	COP:M	N/A □	Yes □	
*SY4	PVC SNDCP Procedures	Annex C	O		Yes □	No □

COP: SY1 and SY2

NOTE — X.25/PLP-1984 Virtual Call procedures are used by a System-1984 implementation. X.25/PLP-1980 Virtual Call procedures are used by a System-1980 implementation. X.25/PLP-1984 and X.25/PLP-1980 Virtual Call procedures, as well as the method of selecting between them, are used by a Compatible implementation.

Item	Protocol Feature	References	Status	Support		
*OC	The system initiates Network Service connection establishment	6	O.2		Yes □	No □
*IC	The system responds to Network Service connection-establishment attempts	6	O.2		Yes □	No □
*ED	The system supports Expedited Data transfer	6.2.4, 10	EDT:O	N/A □	Yes □	No □
*RC	The system supports Network Receipt Confirmation	6.2.3, 8.2.3, 9	O		Yes □	No □
S80FS	The system supports X.25/PLP-1980 Fast Select Procedures	B.1	SY2:O	N/A □	Yes □	No □
*S80A	The system supports X.25/PLP-1980 Alternative Procedures	B.1	SY2:M	N/A □	Yes □	

EDT: SY1 or SY4

D.6.6 Generally applicable items

D.6.6.1 Network Address mapping

Item	Protocol Feature	References	Status	Support		
AE	**Full Network address encoding and decoding (in AEF or AEP)**	6.2.2.1.2, 6.2.2.2.2	M		Yes □	
	Called Network Address					
AFb	Can the system encode the address in the AF without the AEF or AEP	6.2.2.1.1	OC:O	N/A □	Yes □	No □
AFe	Can the system decode the address in the AF without the AEF or AEP	6.2.2.2.1	IC:O	N/A □	Yes □	No □
	Calling Network Address					
AFa	Can the system encode the address in the AF without the AEF or AEP	6.2.2.1.1	OC:O	N/A □	Yes □	No □
AFd	Can the system decode the address in the AF without the AEF or AEP	6.2.2.2.1	IC:O	N/A □	Yes □	No □
	Responding Network Address					
AFf	Can the system encode the address in the AF without the AEF or AEP	6.2.2.1.1	IC:O	N/A □	Yes □	No □
AFc	Can the system decode the address in the AF without the AEF or AEP	6.2.2.2.1	OC:O	N/A □	Yes □	No □
	If, after decoding the Network address, the Network address does not exist, the system					
NAnpa	Clears the NC and indicates diagnostic code 232 (or 224), "Connection Rejection — NSAP Address Unreachable (Permanent Condition)"	6.2.2.2	O.3		Yes □	No □
NAnpb	other diagnostic code		O.3		Yes □ (if yes, indicate the value)	No □
	If a Network address cannot be derived from the Called AEF or AEP in an INCOMING CALL packet, the system					
NAcda	Clears the NC and indicates diagnostic code 232 (or 224) "Connection Rejection — NSAP Address Unreachable (Permanent Condition)"	6.2.2.2.2	IC:O.4	N/A □	Yes □	No □
NAcdb	other diagnostic code		IC:O.4	N/A □	Yes □ (if yes, indicate the value)	No □
	If insufficient local knowledge exists to derive an Network address from a received AF-only Called Address in an INCOMING CALL packet, the system					
NAilka	Clears the NC and indicates diagnostic code 232 (or 224), "Connection Rejection — NSAP Address Unreachable (Permanent Condition)"	6.2.2.2.1	IC:O.5	N/A □	Yes □	No □
NAilkb	other diagnostic code		IC:O.5	N/A □	Yes □ (if yes, indicate the value)	No □

D.6.6.2 Protocol errors

D.6.6.2.1 Interrupt packet

Item	Protocol Feature	References	Status	Support
	If an INTERRUPT packet is received when Non-Use of expedited data has been agreed for the NC, the system:			
MV1a	Clears the NC and indicates a diagnostic code 226 (or 224)	12	O.6	Yes □ No □
MV1b	Resets the NC and indicates a diagnostic code 233 (or 224)	12	O.6	Yes □ No □
MV1c	Other	12	O.6	Yes □ No □

D.6.6.2.2 Data packet with D-bit set to 1

Item	Protocol Feature	References	Status	Support
	If a DATA packet is received with the D-bit set to 1 when Non-Use of receipt confirmation has been agreed for the NC, the system:			
MV2a	Clears the NC and indicates a diagnostic code 226 (or 224)	12	O.7	Yes □ No □
MV2b	Resets the NC and indicates a diagnostic code 233 (or 224)	12	O.7	Yes □ No □
MV2c	Other	12	O.7	Yes □ No □

D.6.6.2.3 Data packet with Q-bit set to 1

Item	Protocol Feature	References	Status	Support
	If a DATA packet is received with the Q-bit set to 1 during data the transfer phase of an NC, the system:			
MV3a	Clears the NC and indicates a diagnostic code 226 (or 224)	12	O.8	Yes □ No □
MV3b	Resets the NC and indicates a diagnostic code 233 (or 224)	12	O.8	Yes □ No □
MV3c	Other	12	O.8	Yes □ No □

D.6.6.2.4 Zero-length M-bit Sequence

Item	Protocol Feature	References	Status	Support
	If a zero-length M-bit sequence is received during the data transfer phase of an NC, the system:			
MV4a	Clears the NC and indicates a diagnostic code 226 (or 224)	12	O.9	Yes □ No □
MV4b	Resets the NC and indicates a diagnostic code 233 (or 224)	12	O.9	Yes □ No □
MV4c	Ignore	12	O.9	Yes □ No □

D.6.6.2.5 Facilities missing in an INCOMING CALL packet

If SY2, mark N/A and continue at D.6.7. N/A □

Item	Protocol Feature	References	Status	Support
MV5a	If an INCOMING CALL packet is received without the Fast Select facility, the system clears the NC and indicates a diagnostic code of 228 (or 224)	12	0.10	Yes □ No □
MV5b	Other diagnostic code	12	0.10	Yes □ No □
MV6a	If an INCOMING CALL packet is received without the TCN facility, the system clears the NC and indicates a diagnostic code of 228 (or 224)	12	0.11	Yes □ No □
MV6b	Other diagnostic code	12	0.11	Yes □ No □

D.6.6.2.6 Facilities missing in a CALL CONNECTED packet

Item	Protocol Feature	References	Status	Support
MV7a	If a CALL CONNECTED packet is received without the EETDN facility, the system clears the NC and indicates a diagnostic code of 228 (or 224)	12	O.12	Yes □ No □
MV7b	Other diagnostic code	12	O.12	Yes □ No □
MV8a	If a CALL CONNECTED packet is received with a Selected QOS value, when present, that is not valid with respect to the CALL REQUEST packet, the system clears the NC and indicates a diagnostic code of 228 (or 224)	12	O.13	Yes □ No □
MV8b	Other diagnostic code	12	O.13	Yes □ No □

D.6.7 Questions related to 1980 SNDCP

If 1980 SNDCP procedures (SY2), are not supported, mark N/A and continue with D.6.8 below. N/A □

Item	Protocol Feature	References	Status	Support
SNDCP1	The implementation supports protocol id subfield of Call User Data Field in CALL REQUEST packet	A.1.2	SY2:M	Yes □
SNDCP2	The implementation supports alternative NC release procedure	A.3.2	SY2:M	Yes □
SNDCP3	The implementation supports SNDCP encoding in Call, Called, and Clear User Data Fields or in MBS (of one or more data packets) with Q-bit set to 1	A.4.2	SY2:M	Yes □

D.6.7.1 1980 SNDCP parameters

Item	Protocol Feature	References	Status	Support	
	N-CR Message				
NCRCdae	— Called Address Extension	A.5	¬AFb:M	N/A □	Yes □
NCRCgae	— Calling Address Extension	A.5	¬AFa:M	N/A □	Yes □
NCRmtc	— Minimum Throughput Class Negotiation	A.5	M		Yes □
NCRtd	— Transit Delay	A.5	M		Yes □
NCRnsud	— NS-user-data	A.5	M		Yes □
	N-CC Message				
NCCCdae	— Called Address Extension	A.5	¬AFe:M	N/A □	Yes □
NCCmtc	— Minimum Throughput Class	A.5	M		Yes □
NCCtd	— Transit Delay	A.5	M		Yes □
NCCnsud	— NS-user-data	A.5	M		Yes □
	N-DR Message				
NDRCdae	— Called Address Extension	A.5	¬AFe:M	N/A □	Yes □
NDRdo	— Disconnect Originator	A.5	M		Yes □
NDRdr	— Disconnect Reason	A.5	M		Yes □
NDRnsud	— NS-user-data	A.5	M		Yes □

D.6.8 Questions applicable for PVC SNDCP

D.6.8.1 Procedures, packet types, and packet image formats

If PVC SNDCP procedures are not supported, mark N/A and continue at D.7. N/A □

Item	Call Setup Packet Images	Status	Support	
PIS1	Are **outgoing calls** supported:			
PIS1a	— Fast Select, no restriction on response?	OC:M	N/A □	Yes □
PISP1e	send CALL REQUEST, extended format	OC:M	N/A □	Yes □
PIS2	Are **incoming calls** supported:			
PIS2a	— Fast Select, acceptance possible?	IC:M	N/A □	Yes □
PISP4b	send CALL ACCEPTED, basic format	IC:M	N/A □	Yes □
PISP4e	send CALL ACCEPTED, extended format	IC:M	N/A □	Yes □
	Is D-bit negotiation supported:			
PIDN1	— for outgoing calls	OC:M	N/A □	Yes □
PIDN2	— for incoming calls	IC:M	N/A □	Yes □

Procedures, packet types, and packet image formats (continued)

Item	Call Clearing Packet images	Status	Support
	Is call clearing supported, as:		
PIC1	— response to indication of clearing?	M	Yes □
PIC2a	— aborting an outgoing call attempt?	IC:M	N/A □ Yes □
PIC2c	— originating clearing of an established call?	M	Yes □
PICP3b	send CLEAR REQUEST, basic format	M	Yes □
PICP3e	send CLEAR REQUEST, extended format	M	Yes □

D.6.8.2 PVC SNDCP parameters (SY4)

D.6.8.2.1 Parameters sent in CALL REQUEST packet images

If Outgoing Calls (OC) are not supported, mark N/A and continue at D.6.8.2.2. N/A □

Item	Protocol Feature	Status Status	Support
PIFS2i	Throughput Class Negotiation	M	Yes □
PIFS6a	Fast Select	M	Yes □
PIFS12	Transit Delay Selection And Indication	M	Yes □
PIFS20i	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFS21i	Calling Address Extension	M	Yes □
PIFS22i	Called Address Extension	M	Yes □
PIFS23i	Minimum Throughput Class Negotiation	M	Yes □
PIFS24i	End-to-End Transit Delay Negotiation	M	Yes □
PIFS26i	Priority	M	Yes □

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

D.6.8.2.2 Parameters sent in CALL ACCEPTED packet images

If Incoming Calls (IC) are not supported, mark N/A and continue at D.6.8.2.3. N/A □

Item	Protocol Feature	Status	Support
PIFS2r	Throughput Class Negotiation	M	Yes □
PIFS20r	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFS22r	Called Address Extension	M	Yes □
PIFS24r	End-to-End Transit Delay Negotiation	M	Yes □
PIFS26r	Priority	M	Yes □

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

D.6.8.2.3 Parameters sent in CLEAR REQUEST packet images

If Incoming Calls (IC) are not supported, mark N/A and continue at D.6.8.2.4. N/A □

Item	Protocol Feature	Status	Support
PIFS20d	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFS22d	Called Address Extension	M	Yes □

D.6.8.2.4 Parameters received in INCOMING CALL packet images

If Incoming Calls (IC) are not supported, mark N/A and continue at D.6.8.2.5. N/A □

Item	Protocol Feature	Status	Support
PIFR2i	Throughput Class Negotiation	M	Yes □
PIFR6a	Fast Select	M	Yes □
PIFR12i	Transit Delay Selection And Indication	M	Yes □
PIFR20i	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFR21	Calling Address Extension	M	Yes □
PIFR22i	Called Address Extension	M	Yes □
PIFR23	Minimum Throughput Class Negotiation	M	Yes □
PIFR24i	End-to-End Transit Delay Negotiation	M	Yes □
PIFR26i	Priority	M	Yes □

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

D.6.8.2.5 Parameters received in CALL CONNECTED packet images

If Outgoing Calls (OC) are not supported, mark N/A and continue at D.7. N/A □

Item	Protocol Feature	Status	Support
PIFR2r	Throughput Class Negotiation	M	Yes □
PIFR12r	Transit Delay Selection And Indication	M	Yes □
PIFR20r	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFR22r	Called Address Extension	M	Yes □
PIFR24r	End-to-End Transit Delay Negotiation	M	Yes □
PIFR26r	Priority	M	Yes □

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

D.6.8.2.6 Parameters received in CLEAR INDICATION packet images

If Outgoing Calls (OC) are not supported, mark N/A and continue at D.7. N/A □

Item	Protocol Feature	Status	Support
PIFR20d	Facility Marker for CCITT-Specified DTE facilities	M	Yes □
PIFR22d	Called Address Extension	M	Yes □

D.7 Modified PICS requirements for ISO/IEC 8208

Use of this International Standard imposes requirements on the underlying ISO/IEC 8208 implementation that go beyond those of ISO/IEC 8208 itself; these result in modifications to the requirements expressed in the ISO/IEC 8208 PICS proforma. This subclause specifies the modifications that apply to the status of the items affected in the ISO/IEC 8208 PICS proforma, with consequently modified requirements on the answers to be provided.

Most of the modifications consist in change from optional or conditional status to mandatory or, in a few cases, prohibited status.

D.7.1 Modified status of ISO/IEC 8208 questions

D.7.1.1 Service

Item	Protocol Feature	8878 Status
Vp	— PVC	O
Vs	— VC	M

D.7.1.2 Procedures, packet types, and packet formats

Item	Protocol Feature	8878 Status
SP4b	send CALL ACCEPTED, basic format	IC:M
	Is D-bit negotiation supported:	
DN1	— for outgoing calls	OC:M
DN2	— for incoming calls	IC:M

Procedures, packet types, and packet formats (continued)

Item	Call Clearing packets/Packet images	8878 Status
	Is call clearing supported, as:	
C1	— response to indication of clearing?	M
C2a	— aborting an outgoing call attempt?	OC:M
C2c	— originating clearing of an established call?	M
CP3b	send CLEAR REQUEST, basic format	M

Item	Resetting of Logical Channels	8878 Status
	Is resetting supported:	
RSi	— as initiator? send RESET REQUEST receive RESET CONFIRMATION/INDICATION	M
RSr	— as responder? receive RESET INDICATION send RESET CONFIRMATION	M

Item	Normal Data Transfer and Flow Control	8878 Status
	Are the following supported?	
DS1	Sending DATA packets	M
DS2	Send-window rotation on receiving updated P(R) values	M
DS4b	Sending DATA packets with M = 1	M
DS5a	Sending Q = 0 in DATA packets	M

Procedures, packet types, and packet formats (continued)

Item	Normal Data Transfer and Flow Control	8878 Status
DR1	Receiving DATA packets	M
DR2	Receive-window rotation by sending updated P(R) values	M
DR4b	Receiving M = 1 in DATA packets	M
DR5a	Receiving Q = 0 in DATA packets	M
DC	Receiving D = 1 in DATA packets	RC:M

Item	Error Procedures	8878 Status
W1a	Error-C procedure — clear the virtual call	M
W1b	Error-C procedure — restart the packet layer	X
W2sc	Error-R procedure — restart the packet layer	X

Item	Cause and Diagnostic Codes	8878 Status
Y3a	In CLEAR REQUEST packets sent: — Cause = 0, standard diagnostic codes, — specific codes	M

Item	Interrupt Transfer	8878 Status
Is	Is sending interrupts supported? send INTERRUPT receive INTERRUPT CONFIRMATION	ED:M
Ir	Is receiving interrupts supported? receive INTERRUPT send INTERRUPT CONFIRMATION	ED:M

D.7.1.3 Facilities applicable when outgoing NC establishment is supported

If outgoing calls (OC) are not supported, continue at D.7.1.4.

Item	Protocol Feature	8878 Status
	Facilities sent in CALL REQUEST packets	
FS2i	Throughput Class Negotiation	M
	Facilities received in CALL CONNECTED packets	
FR2r	Throughput Class Negotiation	M

D.7.1.4 Facilities applicable for incoming NCs

If incoming calls (IC) are not supported, continue at D.7.2.

Item	Protocol Feature	8878 Status
	Facilities received in INCOMING CALL packets	
FR2i	Throughput Class Negotiation	M
	Facilities sent in CALL ACCEPTED packets	
FS2r	Throughput Class Negotiation	M

D.7.2 Modified requirements applicable for PVCs (SY4)

Item	Normal Data Transfer	8878 Status
DS5b	Sending Q = 1 in DATA packets	M
DR5b	Receiving Q = 1 in DATA packets	M

Item	Error Procedures	8878 Status
W2pa	ERROR-R procedure — reset the logical channel	M
W2pb	ERROR-R procedure — restart the packet layer	X

D.7.3 Modified requirements applicable for 1984 (SY1) or 1980 Fast Select (S80FS)

D.7.3.1 Procedures, packet types, and formats

Item	Call Setup Packets	8878 Status
S1	Are **outgoing calls** supported:	
S1a	— Fast Select, no restriction on response?	OC:M
SP1e	sends CALL REQUEST, extended format	OC:M
S2	Are **incoming calls** supported:	
S2a	— Fast Select, acceptance possible?	IC:M
S2b	— Fast Select, always cleared?	IC:X
SP4e	send CALL ACCEPTED, extended format	IC:M
CP3e	send CLEAR REQUEST, extended format	M

D.7.3.2 Facilities sent in CALL REQUEST packets

Item	Protocol Feature	8878 Status
FS6a	Fast Select	M

D.7.3.3 Facilities received in INCOMING CALL packets

Item	Protocol Feature	8878 Status
FS6a	Fast Select	M

D.7.4 Modified requirements applicable for 1980 Alternative Procedures (S80A)

D.7.4.1 Procedures, packet types and formats

Item	Call Set Packets	8878 Status
	Are **incoming calls** supported:	
S2c	— non-Fast-Select, acceptance possible?	IC:M
S2d	For Incoming Calls non-Fast-Select, always cleared?	S80A:X

D.7.5 Modified requirements applicable for 1984 implementations (SY1)

D.7.5.1 Facilities applicable when outgoing NC establishment is supported

If Outgoing Calls (OC) are not supported, continue at D.7.5.2.

Item	Protocol Feature	8878 Status
	Facilities sent in CALL REQUEST packets	
FS12	Transit Delay Selection And Indication	M
FS20i	Facility Marker for CCITT-Specified DTE facilities	M
FS21i	Calling Address Extension	M
FS22i	Called Address Extension	M
FS23i	Minimum Throughput Class Negotiation	M
FS24i	End-to-End Transit Delay Negotiation	M
FS25i	Expedited Data Negotiation	ED:M
FS26i	Priority	M
	Facilities received in CALL CONNECTED packets	
FR12r	Transit Delay Selection And Indication	M
FR20r	Facility Marker for CCITT-Specified DTE facilities	M
FR22r	Called Address Extension	M
FR24r	End-to-End Transit Delay Negotiation	M
FR25r	Expedited Data Negotiation	M
FR26r	Priority	M
	Facilities received in **CLEAR INDICATION** packets	
FR20d	Facility Marker for CCITT-Specified DTE facilities	M
FR22d	Called Address Extension	M

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

D.7.5.2 Facilities applicable for incoming NCs

If Incoming Calls (IC) are not supported, skip this subclause.

Item	Protocol Feature	8878 Status
	Facilities sent in CALL ACCEPTED packets	
FS20r	Facility Marker for CCITT-Specified DTE facilities	M
FS22r	Called Address Extension	M
FS24r	End-to-End Transit Delay Negotiation	M
FS25r	Expedited Data Negotiation	ED:M
FS26r	Priority	M
	Facilities sent in CLEAR REQUEST packets	
FS20d	Facility Marker for CCITT-Specified DTE facilities	M
FS22d	Called Address Extension	M
	Facilities received in INCOMING CALL packets	
FR12i	Transit Delay Selection And Indication	M
FR20i	Facility Marker for CCITT-Specified DTE facilities	M
FR21	Calling Address Extension	M
FR22i	Called Address Extension	M
FR23	Minimum Throughput Class Negotiation	M
FR24i	End-to-End Transit Delay Negotiation	M
FR25i	Expedited Data Negotiation	M
FR26i	Priority	M

NOTE — Priority applies to 1988 and later implementations and may be N/A for pre-1988 implementations.

Annex E
(informative)

Additional Considerations of CONS Primitives

E.1 Introduction

The main body and Annex A of this International Standard present a mapping between the CONS, on the one hand, and the X.25/PLP-1984 and X.25/PLP-1980 with SNDCP, on the other. However, the designer of an end system should be aware that there are several issues related to the issuing of CONS primitives in addition to mapping them to X.25/PLP protocol elements. These issues relate to the provision of the appropriate "environment" (i.e., supporting protocols at appropriate layers) within the end system in which the X.25/PLP is to operate. The purpose of this annex is to briefly describe these issues.

E.2 Environment for X.25/PLP operation

For the purpose of this annex, the environment in which the X.25/PLP operates depends on the technology of the subnetwork(s) to which the end system is attached. For example, the end system may be attached to a Local Area Network or to a packet-switched public data network. While the mapping between the primitives of the CONS and the elements of the X.25/PLP does not depend on the particular subnetwork, the proper provision of the environment for the X.25/PLP to operate does depend on it. The following subclauses illustrate the issues pertaining to provision of the environment in which the X.25/PLP operates. Complete details on these aspects are given in the following:

a) for LANs: ISO/IEC 8881:1989;

b) for ISDNs: CCITT Rec. X.612 (1992) | ISO/IEC 9574:1992;

c) for environments using X.21/X.21 *bis* (CSDN and an ISDN Terminal Adapter complying with Rec. X.30): CCITT Rec. X.613 (1992) | ISO/IEC 10588:1992;

d) for the telephone network: CCITT Rec. X.614 (1992) | ISO/IEC 10732:1992.

E.2.1 Initialization

If, when receiving an N-CONNECT request primitive, the NL entity determines that the necessary subnetwork point of attachment (SNPA) in this end system is not available (i.e., cannot be used for transmitting a CALL REQUEST packet), then appropriate procedures are necessary to be executed in the end system to make the SNPA available. Alternatively, the NL entity may reject the request. In this case, the corresponding procedures are not executed and the NL entity signals an N-DISCONNECT indication primitive to the Calling NS user. The Originator parameter is "NS Provider" and the Reason parameter is "Connection Rejection — Reason Unspecified/Permanent Condition."

NOTE — This International Standard does not indicate how the NL entity determines whether the necessary SNPA is or is not available.

It is not the intent of this annex to provide a complete set of procedures that are executed for the various subnetwork technologies in which the X.25/PLP may be used. Still, an example will provide an indication of these procedures.

EXAMPLE: Connection of an End System to an X.25 Packet-Switched Data Network

Consider an end system connected to an X.25 packet-switched (public or private) data network by a dedicated line conforming to CCITT Recommendation X.21. If this interface is not available when an N-CONNECT request primitive is received by the NL entity, then the following steps are taken (in the order shown):

a) the X.21 establishment procedures are performed and the X.21 data transfer phase is entered;

b) the ISO 7776 protocol is executed to establish the Data Link Layer of the X.25 DTE/DCE interface and enter its data transfer phase;

c) the X.25/PLP restart procedure is executed.

Only after the successful completion of all three steps above can the NL entity transfer an X.25/PLP CALL

REQUEST packet across the DTE/DCE interface.

It is also not the intent of this annex to indicate how the NL entity is informed of the outcome of the initialization procedures. However, it is assumed that the NL entity is informed whether these procedures are successfully completed. The subsequent action of the NL entity depends on the outcome, for example:

a) Successful Initialization: the NL entity transmits a CALL REQUEST packet; or

b) Unsuccessful Initialization: the NL entity may reattempt the initialization procedures again or signal an N-DISCONNECT indication primitive to the NS user but without transmitting a CLEAR REQUEST packet. In the latter case, the Originator parameter is "NS Provider." The Reason parameter is "Connection Rejection — Reason Unspecified/Transient Condition."

NOTE — A more detailed mapping of the Reason parameter to any diagnostic information available as a result of the failure of the initialization procedures may also be desired.

In a similar fashion as above for an N-CONNECT request primitive, it should be recognized that the initialization procedures must be completed before an N-CONNECT indication primitive can be signaled to an NS user.

E.2.2 Premature closedown

If the environment in which the X.25/PLP operates prematurely closes down (i.e., while one or more NCs are established or in the process of being established), then the NL entity signals, for each established NC or NC in the process of being established, an N-DISCONNECT indication primitive to the NS user but does not transmit a CLEAR REQUEST packet. The Originator parameter is "NS Provider." The Reason parameter is:

a) for established NCs, "Disconnection — Transient Condition;" or

b) for NCs in the process of being established, "Connection Rejection — Transient Condition."

NOTE — A more detailed mapping of the reason parameter to any diagnostic information available as a result of the premature closedown may also be desired.

Annex F
(informative)

Use of X.25/PLP NPAI

F.1 Introduction

This annex discusses the use of X.25/PLP NPAI (i.e., the Address Field and the Address Extension Facilities). It provides guidelines for obtaining the SNPA Address from the Network Address. It also illustrates how a Network Address may be encoded in X.25/PLP NPAI.

F.2 Obtaining an SNPA address

Two methods for obtaining an SNPA Address from a Network Address are described. The first one makes use of a directory, the second describes an algorithmic procedure. The two methods are not exclusive.

F.2.1 Directory

The directory is an abstract object which, given a Network Address, returns an SNPA Address. The operation of such a directory is not within the scope of this annex. Conceptually, it may be viewed as a table look-up, a local directory, or a distributed directory. (For more information, consult CCITT Rec. X.650 | ISO/IEC 7498-3.)

F.2.2 Algorithmic procedure

There are three cases that may be considered for deriving an SNPA Address from a Network Address:

a) DSP absent:

   1) The Network Address is composed of an AFI and an IDI. If the AFI is consistent with the AFI format of the subnetwork provider, the IDI may be used directly in the Address Field subject to network-dependent prefixes and formats to provide the encoded SNPA Address. In this case, the AFI is not conveyed as explicit protocol control information. Its existence is thus implied and must be capable of being correctly deduced by the recipient.

   2) In the case where the AFI format of the Network Address is not consistent with the subnetwork provider, it may be necessary to make use of a directory as described in F.2.1 above.

b) DSP present:

   The procedure to be followed in this case requires that the IDI and AFI be operated on as specified in Case (a) above to determine the SNPA Address. The only difference for this case is that, in addition to the above, the complete Network Address is inserted in the AEF.

c) There may be cases, such as the use of escape digits (e.g., 8=F.69, 9=E.163), that do not require the use of directories. In cases such as this, the procedure defined in the appropriate addressing standard/recommendation (e.g., CCITT Recommendation X.121) may also be implied.

F.3 Examples of Network Address encoding

Below are several examples of how a Network Address is encoded in X.25/PLP-1984 NPAI (i.e., the AF and the AEF). Subclause 6.2.2 specifies how this encoding is performed. As indicated, the preferred binary encoding, as defined in CCITT Rec. X.213 | ISO/IEC 8348, is used as the encoding technique.

The examples make use of hexadecimal notation; that is $X'h_1h_2\ldots'$ represents a string of hexadecimal digits. Padding digits are highlighted with an underscore.

EXAMPLE 1:

AFI	IDI	DSP
X'36'	X'313412345678'	null

Assuming the conditions in 6.2.2.1.1 are all satisfied, the above Network Address may be conveyed in the AF. The AF would then be encoded as:

AF
X'313412345678'

Note that the need to include the Data Network Identification Code, which is 3134 in this example, and any prefix digits is a matter dependent on the packet-switched network to which the end system is attached.

The above Network Address may also be conveyed in the AEF. The encoding of the FPF of the AEF would then be:

FPF of AEF	
X'10'	X'360 0 313412345678'

Note that the first octet of the FPF of the AEF indicates the usage of the AEF (in this case, full Network Address) in bits 8 and 7 and the number of semi-octets that follow (sixteen) in bits 6, 5, 4, 3, 2, and 1.

EXAMPLE 2:

AFI	IDI	DSP
X'37'	X'31341234567890'	X'5F4230A26789'

This Network Address can only be conveyed in the AEF. The encoding of the FPF of the AEF is as follows:

FPF of AEF	
X'1C'	X'37313412345678905F4230A26789'

EXAMPLE 3:

AFI	IDI	DSP
X'44'	X'123456789012345'	X'4297'

This Network Address can only be conveyed in the AEF. The encoding of the FPF of the AEF is as follows:

FPF of AEF	
X'16'	X'4412345678901234542 97F '

EXAMPLE 4:

AFI	IDI	DSP
X'45'	X'1234567890123'	X'FE496A'

This Network Address can only be conveyed in the AEF. The encoding of the FPF of the AEF is as follows:

FPF of AEF	
X'18'	X'450 0 1234567890123F FE496A'

EXAMPLE 5:

AFI	IDI	DSP
X'47'	X'4368'	X'43678A4B095ECF'

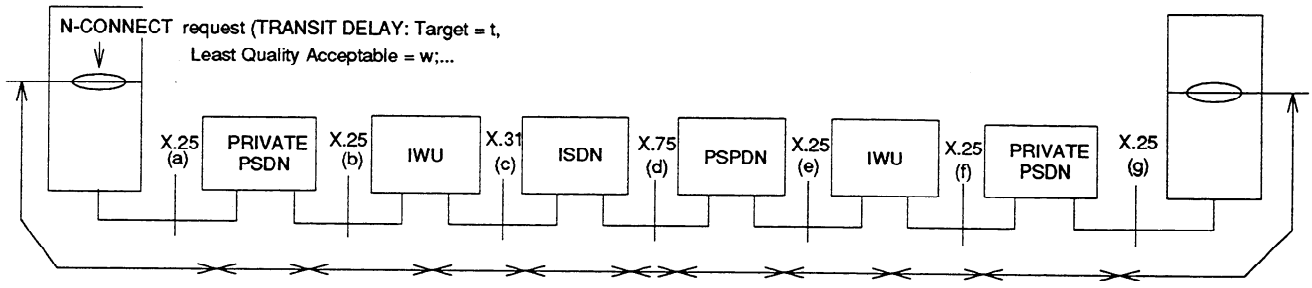
This Network Address can only be conveyed in the AEF. The encoding of the FPF of the AEF is as follows:

FPF of AEF	
X'14'	X'47436843678A4B095ECF'

Annex G
(informative)

Transit Delay Calculations

This annex illustrates how the various X.25 facilities are used to negotiate the end-to-end value of the transit delay QOS parameter.



DELAY VALUES: d1 p1 g1 g2 p2 e p3 g3 g4 p4 d2

LEGEND:

ISDN:	Integrated Services Digital Network
IWU:	Interworking Unit
PSDN:	Packet Switched Data Network
PSPDN:	Packet Switched Public Data Network

The labels (a), (b), (c), (d), (e), (f), and (g) represent the various points between the entities involved in the scenario shown above at which the transit delay information is visible in the protocol control information.

	X.25 Facility	X.75 Utilities		EETDN Facility		
	TDSAI	TDS	TDI	CTD	TTD	MATD
Call Request Phase						
a)	t – d1 – dx (Note 1)	NA	NA	d1	t	w
b)	p1	NA	NA	d1	t	w
c)	t – d1 – p1 – (g1+g2) – dy (Note 1)	NA	NA	d1+p1+(g1+g2)	t	w
d)	NA	t – d1 – p1 – (g1+g2) – dy	p2+e	d1+p1+(g1+g2)	t	w
e)	p2+e+p3	NA	NA	d1+p1+(g1+g2)	t	w
f)	t – (d1+p1+(g1+g2)) – (g3+g4) – (p2+e+p3) – dz (Note 1)	NA	NA	d1+p1+(g1+g2) +(p2+e+p3)+(g3+g4)	t	w
g)	p4	NA	NA	d1+p1+(g1+g2) +(p2+e+p3)+(g3+g4)	t	w
Call Confirmation Phase (Note 2)						
g)	NA	NA	NA	d1+p1+(g1+g2) +(p2+e+p3)+(g3+g4)+p4+d2	NA	NA
f)	p4	NA	NA	"	NA	NA
e)	NA	NA	NA	"	NA	NA
d)	NA	NA	p2+e+p3	"	NA	NA
c)	p2+e+p3	NA	NA	"	NA	NA
b)	NA	NA	NA	"	NA	NA
a)	p1	NA	NA	"	NA	NA

NOTES

1 The values dx, dy, and dz represent an estimate of d2 included in the CALL REQUEST packet at interfaces (a), (c), and (f), respectively, given an algorithm that may, for example, make use of a "routeing management information base" to refine the value in the TDSAI Facility (see 6.2.5.2.1). In the absence of this algorithm, dx, dy, or dz would be zero.

2 The called DTE accepts the call if d1+p1+(g1+g2)+(p2+e+p3)+(g3+g4)+p4+d2 ≤ w. The Available transit-delay value in the Transit Delay QOS parameter of the N-CONNECT indication primitive signaled to the Called NS user is d1+p1+(g1+g2)+(p2+e+p3)+(g3+g4)+p4+d2.

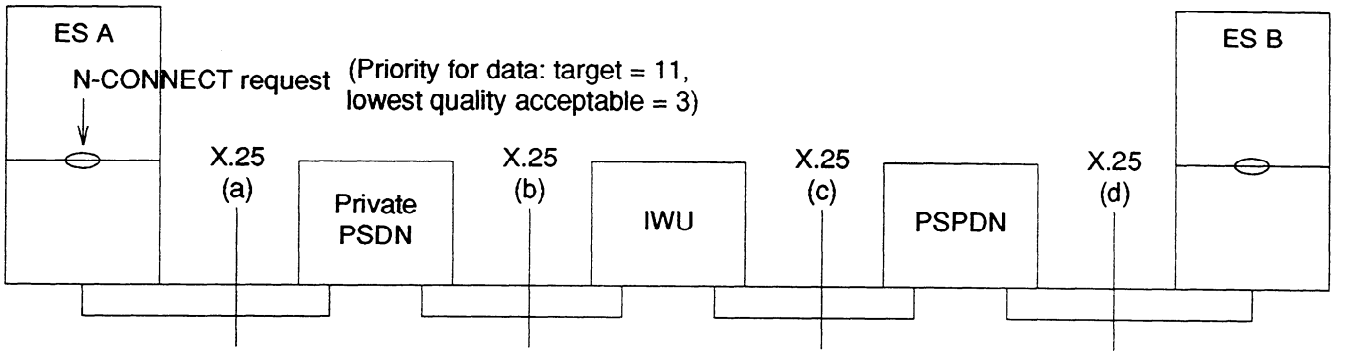
LEGEND:

CTD:	Cumulative Transit Delay
EETDN:	End-to-End Transit Delay Negotiation (Facility)
MATD:	Maximum-Acceptable Transit Delay
NA:	Not Applicable
TDI:	Transit Delay Indication (Utility)
TDS:	Transit Delay Selection (Utility)
TDSAI:	Transit Delay Selection And Indication (Facility)
TTD:	Target Transit Delay

Annex H
(informative)

Example of Priority Negotiation

The example below is concerned only with the negotiation of priority for data transfer (operation of the negotiation of the other two priority subparameters in CCITT Rec. X.25 | ISO/IEC 8208 is identical).



LEGEND:

ES:	End System
IWU:	Interworking Unit
PSDN:	Packet Switched Data Network
PSPDN:	Packet Switched Public Data Network

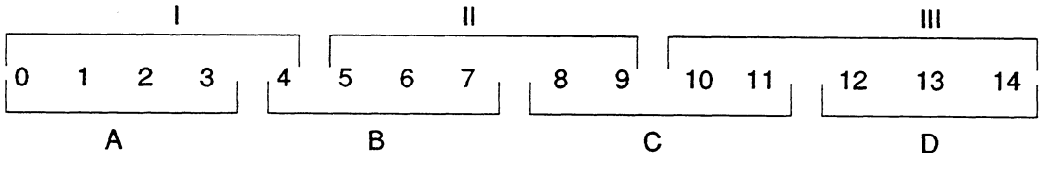
The labels (a), (b), (c), and (d) represent the various points between the entities involved in the scenario shown above at which priority information is visible in protocol control information.

The priority values supported by the Private PSDN and the PSPDN, which are conveyed in a "network-specific" X.25 facility local to the network, are as follows:

— PSPDN: I (lowest), II, III (highest)

— Private PSDN: A (lowest), B, C, D (highest)

The mapping to the 0-14 OSI priority range is as follows



The top mapping is used by the IWU and ES B; the bottom mapping is used by ES A and the IWU.

	Network-Specific X.25 Facility	Priority Facility: Target	LQA
Call Request Phase:			
(a)	C	11	3
(b)	B	11	3
(c)	II	7 (Note)	3
(d)	II	7	3

NOTE — The IWU downgrades the Target priority to 7 in its CALL REQUEST packet at (c) because of the lowered priority (to B) in the INCOMING CALL packet at (b).

Call Confirmation Phase:			
(d)	I	4 (Note)	NA
(c)	I	4	NA
(b)	B	4	NA
(a)	B	4	NA

NOTE — The called NS User downgrades the priority from 7 to 4.

LEGEND:

LQA: Lowest Quality Acceptable
NA: Not Applicable

PSDNs and PSPDNs may choose to consider the values in the CCITT-Specified DTE Priority Facility while still maintaining a smaller number (less than 15) of priority levels. In such a case, the above mapping operations would take place internally within the network with the same results. However, no "network-specific X.25 Priority Facility" would be transmitted across any of the X.25 interfaces.

Annex I
(informative)

Differences between Recommendation X.223 and ISO/IEC 8878

The draft revision of the 1988 version of Recommendation X.223 proposed for adoption in 1993 is technically aligned with ISO/IEC 8878 except for the following items.

a) In Recommendation X.223, the text in 6.2.2.1.1 specifies that, under certain conditions, the Network Address is always carried in the AF whereas ISO/IEC 8878 leaves this as an option. ISO/IEC 8878 lists three conditions; Recommendation X.223 lists these three plus a fourth, as follows: "the NL entity, through local knowledge, is aware that the remote NL entity does not operate according to CCITT Recommendation X.223 and cannot recognize the AEF."

b) In Recommendation X.223, the text in 6.2.4 specifies that if "no use of Expedited Data" is indicated or if the NL entity cannot support 32-octet INTERRUPT packets, then the EDN facility is **always** omitted. For the same case, ISO/IEC 8878 specifies that the EDN Facility either may be carried specifying "no use of Expedited Data" or may be omitted.

c) In 6.2.5.1 (Throughput QOS Parameters) of Recommendation X.223, a new paragraph has been added that is not present in ISO/IEC 8878. This paragraph, which is the last paragraph in 6.2.5.1.1, specifies that whenever the Lowest Quality Acceptable subparameters of the Throughput QOS Parameters for both directions are "unspecified" in the N-CONNECT request, the B-MTCN Facility is **not** included in the CALL REQUEST packet. ISO/IEC 8878 specifies that, in such a case, the B-MTCN Facility is encoded as 75 bits per second.

   NOTE — This difference does not affect interworking.

d) In 6.2.5.2 (Transit Delay QOS Parameter), CCITT Rec. X.223 and ISO/IEC 8878 differ on handling some cases of transit delay negotiation. In 6.2.5.2.1 for CCITT Rec. X.223, the TDSAI and EETDN Facilities are omitted from a CALL REQUEST packet when the Target and Lowest Quality Acceptable transit delays are "unspecified." ISO/IEC 8878 specifies that only the TDSAI Facility is omitted. In 6.2.5.2.2, an NL entity acts differently if either the TDSAI or EETDN Facility is absent from the INCOMING CALL packet: for CCITT Rec. X.223, the NL entity specifies the Available transit delay as "unspecified;" for ISO/IEC 8878, the NL entity derives a value for the missing information.

   NOTE — This difference does not affect interworking.

   Additionally, in 6.2.5.2.1 of Recommendation X.223, the last sentence in Item d) specifies that in DTE-to-DTE operational environments the TDSAI facility is for further study. ISO/IEC 8878 does not have such a sentence.

e) Both Recommendation X.223 and ISO/IEC 8878 provide, in clause 12, a list of error conditions in the operation of the protocol. ISO/IEC 8878 includes receipt of a CALL CONNECTED packet without an EETDN Facility as an error condition; Recommendation X.223 does not include this case. ISO/IEC 8878 considers receipt of an INCOMING CALL packet without a Fast Select Facility as an error while Recommendation X.223 leaves this case for further study. Finally, ISO/IEC 8878, upon receipt of a zero-length MBS, allows an NL entity to clear or reset the call or ignore the MBS; Recommendation X.223 only allows ignoring the MBS.

   NOTE — These differences do not affect interworking.

f) There are a few differences between Recommendation X.223 and ISO/IEC 8878 in the conformance requirements of an NL entity. For ISO/IEC 8878, an NL entity must be capable of conveying a Network Address in the AEF; for Recommendation X.223, the AEF is used only when the conditions in 6.2.2.1.1 are not satisfied. Also, conformance to ISO/IEC 8878 requires an indication of whether Annexes A and C (see below) are supported.

   NOTE — These differences do not affect interworking.

g) The scope of Recommendation X.223 does not include for provision of the OSI Connection-mode Network Service over 1980 X.25 subnetworks. Conversely, ISO/IEC 8878 provides for this and defines a protocol mechanism in Annex A. Also, material related to interoperability issues, including those raised by the presence of Annex A, is included in Annex B to ISO/IEC 8878 and is not included in Recommendation X.223.

h) The scope of Recommendation X.223 does not include for provision of the OSI Connection-mode Network Service using Permanent Virtual Circuits. Conversely, ISO/IEC 8878 provides for this and defines a protocol mechanism in Annex C.

i) ISO/IEC 8878 contains a normative Annex D that specifies a Protocol Implementation Conformance Statement (PICS). Recommendation X.223 does not contain this material.

j) ISO/IEC 8878 contains an informative Annex H that illustrates the use of priority-related facilities. Recommendation X.223 does not contain this material.

k) Recommendation X.223 contains an appendix that shows the relationship between the various quality of service parameters covered by the Network Service and those used in the X.130-series of Recommendations. ISO/IEC 8878 does not contain this material.

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