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Information processing systems — Data communications — Use of X.25 to provide the OSI connection-mode network service

Systèmes de traitement de l'information — Communication de données — Utilisation du protocole X.25 pour fournir le service de réseau OSI en mode connexion

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Foreword

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

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Information processing systems — Data communications — Use of X.25 to provide the OSI connection-mode network service

0 Introduction

This International Standard defines two methods for providing the OSI Connection-Mode Network Service (CONS) through the use of the X.25 Packet Level Protocol (X.25/PLP). The first method, which is presented in the main body of this International Standard, specifies a mapping between elements of the 1984 version of the X.25/PLP (X.25/PLP-1984) and elements of the OSI CONS. The second method, which is presented in Annex A of this International Standard, defines a Subnetwork Dependent Convergence Protocol (SNDCP) that shall be used to provide the OSI CONS over subnetworks or with equipment using the 1980 version of the X.25/PLP. This SNDCP should only be used if the elements of the X.25/PLP-1984, as defined in 5.1 of this International Standard, are not available to support the OSI CONS.

Annex B gives the conformance requirements for equipment providing the OSI CONS by one or more of the methods in this International Standard and defines the possibilities and rules for interworking between such equipment.

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. Their status will be reviewed periodically.

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

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

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

The above three annexes 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; and
- c. the interrelationship between, and the valid sequences of, these actions and events.

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

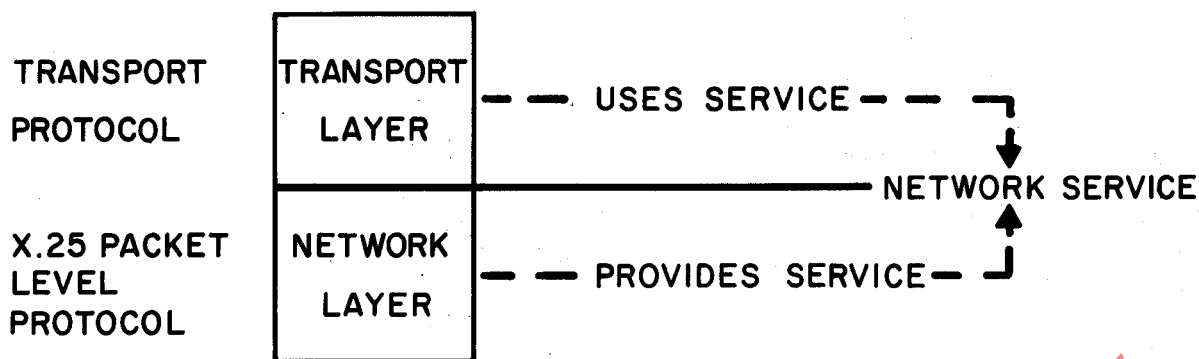


FIGURE 1

Relationship of the X.25 Packet Level Protocol
to the OSI Connection-Mode Network Service

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 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 X.21 for a circuit-switched network or X.25 for a packet-switched network.

Throughout the set of OSI 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 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).

1 Scope and field of application

The OSI CONS, as stated above, 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. This International Standard provides such a mapping for the X.25/PLP-1984. It also provides a mapping of the CONS primitives and parameters to the X.25/PLP-1980 plus an SNDCCP (Annex A). 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).

This International Standard specifies the conformance requirements for three classes of implementation. These requirements 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 *Conforming-1984* implementation. Implementations in this class are designed to operate directly and efficiently with other Conforming-1984 implementations, including cases of operation across an X.25(1984) subnetwork.

This International Standard also specifies the requirements to be met by a *Conforming-1980* implementation. Implementations in this class are designed to operate directly with other Conforming-1980 implementations, including cases of operation across any form of X.25 subnetwork, but will operate less efficiently than Conforming-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-1984 or X.25/PLP-1980 with the SNDCP 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-1984 or X.25/PLP-1980 with the SNDCP 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; and
- d. an end system connected to an Integrated Services Digital Network.

2 References

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

ISO 8208, *Information processing systems — Data communications — X.25 Packet Level Protocol for Data Terminal Equipment*.

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

ISO 8348/Add. 2, *Information processing systems — Data communications — Network service definition — Addendum 2: Network layer addressing*.

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

CCITT Recommendation X.25, *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*, 1984 (Red Book).

CCITT Recommendation X.96, *Call Progress Signals in Public Data Networks*, 1984 (Red Book).

SECTION ONE: GENERAL

3 Definitions

3.1 Reference Model definitions

The following concepts, developed and defined in the OSI Reference Model (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 Service Conventions Standard (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 (ISO 8348), are used:

- a. Calling Network Service user

- b. Called Network Service user

3.4 Addressing definitions

The following concepts, as defined in ISO 8348/Add. 2, are used:

- a. Subnetwork Point of Attachment address
- b. Network Protocol Address Information
- c. Initial Domain Part
- d. Authority and Format Identifier
- e. Initial Domain Identifier
- f. Domain Specific Part

3.5 X.25 definitions

The following concepts, as developed in the X.25 Packet Level Protocol for DTEs (ISO 8208) and in CCITT Recommendation X.25, are used:

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

3.6 X.96 definitions

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

- a. Category C call progress signal
- b. Category D call progress signal

4 Abbreviations

4.1 Network Service abbreviations

CONS	Connection-Mode Network Service
N	Network
NC	Network-connection
NL	Network Layer
NS	Network Service
NSAP	Network Service Access Point
OSI	Open Systems Interconnection
QOS	Quality of Service

4.2 Addressing abbreviations

AFI	Authority and Format Identifier
DSP	Domain Specific Part
IDI	Initial Domain Identifier
IDP	Initial Domain Part
NPAI	Network Protocol Address Information
SNPA	Subnetwork Point of Attachment

4.3 X.25 abbreviations

AEF	Address Extension Facility
AF	Address Field
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
MTCN	Minimum Throughput Class Negotiation (Facility)
PLP	Packet level protocol
P(R)	Packet receive sequence number
P(S)	Packet send sequence number
TCN	Throughput Class Negotiation (Facility)
TDSAI	Transit Delay Selection And Indication (Facility)
VC	Virtual Call

4.4 Abbreviations applying to Annex A

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
SNDP	Subnetwork Dependent Convergence Protocol

5 Overview

The Network Service 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 ISO 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:

- the virtual-circuit types;
- the packet types and fields to be mapped to the primitives and parameters of the OSI CONS; and
- the optional user facilities and CCITT-Specified DTE facilities.

Of the two types of virtual circuits defined in ISO 8208, the use of Virtual Calls (VCs) is mapped to the NC Establishment and Release Phases of the OSI CONS.

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

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

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 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 GFI in these 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.
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.

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

a. optional user facilities —

- 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),
- Fast Select Acceptance (facility agreed to if operating in a packet-switched network environment),
- Throughput Class Negotiation (facility agreed to and used), and

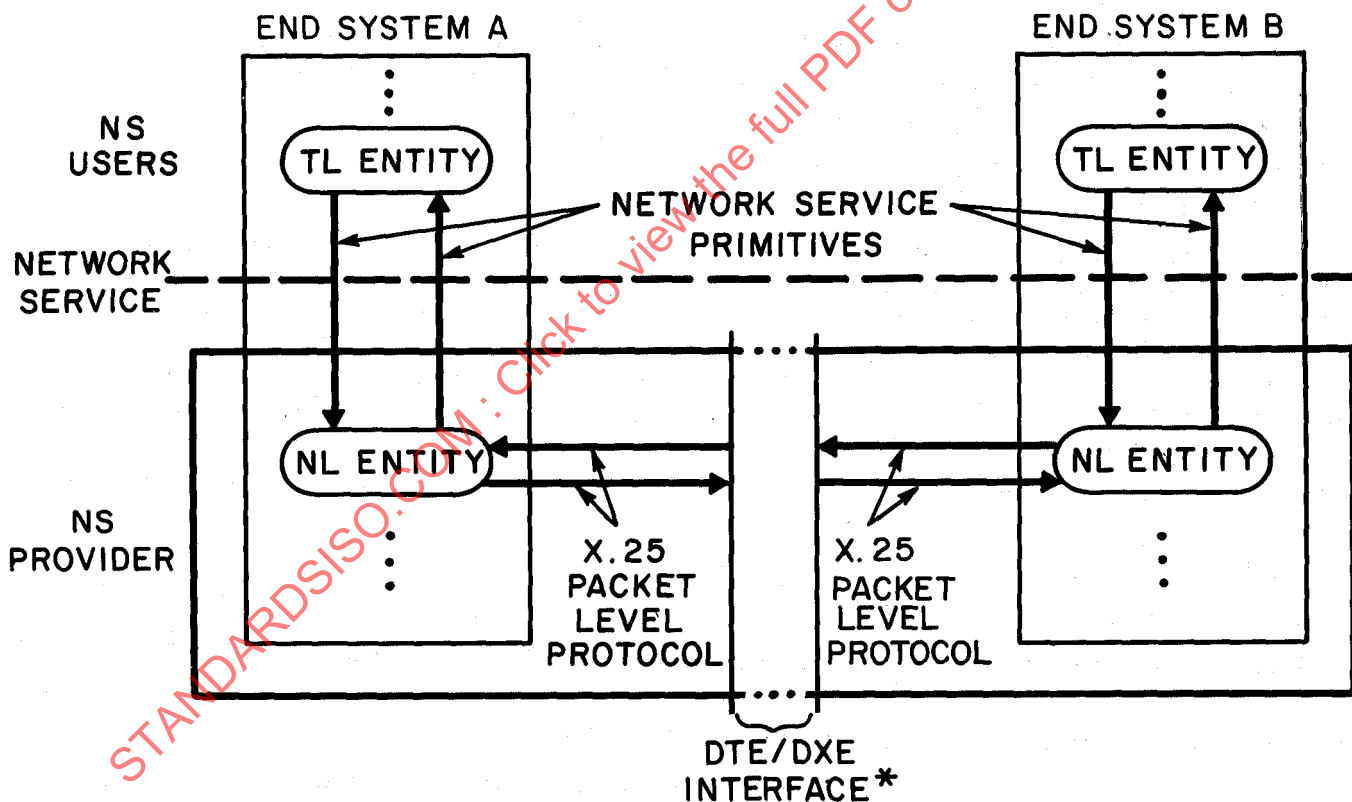
- Transit Delay Selection And Indication (facility used);
- b. CCITT-Specified DTE facilities —
 - Called Address Extension (facility used),
 - Calling Address Extension (facility used),
 - End-to-End Transit Delay Negotiation (facility used),
 - Expedited Data Negotiation (facility used), and
 - Minimum Throughput Class Negotiation (facility used).

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 NL entity in an end system) must provide a translation between

- a. the primitives and parameters of the OSI CONS; and
- b. the packets and associated fields of the X.25/PLP-1984.



* 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 Level 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 C 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 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 LC number used to identify a particular virtual circuit. This relationship is a local matter and is not discussed here.

SECTION TWO: MAPPING THE OSI CONS TO/FROM THE X.25/PLP-1984

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 Network Connection Establishment Phase and the packets/fields associated with the Call Setup Procedures.

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 NSAP addresses

Local operation determines the contents of the NPAI and whether NSAP 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 D describes guidelines for the methods by which the required AF contents may be derived from the NSAP Address. The permitted techniques for the placement of NSAP Addresses in either the AF or AEF are given in this clause. The encoding techniques to be employed are those specified in ISO 8208 for the AF and AEF. The content of these fields shall be in the preferred binary encoding defined in ISO 8348/Add. 2. Examples of encoding NSAP Addresses in the NPAI of the X.25/PLP-1984 are also given in Annex D.

NOTE — The use of the preferred binary encoding results in binary-coded decimal digits in the AF, as required by ISO 8208.

6.2.2.1 Encoding of NSAP addresses

6.2.2.1.1 Use of the AF

Under certain conditions, the NSAP Address, as defined in ISO 8348/Add. 2, may be conveyed entirely in the AF. These conditions are:

- a. the NSAP Address consists solely of the IDP (i.e., the DSP is null);
- b. the AFI can be deduced from the contents of the AF (e.g., with knowledge of the subnetwork to which the DTE is attached); and
- c. the IDI is the same as the SNPA Address.

When all of the above conditions are satisfied, the AF may be used to convey the semantics of the entire NSAP 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).

6.2.2.1.2 Use of the AEF

When the conditions in 6.2.2.1.1 are not satisfied, the AEF shall be used. The NSAP Address, complete with AFI, is placed in the AEF (bits 8 and 7 of the first octet of the FPF of the AEF are both set to zero). In this case,

TABLE 2
CONS:X.25/PLP-1984 MAPPING
FOR THE NETWORK CONNECTION ESTABLISHMENT PHASE

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

NOTES

1. Bit 7 of octet 1 of the GFJ 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.

the contents of the AF are not defined by this International Standard. Guidelines for their derivation are given in Annex D.

6.2.2.2 Decoding of NSAP addresses

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 an OSI NSAP Address is to be deduced from the content of the AF. If this local knowledge indicates that an NSAP 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; and
- c. the DSP is absent.

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 NSAP 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; and
- c. the DSP, if present, constitutes the remainder of the AEF content after any trailing padding digits are discarded.

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 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 is encoded to indicate no use of expedited data; alternatively, the EDN Facility may be 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 (respectively, no use) of Expedited Data," it encodes the EDN Facility in the CALL ACCEPTED packet to indicate use (respectively, no use) of expedited data. If the Expedited Data Selection parameter indicates "no use of Expedited Data," the NL entity may omit the EDN Facility from the CALL ACCEPTED packet.

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 three parameters:

- the throughput for the direction of data transfer from the Calling NS user to the Called NS user;
- the throughput for the direction of data transfer from the Called NS user to the Calling NS user; and
- the transit delay that applies to both directions of data transfer.

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

- a "Target" value, which is the QOS value desired by the Calling NS user;
- a "Lowest Quality Acceptable" value, which is the lowest QOS value agreeable to the Calling NS user;
- an "Available" value, which is the QOS value the NS provider is willing to provide; and
- 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 Throughput Class Negotiation (TCN) Facility and the Minimum Throughput Class Negotiation (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

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

The set of values that can be specified for each Throughput subparameter ranges from 75 bits per second through 48000 bits per second, inclusive. This set consists of the following discrete values: 75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, and 48000 bits per second. An NL entity supports either all of these values or a contiguous subset of them. The value "unspecified" is also allowed.

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 (i.e., the minimum throughput) when specified for both directions of data transfer, then it encodes the Target and Lowest Quality Acceptable values in the TCN and MTCN Facilities, respectively (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 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 MTCN Facility for the corresponding direction(s) of data transfer as 75 bits per second. The TCN and 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, an NL entity compares the minimum throughput value specified in the MTCN Facility for each direction of data transfer to the available throughput value specified in the 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 TCN and MTCN Facilities, respectively, as shown in Table 3.

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 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 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 millisecond through 65 534 milliseconds, inclusive, in increments of 1 millisecond. 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 E 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 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 — According to ISO 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 (but see Note 2 to item (d) below).

- 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); and
- 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).

NOTES

1. Given a "routing 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.
2. Specification of equal transit-delay values for the Target and Least Quality Acceptable does not allow for the transit delay attributable to the NS provider in the called end system (see 6.2.5.2.2 below).

The TDSAI and EETDN Facilities are transmitted across the DTE/DXE interface in a CALL REQUEST packet.

NOTE — 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 computes the total NC transit delay 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; and
- 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 "routing 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

1. the total NC transit delay is less than or equal to the maximum-acceptable transit delay, or

2. 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.

6.2.6 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.

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.

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 Recommendation X.96); on the other hand, a Category D code indicates a problem of a more permanent nature.

TABLE 4
CONS:X.25/PLP-1984 MAPPING
FOR THE NETWORK CONNECTION 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

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 Level 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.

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; and
- 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 follows:

- 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:
 - cause codes "Out Of Order," "Local Procedure Error," "Remote Procedure Error," or "RPOA Out Of Order;"
 - 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:
 - cause code "Network Congestion;"
 - diagnostic codes 113 or 115;
 - 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:
 - 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:
 - 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;"
 - diagnostic codes 121 or 122;
 - 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:
 - cause codes "Network Congestion" or "Number Busy;"
 - diagnostic codes 112-120;
 - cause code "DTE Originated" (coded as all zeros) with a diagnostic code other than those listed above;
- 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 NSAP 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 NSAP 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

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)

the packets/fields associated with the Data Transfer Procedures.

8.2 Procedures

8.2.1 Primitive/Package 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 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).

When an NL entity receives an MBS, 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 may 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.

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

TABLE 7
CONS:X.25/PLP-1984 MAPPING
FOR THE RESET SERVICE

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

NOTES

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.

packets/fields associated with the Reset Procedures.

11.2 Procedures

11.2.1 Primitive/Package 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 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.

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:
 - those awaiting transmission may either be transmitted prior to transmitting a reset packet or flushed from the queue of DATA packets awaiting transmission,
 - those remaining in the transmit window when the Reset Procedure is completed are flushed, and

- 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 value.

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 ISO 8208 correspond to an Originator-parameter value of "NS Provider." The value of the Reason parameter is derived as follows:

- a. "congestion" if any of the following applies:
 - cause code "Network Congestion;"
 - cause code "DTE Originated" (coded as all zeros) and diagnostic 234;
- b. "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 ISO 8208 with any diagnostic code, corresponds to values of both the Originator parameter and the Reason parameter of "Undefined."

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ANNEX A

X.25 (1980) Subnetwork Dependent Convergence Protocol

This annex is an integral part of this International Standard. 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 of this International Standard, are not available to support provision of the OSI CONS.

The integral status of this annex will be reviewed one (1) year after publication.

A.0 Introduction

The 1984 version 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 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.1 Scope**A.1.1 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:

- 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);
- 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; and
- 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.1.2 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. X.25 Fast Select 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.2 Overview of the protocol

A.2.1 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 ISO 8348.

A.2.2 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.2.2.1 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:
 - user data field length need only be the standard length (4.3.2); however, other lengths may be supported,
 - the D-bit is not mandatory; if it is not available, then the Receipt Confirmation Service shall not be available (4.3.3), and
 - 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 (6.2);
- f. flow control packets and reset packets (6.5); and
- g. coding of X.25-subnetwork-generated diagnostics in clear, reset, and restart packets (*Annex E*).

A.2.2.2 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); and
- 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*); and
- d. actions taken by a DCE (*Annex C*).

A.2.2.3 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.3). However, this is not essential, as the Alternative NC Release Procedure can carry the reason as a parameter.

A.2.2.4 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.2.2.5 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); and
- c. D-bit Modification Facility (7.2.6).

A.2.3 Functions provided by the protocol

A.2.3.1 Network Connection Establishment phase

- a. NC Establishment: initial establishment of the NC;
- b. Addressing: conveyance of the Calling and Called NSAP 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; and
- e. User Data: carrying of user data during the NC Establishment Phase.

A.2.3.2 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 NSAP Address;
- c. Originator/Reason: transfer of the location and reason for failure; and
- d. User Data: carrying user data during the NC Release Phase.

A.2.3.3 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; and
- h. Expedited Data: not provided.

A.2.3.4 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; and
- e. Protocol Errors: if an unexpected packet, or a packet with an error in the SND CP parameters, is received, then the protocol specifies the action to be taken.

A.3 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 A.4 and A.5.

A.3.1 Network Connection Establishment phase

This clause describes the protocol support for the N-CONNECT primitives. Table 8 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 SND CP 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.

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 SND CP message code shall be sent.

c. Addressing:

TABLE 8
MAPPING FOR NC ESTABLISHMENT PHASE

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

* These items are not required to directly support the OSI CONS in the X.25 (1980) SND CP.

Local operation determines the contents of the NPAI and whether NSAP Addresses, where explicitly supplied, are mapped to and from the Address Field (AF) or the SND CP Address Extension (AE) parameters. Annex D describes guidelines for the methods by which the required AF contents may be derived from the NSAP Address. The permitted techniques for the placement of NSAP Addresses in the AF are given in 6.2.2.1.1 and 6.2.2.2.1 of the main body of this International Standard, and those for the AE parameters are given in A.4.4.6 of this annex. The content of these fields shall be in the preferred binary encoding defined in ISO 8348/Add. 2.

NOTES

1. The use of the preferred binary encoding results in binary-coded decimal digits in the AF, as required by CCITT Recommendation X.25 (1980).
2. If the Responding Address is not present in a CALL ACCEPTED/CALL CONNECTED packet, then the previous Called NSAP 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.3.5. 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.3.2 Network Connection Release phase

This clause describes the protocol support for the N-DISCONNECT primitives. Table 9 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 9
MAPPING FOR NC RELEASE PHASE

CONS	X.25 / PLP-1980
Primitive N-DISCONNECT request N-DISCONNECT indication	Packet Type CLEAR REQUEST or + DATA(N-DR) CLEAR INDICATION RESTART INDICATION CLEAR REQUEST or + DATA (N-DR) Continuation parameter
Parameters Originator and Reason NS-user-data Responding Address	Fields (including Facility and Additional Parameter Cause and Diagnostic Code Fields or Disconnect Reason Parameter Disconnect Originator Parameter NS-User-Data Parameter 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 10.

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 11.

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 10.
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.3.3 Data Transfer phase

This clause 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 ISO 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:**

TABLE 10
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

TABLE 11
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 or Disconnection — permanent	NS Provider NS Provider
Remote Procedure Error	11	Connection rejection — reason unspecified permanent or Disconnection — permanent	NS Provider 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 or Disconnection — transient	NS Provider NS Provider
Network Congestion	5	Connection rejection — reason unspecified transient or Disconnection — transient	NS Provider NS Provider
Not Obtainable	D	Connection rejection — NSAP address unknown permanent	NS Provider
RPOA Out Of Order	15	Connection rejection — reason unspecified permanent or Disconnection — permanent	NS Provider NS Provider

NOTES

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.

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, it is recommended that the NS provider exercise the option not to provide this optional service.

A.3.4 Network Connection control

This clause 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 12, above, 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 13.

For NS-provider-originated reset requests, the X.25 Resetting Cause and Diagnostic Code Fields are mapped to a reason, as shown in Table 14.

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 ISO 8208. If errors are detected in the SNDP parameters of a received packet or any other error is

TABLE 12
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*, 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

* This item is not required to directly support the OSI CONS in the X.25 (1980) SNDGP.

TABLE 13
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 14
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

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.3.5 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 15.

The set of values that can be specified for each Throughput subparameter ranges from 75 bits per second through 48000 bits per second, inclusive. This set consists of the following discrete values: 75, 150, 300, 600, 1200, 2400, 4800, 9600, 19200, and 48000 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.

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

TABLE 15
MAPPING OF THROUGHPUT QOS SUBPARAMETERS
TO X.25 (1980) FACILITY AND SNDCP PARAMETER

CONS		X.25(1980)/SNDP	
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

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.

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 SNDP. If the Target subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the SNDP 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 SNDP entity. If the Lowest Quality Acceptable subparameter (of either or both of the Throughput QOS parameters) is "unspecified," then the SNDP 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.

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 SNDP 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 SNDP entity cannot support the minimum throughput value, then the SNDP 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 SNDP entity could never support the lowest throughput value (these diagnostics have values 229 and 230, respectively). Otherwise, the SNDP 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. If the TCN Facility is supported, then these values are encoded in the TCN Facility returned in the CALL ACCEPTED packet. If the TCN Facility is not supported, then 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

On 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. If the CALL CONNECTED packet does not have the TCN Facility present, then 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 of this International Standard 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.4.4.7 of this annex.
3. The reference to non-transmission of X.25/PLP-1984 packets in 6.2.5.2 applies in this clause to SNDCP messages.

d. Additional QOS Parameters:

Other QOS parameters are not supported. The Network Service does not require that they be negotiated during the NC Establishment Phase.

A.3.6 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.4.

A.3.7 Network relaying

For an NL relay between two X.25 subnetworks using the X.25 (1980) SDCP 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.3.8 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.4.

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 either the Normal or 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.4.

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.4 Protocol description

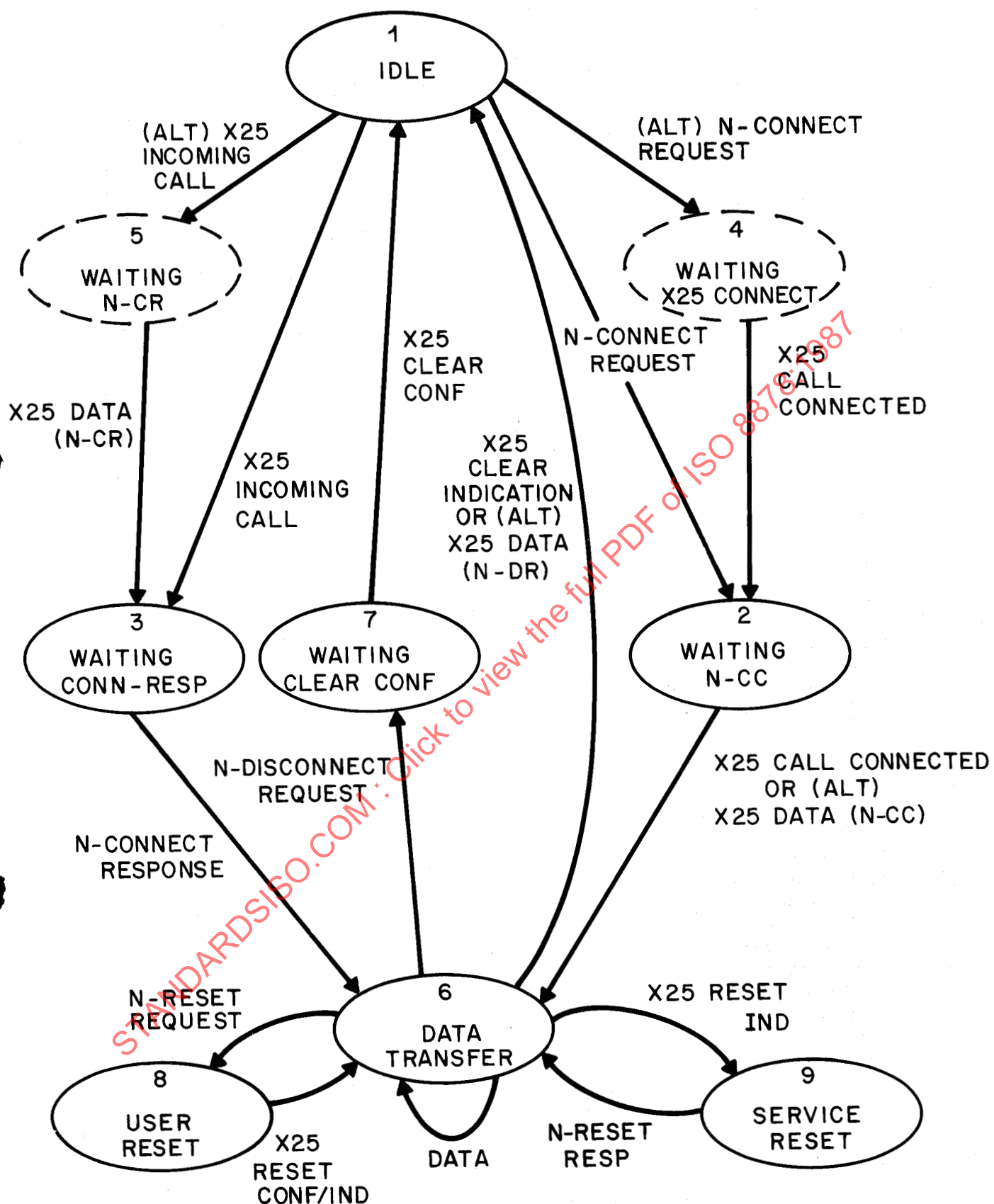
A.4.1 State/Event transitions

The state transition diagram for the X.25 (1980) SNDCP is shown in Figure 3.

The operation of the X.25 (1980) SNDCP is defined by means of two state/event transition tables (Tables 16 and 17). 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; and
- 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.

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

FIGURE 3
State Transition Diagram

TABLE 16
STATE/EVENT TABLE FOR NC ESTABLISHMENT PHASE

STATES	1 IDLE	2 WAITING N-CC	3 WAITING CONN-RESP	4 WAITING X25-CONN
EVENTS	1 2 3 4 5	1 2 3 4 5 6	1 2 3 4 5 6	1 2 3 4
SERVICE PRIMITIVES				
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				
X25 Data (N-CR) (5)				
X25 Clear-Ind		x	x	x
X25 DXE Clear-Conf				
X25 Data (N-DR) (5)				
TIMERS				
Connect Response Timer Expires		x		x
Disconnect Response Timer Expires				
Any Other Valid X.25 Event (excluding RECEIVE READY, RE- CEIVE 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				
X25 Data (N-CR)				x
X25 Call-Acc (F-Sel)			x 4	
X25 Call-Accept				
X25 Data (N-CC)			3 x	
X25 Clear Req		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	6 6 7 1 7 7	2 1 1 7

TABLE 16 (Continued)
STATE/EVENT TABLE FOR NC ESTABLISHMENT PHASE

EVENTS	STATES			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															
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	
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, RE- CEIVE NOT READY, and REJECT)							x					x			x
ACTIONS															
SERVICE PRIMITIVES															
N-CONNECT indication					x										
N-CONNECT confirm															
N-DISCONNECT indication															
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
X25 DTE Clear-Conf						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 17
STATE/EVENT TABLE FOR DATA TRANSFER PHASE

EVENTS	STATES	6 DATA TRANSFER					8 USER RESET				9 SERVICE RESET	
		6	7	8	9	A	1	2	3	4	1	2
SERVICE PRIMITIVES												
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, RE- CEIVE 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											x	
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 16 and 17:

- 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 4, 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 3) 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 16 and the Data Transfer Phase defined by Table 17.

Notes for NC Establishment Phase (Table 16):

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.

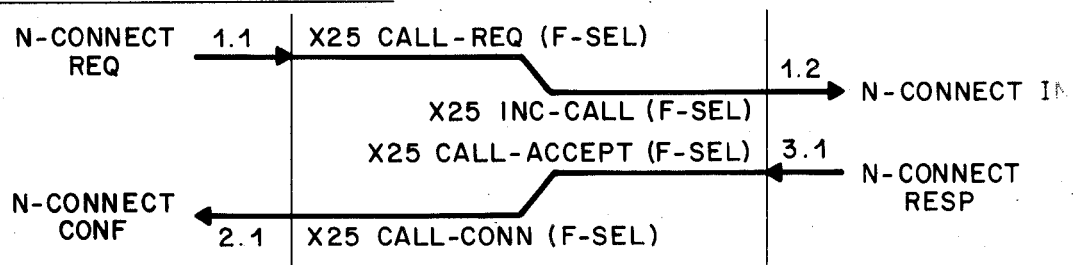
In all cases, the network parameters are then sent to the caller in an N-DR message contained in an MBS (of one or more DATA packets).

5. For received X.25 DATA packets with both the Q- and M-bits set, the X.25 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.

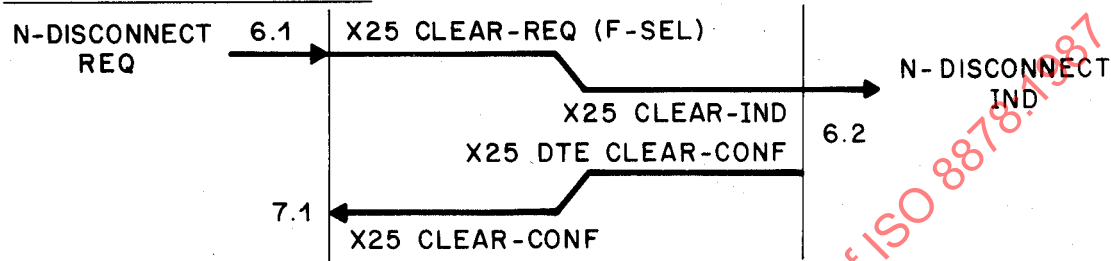
Notes for Data Transfer Phase (Table 17):

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.

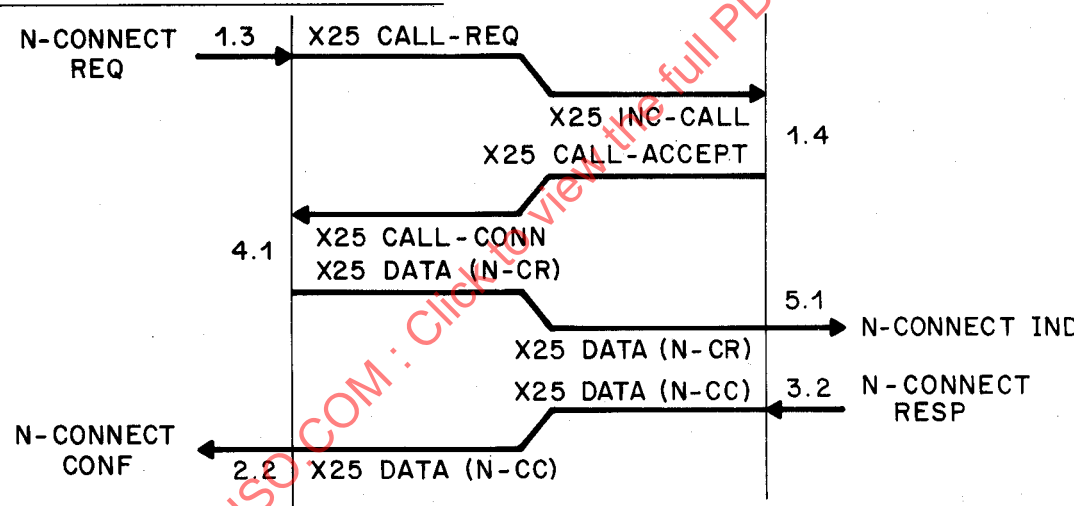
Normal NC Establishment Sequence:



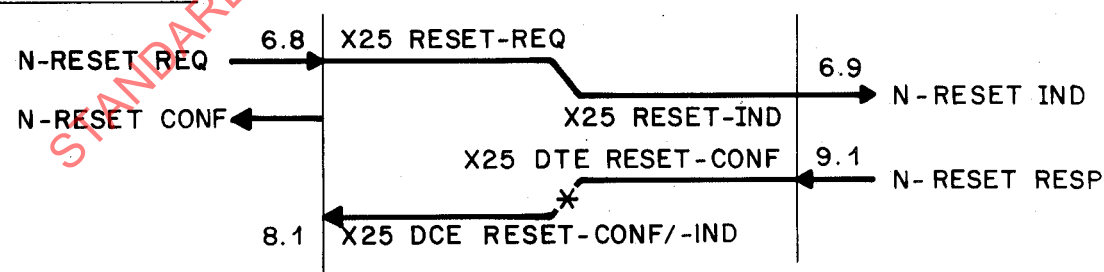
Normal NC Release Sequence:



Alternative NC Establishment Sequence:



Reset Sequence:



* NOTE — Any Reset Procedure initiated by the Network Service Provider at this time is defined to complete this reset sequence.

FIGURE 4
Message Sequence Charts

A.4.2 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.4.4.2) 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.4.3 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.4.4 Parameter descriptions

A.4.4.1 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: or bit:	8 4	7 3	6 2	5 1	Throughput class (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	1200
	1	0	0	0	2400
	1	0	0	1	4800
	1	0	1	0	9600
	1	0	1	1	19200
	1	1	0	0	48000
	1	1	0	1	Reserved
	1	1	1	0	Reserved
	1	1	1	1	Reserved

A.4.4.2 Message code

Message codes are used to identify the type of SDCP 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.4.4.3 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.4.4.4 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 10.

A.4.4.5 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.4.4.6 Address parameters

The Calling Address Extension parameter is used to convey the Calling NSAP Address. The Called Address Extension parameter is used to convey either the Called NSAP Address, when it is present in an X.25 CALL REQUEST packet or in an MBS containing an N-CR message, or the Responding NSAP Address, when it is present in an N-CC or N-DR message.

The various formats of NSAP Addresses are described in ISO 8348/Add. 2.

The detailed encoding rules for NSAP Addresses given in 6.2.2 of this International Standard shall be followed with one modification. The Address Extension Facilities are not available in X.25 (1980) for conveying NSAP Addresses; the Address Extension parameters in the SND CP shall be used for this purpose.

The PV Field of an SND CP 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 NSAP 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 NSAP 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.4.4.7 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 indicates that any transit delay is acceptable for the NC. The optional octets are not present in the CALL ACCEPTED and CALL CONNECTED packets.

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 milliseconds.

A.4.4.8 NS-User-Data

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

A.5 Protocol encoding in X.25 packets

A.5.1 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.5.2 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.5.3 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.5.4 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.5.5 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.5.6 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.5.7 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					
Facilities							
		Protocol ID					
1	0	0	0	0	1	0	0
"Network" Parameters (Note 2)							

Note 3

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.