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Draft for Development

Open Systems Interconnection: use of X.25 to provide the connection-oriented network service (ISO/DP 8878)

Projet à développer. Interconnexion des systèmes ouverts : utilisation du X.25 pour la mise en place d'un service de réseau en mode connexion

Entwurf zur weiteren Ausarbeitung. Verbindung offener Systeme : verbindungsorientierte Vermittlungsdienste für X.25-Netze

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National foreword

This Draft for Development has been prepared under the direction of the Office and Information Standards Committee.

The primary objective of this Draft for Development is to give advance guidance to product and systems designers concerned with the Open Systems Interconnection (OSI) Network Layer.

The text of the Draft for Development is identical with the Draft Proposal ISO/DP 8878 issued February 1985 by the International Organization for Standardization (ISO) (reference ISO/TC 97/SC 6 N 3438).

For ease of reproduction the ISO text has been reproduced unchanged.

The UK has actively participated through BSI Technical Committee OIS/6 in the development of the ISO Draft Proposal. The Technical Committee will review any agreed amendments or addenda to the ISO text and will, where appropriate, update the text of this Draft for Development via an amendment or revision. When the ISO draft reaches an appropriate level of agreement and stability, this Draft for Development may then be converted to a British Standard.

A brief summary of the Network Layer, to assist comprehension of the interrelationship between the various Network Layer publications, is attached as national appendix A.

A Department of Trade and Industry IT Standards Unit Technical Guide, TG 100/1, 'Intercept recommendations for the OSI Network Layer' is currently available from the DTI HQ Library, Room LG37, 1 Victoria Street, London SW1H 0ET.

For information, a list of published British Standards and Drafts for Development (together with those scheduled for publication at the time of publication of this Draft for Development) for OSI and data communications is attached as national appendix B. Press releases for new OSI and data communications British Standard publications will be issued to the computing press, and will be recorded in full in *BSI News*.

Terminology and conventions. The text of the Draft Proposal has been approved as suitable for publication as a Draft for Development without deviation. Some terminology and certain conventions are not identical with those used in Drafts for Development; attention is drawn especially to the following.

Wherever the words 'International Standard' appear, referring to this Draft for Development, they should be read as 'Draft for Development'.

Wherever page numbers are quoted, they are ISO page numbers.

Cross-references

International standards	Corresponding British Standards
ISO 7498-1984	BS 6568 : 1984 Description of basic reference model for open systems interconnection (Identical)

ISO/DP 8509

DD 108* Open Systems Interconnection: service conventions (ISO/DP 8509) (Identical)

ISO/DIS 8208-1984

DD 117 : 1985 Open Systems Interconnection: X.25 packet level protocol for data terminal equipment (ISO/DIS 8208) (Identical)

The Technical Committee has reviewed the provisions of ISO/DIS 8348-1984, ISO/DIS 8348 DAD 2 and CCITT Recommendation X.25, to which reference is made in the text, and has decided that they are acceptable for use in conjunction with this Draft for Development. It is intended to publish ISO/DIS 8348, together with DAD 1 and DAD 2, as a Draft for Development in the near future, subject to the resolution of certain technical problems. A copy of CCITT Recommendation X.25 has been retained at the BSI Library, Milton Keynes, for reference purposes.

Guidance on the possible development of this Draft for Development

This Draft for Development describes the use of X.25 to provide the OSI Connection-oriented Network Service. It consists of three parts.

The main body of the Draft for Development describes the use of X.25 (1984) to provide the OSI Network Service. Although this material may be considered stable, clarification of some points will result in editorial changes. The following sections may be altered:

5.1 : Use of PVCs to Provide the Network Service.

6.2.5.1 : Throughput QOS Parameter.

6.2.5.2 : Transit Delay QOS Parameter.

Annex A specifies a procedure that supplies the Connection-Oriented Network Service, principally by the use of convergence protocol parameters conveyed within X.25 user data fields. As in the main body of the Draft for Development, clarification will be needed in the annex on the use of PVCs to provide the Network Service. The state/event tables given in appendix B of the annex are an essential part of the specification of the convergence protocol. Some descriptive problems encountered in these tables have been overcome, but other changes to the tables are possible while the international standard is under development.

Annex B defines conformance of an implementation to the first two parts of this Draft for Development. It may be refined further while the international standard is under development.

The preferred method of providing the OSI Network Service in an X.25 environment is that defined in the main body of this Draft for Development. However until both public and private packet switched networks support X.25 (1984) facilities, the procedures defined in annex A may be utilized to support the OSI Network Service in X.25 (1980) environments. In the longer term, when X.25 (1984) is generally available, annex A will be removed and annex B will require modification.

* In preparation.

This publication is not to be regarded as a British Standard.

It is being issued in the Draft for Development series of publications and is of a provisional nature because the subject matter is in the process of on-going development within the International Standards Committee (ISO/TC 97, SC6 Telecommunications and Information Exchange between Systems).

It should be applied on this provisional basis, so that information and experience of its practical application may be obtained.

A review of this Draft for Development will be carried out not later than two years after its publication. Notification

of the start of the review period, with a request for the submission of comments from users of this Draft for Development will be made in an announcement in the appropriate issue of *BSI News*. Observations which it is felt should receive attention before the official call for comments will be welcomed.

According to the replies received, the responsible BSI Committee will judge whether the Draft for Development can be converted into a British Standard or what other action should be taken.

0. INTRODUCTION

This document defines two methods for providing the OSI Connection-Oriented 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 document, 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 an annex to this document, defines a Subnetwork Dependent Convergence Protocol that shall be used to provide the OSI CONS over subnetworks or with equipment using the earlier 1980 version of the X.25/PLP. A second annex gives the conformance requirements for equipment providing the OSI CONS by one or more of the methods in this document and defines the possibilities and rules for interworking between such equipment. These annexes are integral parts of this document. 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.

The relationship between the X.25/PLP-1984 and the OSI CONS is shown in Figure 1. This

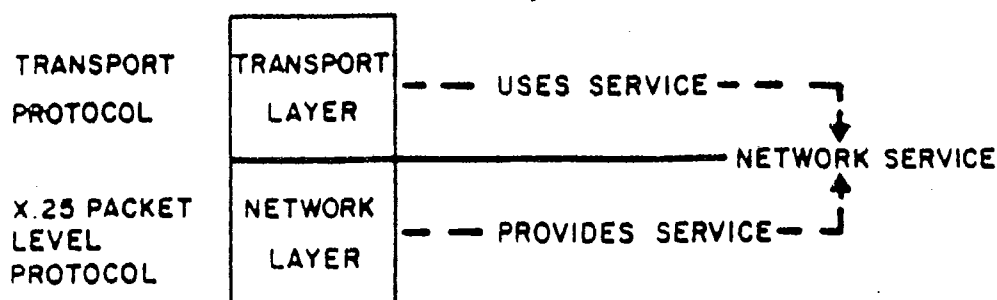


FIGURE 1 RELATIONSHIP OF X.25 PACKET LEVEL PROTOCOL TO THE OSI CONNECTION-ORIENTED NETWORK SERVICE

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:

- the primitive actions and events of the Service;
- the parameters associated with each primitive action and event, and the form which they take; and
- 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:

- procedures for Virtual Calls and Permanent Virtual Circuits;
- formats of packets associated with these procedures; and
- procedures and formats for optional user facilities and CCITT-Specified DTE facilities.

The use of the word "Network" to name the "Network" Layer of the OSI Reference Model should be distinguished from the use of the word "network" to denote a communications network as conventionally

[ISO page 2]

understood. To facilitate this distinction, the term "subnetwork" is used for a collection of physical equipment, commonly called a "network" (Reference IS 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 document 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 a convergence protocol (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 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 the relay operates between two X.25 networks, the two halves of the relay may be the same or different classes of implementation.

This 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 across an X.25(1984) subnetwork.

This Standard also specifies the requirements to be met by a *Conforming-1980* implementation. Implementations in this class are designed to interwork directly with other Conforming-1980 implementations across any form of X.25 subnetwork, but will operate less efficiently than Conforming-1984 implementations across an X.25(1984) subnetwork.

This Standard also specifies the requirements to be met by a *Compatible* implementation. Implementations in this class are designed to interwork directly with all other implementation classes 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 convergence protocol 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 convergence protocol can also be used in other environments to provide the OSI CONS. Examples of such other uses include:

- a. connection of two end-systems by an X.25 packet-switched private data subnetwork; and
- b. direct connection or circuit-switched connection of two end-systems without an intervening packet-switched public data subnetwork.

2. REFERENCES

IS 7498 Information Processing Systems — OSI — Basic Reference Model

[ISO page 3]

This publication is a Draft for Development and is therefore not to be regarded as a British Standard. See page 3.

DP 8509	Information Processing Systems — OSI — Service Conventions
DIS8348	Information Processing Systems — Data Communications — Network Service Definition
DIS8208	Data Communication — X.25 Packet Level Protocol For Data Terminal Equipment
CCITT 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 (Red Book)
DP8348/ DAD2	Information Processing Systems — Data Communications — Addendum to the Network Service Definition Covering Network Layer Addressing

SECTION ONE: GENERAL

3. DEFINITIONS

3.1 Reference Model Definitions

The following concepts, developed and defined in the OSI Reference Model (IS 7498), are used in this document:

- a. Network connection;
- b. Network Layer;
- c. Network Service;
- d. Network Service access point;
- e. Network Service access point address; and
- 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 (DP 8509), are used in this document:

- a. Network Service User;
- b. Network Service Provider;
- c. primitive;
- d. request;
- e. indication;
- f. response; and
- g. confirm.

3.3 Network Service Definitions

The following terms, as defined in the Network Service (DIS 8348), are used in this document:

- a. Calling Network Service user; and
- b. Called Network Service user.

3.4 X.25 Definitions

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

- a. virtual circuit;
- b. Virtual Call;
- c. Permanent Virtual Circuit;

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- d. logical channel;
- e. packet-switched data networks (subnetworks);
- f. Packet Level;
- g. Data Terminal Equipment;
- h. Data Circuit-terminating Equipment; and
- i. DXE (either a DTE or a DCE).

4. ABBREVIATIONS

4.1 Network Service Abbreviations

CONS	Connection-Oriented 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 X.25 Abbreviations

DCE	Data Circuit-terminating Equipment
DTE	Data Terminal Equipment
GFI	General Format Identifier
LC	Logical channel
MBS	M-bit Sequence
PLP	Packet level protocol
P(R)	Packet receive sequence number
PVC	Permanent Virtual Circuit
VC	Virtual Call

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 DIS 8208, provides a specific realization for the transparent transfer of data between NS users of the CONS. The elements of this protocol to be considered are:

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

Of the two types of virtual circuits defined in DIS 8208, the use of Virtual Calls (VCs) to support the OSI CONS is described here. The relationship between the "static" nature of a Permanent Virtual Circuit (PVC) and the "dynamic" nature of a network connection needs further consideration. Alternative approaches regarding the applicability of PVCs to the OSI CONS that need further consideration include:

- a. whether there is a need in the Network Service for a network connection without a connection-establishment phase and a connection-release phase;

[ISO page 5]

- b. whether PVCs are a feature of X.25 additional to the OSI CONS;
- c. whether connection establishment may be considered to be an administrative procedure in the case of a PVC (i.e., permanently associate NSAP addresses, QOS parameters, etc. with the PVC); or
- d. definition of a protocol for use in the PVC case to carry the necessary connection-establishment and connection-release information to allow "dynamic" association of a PVC with a network connection.

The table below lists the packets and associated fields 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
CLEAR REQUEST CLEAR INDICATION	Clearing Cause Code Field, Diagnostic Code Field, Address Field, Facility Field, Clear User Data Field
DATA	D-bit, M-bit, P(R), User Data Field
INTERRUPT	Interrupt User Data Field
RECEIVE READY ⁴ RECEIVE NOT READY ⁴ REJECT ⁴ (if agreed to)	P(R)
RESET REQUEST RESET INDICATION	Resetting Cause Code Field, Diagnostic Code Field
RESTART INDICATION	Restarting Cause Code Field, Diagnostic Code Field

[ISO page 6]

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TABLE 1 (Continued)

PACKETS AND FIELDS OF THE X.25/PLP-1984
USED TO SUPPORT THE OSI CONS**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. 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, it is also necessary for the following optional user facilities and CCITT-Specified DTE facilities to be used and/or agreed to:

a. optional user facilities —

- Fast Select (facility used),
- Fast Select Acceptance (facility agreed to),
- 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

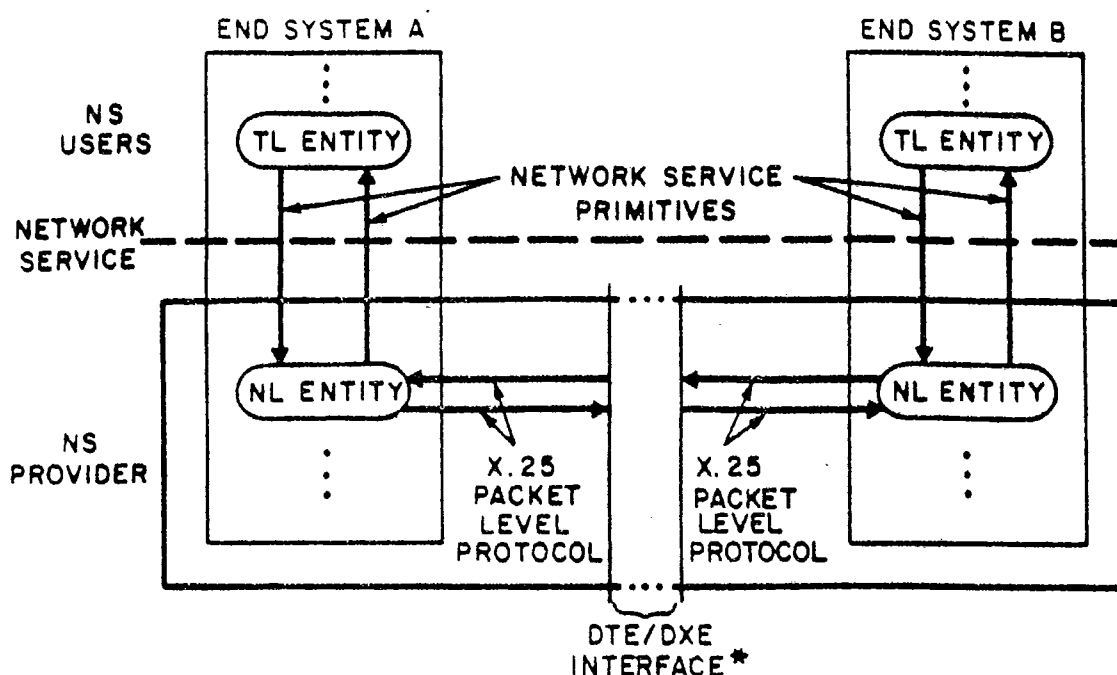
The X.25/PLP-1984 can be used to support the OSI CONS when operating in a public or private X.25 packet-switched network environment. It can also be in environments where the two end-systems are connected by a dedicated path or by a circuit-switched connection. However, the meaning of the Transit Delay QOS parameter in these cases requires further study.

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

[ISO page 7]

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



*THIS INTERFACE CONSISTS OF 0 OR MORE NETWORK LAYER ENTITIES PROVIDING A NETWORK LAYER RELAY FUNCTION

FIGURE 2 OPERATION OF OSI CONNECTION-ORIENTED 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.

TEMP-NOTE: The Network Service Definition specifies valid sequences of primitives at a 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 police compliance and, if so, the NL entity actions to be taken on non-compliance need to be decided.

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. CONNECTION ESTABLISHMENT PHASE

6.1 Primitive/Parameters and Packet/Field Relationships

Table 2 shows the relationships between the primitives/parameters used during the Connection Establishment Phase and the packets/fields associated with the Call Setup Procedures.

TABLE 2
CONS: X.25/PLP-1984 MAPPING
FOR THE 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

[ISO page 9]

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

NOTES:

1. Bit 7 of octet 1 of the GFI in call setup packets is used to negotiate the overall availability of the D-bit in support of the Receipt Confirmation Service. As such, this bit has no specific field-name as defined in the X.25/ PLP-1984.
2. For proper operation, this optional user facility must also be agreed to for use on the interface.
3. For proper operation, the Fast Select Acceptance Facility must also be agreed to on the interface.

.

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 Addresses

Local operation determines the contents of the Address Fields and whether NSAP addresses, where explicitly supplied, are mapped to/ from one of the following in X.25/ PLP-1984 call setup packets:

- a. the Address Fields;
- b. the Address Extension Facilities; or
- c. both the Address Fields and the Address Extension Facilities.

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 Clauses 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 signalled to the 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 signalled 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).

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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 signalled to the Calling NS user.

6.2.4 Expedited Data Selection

The Expedited Data Negotiation 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 Expedited Data Negotiation 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 Expedited Data Negotiation Facility is encoded to indicate no use of expedited data.

When an NL entity receives an INCOMING CALL packet with the Expedited Data Negotiation 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 signalled to the NS user. Otherwise, if the Expedited Data Selection 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 signalled 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 Expedited Data Negotiation Facility in the CALL ACCEPTED packet to indicate use (respectively, no use) of expedited data.

When an NL entity receives a CALL CONNECTED packet with the Expedited Data Negotiation 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 signalled to the Calling NS user.

6.2.5 QOS Parameter Set

6.2.5.1 Throughput QOS Parameter

The Throughput Class Negotiation Facility and the Minimum Throughput Class Negotiation Facility of the X.25/ PLP-1984 are mapped to/ from the Throughput QOS parameter of N-CONNECT primitives.

If an NL entity, when receiving an N-CONNECT request primitive, cannot support the minimum-acceptable throughput specified in the Throughput QOS parameter for either direction of data transfer, then it rejects the request. Otherwise, it encodes the target throughput value for both directions of data transfer in the Throughput Class Negotiation Facility and encodes the minimum-acceptable throughput value for both directions of data transfer in the Minimum Throughput Class Negotiation Facility. This information is transmitted across the DTE/ DXE interface in a CALL REQUEST packet.

TEMP-NOTE: Further study is needed to define the operation of the protocol when no negotiation of throughput is performed and default values apply.

When receiving an INCOMING CALL packet, an NL entity compares the minimum-acceptable throughput value specified in the Minimum Throughput Class Negotiation Facility for each direction of data transfer to the available throughput value specified in the Throughput Class Negotiation Facility. If, for either direction, the available throughput value is less than the minimum-acceptable value or if the NL entity cannot support the minimum-acceptable value, then it clears the call (i.e., transmits a CLEAR REQUEST packet) with the cause "DTE Originated" and the diagnostic "Connection Rejection — Requested Quality of Service Not Available (Transient Condition)," or "Connection Rejection — Requested Quality of Service Not Available (Permanent Condition)" if it could never support the minimum-acceptable value. (These diagnostics have values 229 and 230, respectively.) Otherwise, the

NL entity indicates, for both directions of data transfer, the minimum-acceptable throughput value and the available throughput value in the Throughput QOS parameter of the N-CONNECT indication primitive signalled to the Called NS user.

When an NL entity receives an N-CONNECT response primitive, it encodes the throughput values selected by the NS user for both directions of data transfer, as specified in the Throughput QOS parameter, in the Throughput Class Negotiation Facility returned in the CALL ACCEPTED packet.

When an NL entity receives a CALL CONNECTED packet, it indicates the throughput values for both directions of data transfer, as specified in the Throughput Class Negotiation Facility, in the "selected" values of the Throughput QOS parameter signalled to the Calling NS User.

6.2.5.2 Transit Delay QOS Parameter

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

If an NL entity, when receiving an N-CONNECT request primitive, cannot support the maximum-acceptable transit delay, if specified in the Transit Delay QOS parameter, then it rejects the request. Otherwise, it specifies a transit delay value in the Transit Delay Selection And Indication Facility. It also encodes, in the End-to-End Transit Delay Negotiation Facility, the cumulative transit delay attributable to the NS provider in the calling end-system (i.e., the Network Layer entity itself and all lower-level entities), including the effects of the access line transmission rate. The NL entity also encodes the target transit delay, if specified, and the maximum-acceptable transit delay, if specified, in the End-to-End Transit Delay Negotiation Facility. This information is transmitted across the DTE/DXE interface in a CALL REQUEST packet.

NOTE: The relationship of the value of the Transit Delay Selection And Indication Facility in a CALL REQUEST packet to the desired or maximum-acceptable transit delay specified in the N-CONNECT request primitive is not constrained. The value in the CALL REQUEST packet only 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.

TEMP-NOTE: Further study is needed to define the operation of the protocol when no negotiation of transit delay is performed and default values apply.

When receiving an INCOMING CALL packet, an NL entity computes the total transit delay for the NC by summing the values of:

- a. the Transit Delay Selection And Indication Facility, if present;
- b. the cumulative transit delay indicated in the End-to-End Transit Delay Negotiation Facility; and
- c. the transit delay attributable to the NS provider in the called end-system (i.e., the Network Layer entity itself and all lower-level entities), including the effects of the access line transmission rate.

If this sum is greater than the maximum-acceptable transit-delay value, then it clears the call (i.e., transmits a CLEAR REQUEST packet) with the cause "DTE Originated" and the diagnostic "Connection Rejection — Requested Quality of Service Not Available (Transient Condition)," or "Connection Rejection — Requested Quality of Service Not Available (Permanent Condition)" if it could never support the maximum-acceptable value. (These diagnostics have values 229 and 230, respectively.) Otherwise, the NL entity indicates the maximum-acceptable transit-delay value and the available transit-delay value in the Transit Delay QOS parameter of the N-CONNECT indication primitive signalled to the Called NS user.

When an NL entity receives an N-CONNECT response primitive, it encodes the transit-delay value selected by the NS user, as specified in the Transit Delay QOS parameter, in the cumulative delay of the End-to-End Transit Delay Negotiation Facility returned in the CALL ACCEPTED packet.

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TEMP-NOTE: The Network Service Definition specifies that the called NS user selects a value for transit delay between the "available" QOS value and the "lowest-acceptable" QOS value. Since transit delay is the delay between NC endpoints, the only valid "selected" value is the "available" value. Thus, there is no need for the "selected" value of transit delay to be indicated in the N-CONNECT response primitive as the NL entity already knows the value. This needs to be resolved.

When an NL entity receives a CALL CONNECTED packet, it indicates the transit-delay value, as specified in the cumulative delay of the End-to-End Transit Delay Negotiation Facility, in the "selected" values of the Transit Delay QOS parameter signalled 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 and the Called User Data Field of X.25/ PLP-1984 CALL ACCEPTED and CALL CONNECTED packets are used to transfer the NS-User-Data between NS users. In addition, the Fast Select Facility must be indicated in the CALL REQUEST packet sent by the Calling NL entity.

7. CONNECTION RELEASE PHASE

7.1 Primitive/Parameter and Packet/Field Relationships

Table 3 shows the relationships between the primitives/ parameters used during the Connection Release Phase and the packets/ fields associated with the Call Clearing Procedures.

TABLE 3
CONS: X.25/PLP-1984 MAPPING
FOR THE 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 Code and Diagnostic Code Fields ³ Clear User Data Called DTE Address Field Called Address Extension Facility

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TABLE 3 (Continued)

**CONS: X.25/PLP-1984 MAPPING
FOR THE CONNECTION RELEASE PHASE**

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 Code and Diagnostic Code Fields are then treated in the same manner as the Clearing Cause Code and Diagnostic Code Fields.
2. See Clause 7.2.1, Paragraph 2.
3. The combination of Cause Code and Diagnostic Code Fields is mapped to/ from the combination of Originator and Reason parameters.

.

7.2 Procedures**7.2.1 Primitive/ Packet Mapping**

When an NL entity receives an N-DISCONNECT request primitive from an NS user, it transmits a CLEAR REQUEST packet across the DTE/ DXE interface. If, however, the NL entity had previously transmitted a CLEAR REQUEST packet and signalled 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.

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 Code (or Restarting Cause Code) and the 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.

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The cause code "DTE Originated" (coded as all zeros) used in combination with diagnostic codes other than those listed above, as well as any other cause codes, corresponds to an Originator-parameter value of "NS Provider." In the case of the cause code "DTE Originated," there is a one-to-one relationship between the values of Reason parameter and diagnostic codes 225-232. In other cases, the Reason parameter depends on:

- a. the cause and/ or diagnostic codes; and
- b. whether the NC is in the Connection Establishment Phase or the Data Transfer Phase.

The value for the Reason parameter is derived as follows:

- a. "disconnection — permanent condition" when the NC is in the Data Transfer Phase and any of the following applies:
 - cause codes "Out Of Order," "Remote Procedure Error," or "FPOA Out Of Order;"
 - diagnostic code 122;
- b. "disconnection — transient condition" when the NC is in the Data Transfer Phase and any of the following applies:
 - cause codes "Local Procedure Error" or "Network Congestion;"
 - diagnostic codes 113 or 115;
 - cause code "DTE Originated" with diagnostic codes 162 or 163;
- c. "connection rejection — NSAP address unknown (permanent condition)" when the NC is in the Connection Establishment Phase and any of the following applies:
 - cause codes "Not Obtainable" or "Ship Absent;"
- d. "connection rejection — reason unspecified/ permanent condition" when the NC is in the Connection 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," "Remote Procedure Error," "Reverse Charging Acceptance Not Subscribed," or "FPOA Out Of Order;"
 - diagnostic codes 121 or 122;
 - cause code "DTE Originated" with diagnostic code 164
- e. "connection rejection — reason unspecified/ transient condition" when the NC is in the Connection Establishment Phase and any of the following applies:
 - cause codes "Local Procedure Error," "Network Congestion," or "Number Busy;"
 - diagnostic codes 112-120;
 - cause code "DTE Originated" with a diagnostic code other than those listed above.

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 one of the following in X.25/ PLP-1984 call clearing packets:

- a. the Address Fields;

- b. the Address Extension Facilities; or
- c. both the Address Fields and the Address Extension Facilities.

8. DATA TRANSFER PHASE — DATA TRANSFER SERVICE

8.1 Primitive/Parameter and Packet/Field Relationships

Table 4 shows the relationships between the primitives/parameters used for the Data Transfer Service and the packets/fields associated with the Data Transfer Procedures.

TABLE 4
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

.....

8.2 Procedures

8.2.1 Primitive/ Packet Mapping

When an NL entity receives an N-DATA request primitive from an NS user, it transmits a sequence of one or more DATA packets, known as an M-bit Sequence (MBS), across the DTE/ DXE interface. The number of DATA packets needed in an MBS depends on the amount of NS-User-Data and on the maximum packet size 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 Clause 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). The NL entity uses a locally-defined mechanism to associate N-DATA request primitives with DATA packet sequence numbers to be able to return the corresponding N-DATA ACKNOWLEDGE indication primitive to the NS user (see Clause 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). The NL entity uses a locally-defined mechanism to associate N-DATA indication primitives and subsequently-returned N-DATA ACKNOWLEDGE request primitives with DATA packet sequence numbers.

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 Clause 8.2.3 for associating N-DATA ACKNOWLEDGE request primitives with DATA packet sequence numbers to determine a P(R) to be transferred in the appropriate packet across the DTE/DXE interface. (Note that such acknowledgements must be issued in the same order that the corresponding N-DATA indications were issued.)

When an NL entity receives a P(R), it uses its locally-defined mechanism mentioned in Clause 8.2.3 for associating N-DATA request primitives with DATA packet sequence numbers to determine whether the P(R) is inclusive of a DATA packet that had had its D-bit set to 1. If such an association is made, then the NL entity signals an N-DATA ACKNOWLEDGE indication primitive to the NS user.

10. DATA TRANSFER PHASE—EXPEDITED DATA TRANSFER SERVICE

10.1 Primitive/Parameter and Packet/Field Relationships

Table 5 shows the relationships between the primitives/parameters used for the Expedited Data Transfer Service and the packets/fields associated with the Interrupt Transfer Procedures.

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.

NOTE: A NL entity may 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.

TABLE 5
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

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10.2.2 NS-User-Data

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

11. DATA TRANSFER PHASE—RESET SERVICE

11.1 Primitive/Parameter and Packet/Field Relationships

Table 6 shows the relationships between the primitives/ parameters used for the Reset Service and the packets/ fields associated with the Reset Procedures.

11.2 Procedures

11.2.1 Primitive/ Packet Mapping

When an NL entity receives an N-RESET request primitive from an NS user, it transmits a RESET REQUEST packet across the DTE/ DXE interface and signals an N-RESET confirm primitive to the NS user. When an NL entity signals the N-RESET confirm primitive, it indicates that it is 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.

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 and signals an N-RESET Indication primitive to the NS user.

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 must 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:

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TABLE 6
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 Code and Diagnostic Code Fields ²

NOTES:

1. See Clause 11.2.1, Paragraph 2.
2. The combination of Cause Code and Diagnostic Code Fields is mapped to/ from the combination of Originator and Reason parameters.

.....

a. For DATA packets:

- those awaiting transmission may either be transmitted prior to transmitting a reset packet or are 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 a 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 must 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 Code and Diagnostic Code Fields.

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The combination of the cause code "DTE Originated" (coded as all zeros) with the diagnostic "Reset — 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 and diagnostic codes 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" and diagnostic 234;
- b. "reason unspecified" for any other combination of cause and diagnostic codes.

ANNEX A

X.25 (1980) NETWORK CONVERGENCE PROTOCOL

This annex forms an integral part of this Standard and is subject to periodic review.

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0. INTRODUCTION

The 1984 version of CCITT Recommendation X.25 contains adequate mechanisms to enable the provision of the ISO Connection-Oriented Network Service over X.25 subnetworks. Until such time as all public and private packet-switched X.25 data networks conform to the 1984 version, and all existing X.25 DTEs are upgraded, there is a need for a method of providing the Connection-Oriented Network Service over the X.25 (1980) subnetwork access protocol.

This annex specifies a procedure that supplies the Connection-Oriented Network Service, principally by the use of convergence protocol 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 networks and DTEs.

1. SCOPE AND FIELD OF APPLICATION

1.1 Scope Of This Annex

This annex specifies a subnetwork dependent convergence protocol to offer the ISO Connection-Oriented Network Service over an X.25 subnetwork service. The convergence protocol is applicable in the following cases :-

- When the X.25 service does not support the full Network Service (that is when the X.25 service conforms to the 1980 recommendation or earlier).
- When the resulting service for a concatenation of X.25 subnetworks only conforms to the 1980 recommendations, even when one or more of the subnetworks conform to later X.25 recommendations.
- When the X.25 subnetwork conforms to a CCITT recommendation later than 1980, but when the calling or called DTE only implements the 1980 recommendation.

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