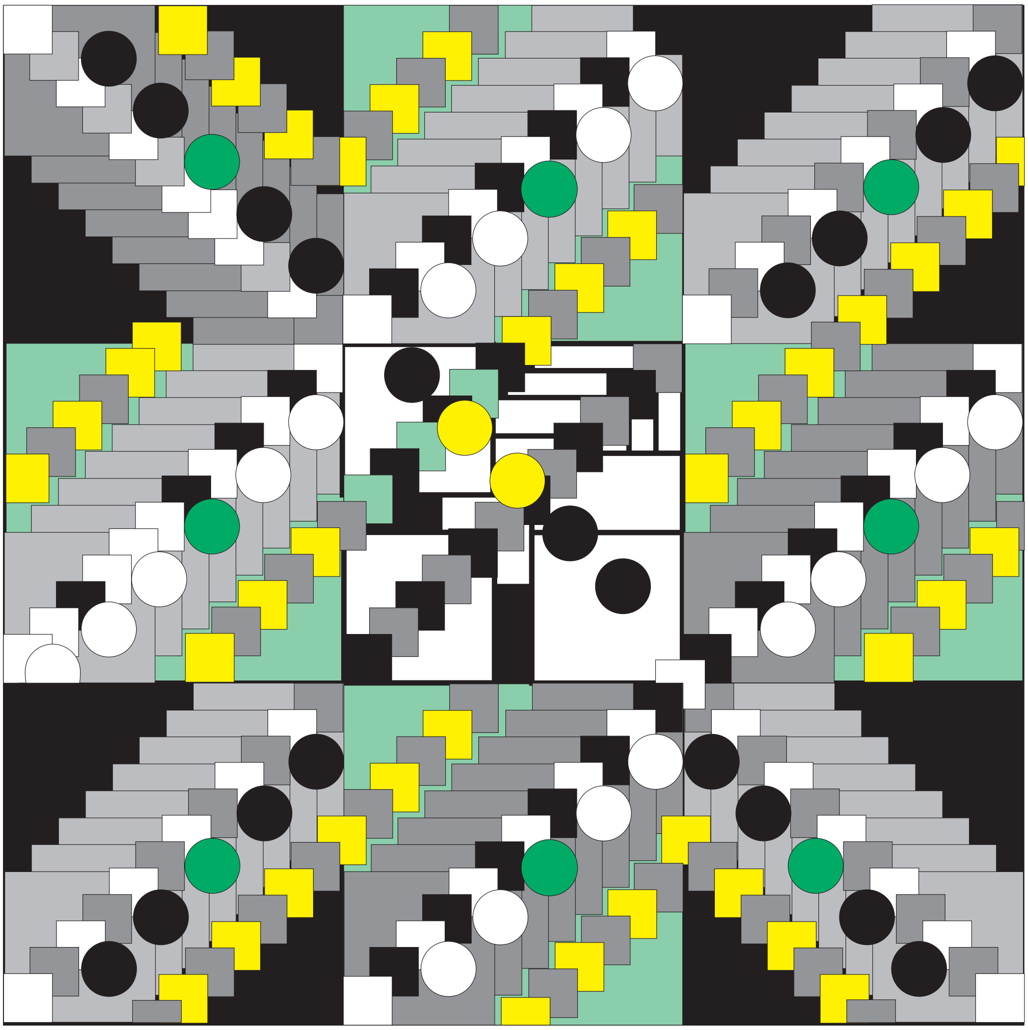
2220 Nways BroadBand Switch
Models 300, 500, and 501

Planning Series

X.25 Interface Specifications



GA33-0413-00

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Note!

This booklet is part of the *2220 Nways BroadBand Switch Physical Lines Interface Specifications*, GA33-0379. Before using the information given in this booklet, be sure to read the general information and notices. The abbreviations and glossary are also in the *Physical Lines Interface Specifications*.

First Edition (November 1996)

The information contained in this booklet is subject to change from time to time. Any such changes will be reported in subsequent revisions.

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Generalities

This book describes the logical interface (layer 2) of the X.25 DCE access agent of the IBM 2220 Nways BroadBand Switch. It is intended for service network providers who wish to evaluate and plan connections between DTEs through an NBBS network.

About the X.25 Interface

This book describes the interface that a network based on the Nways Switch provides for attachment of data terminal equipment (DTE).

X.25 DTEs can be attached to the Low-Speed Adapter Type 3 (LSA3) of the Nways Switch.

For synchronous, packet-mode attachments, the interface is based on the ITU-T Recommendation X.25.

The packet-mode DTE interface provided by the Nways Switch is based on the *1988 version of ITU-T Recommendation X.25,* but maintains compatibility with the 1980 and 1984 versions.

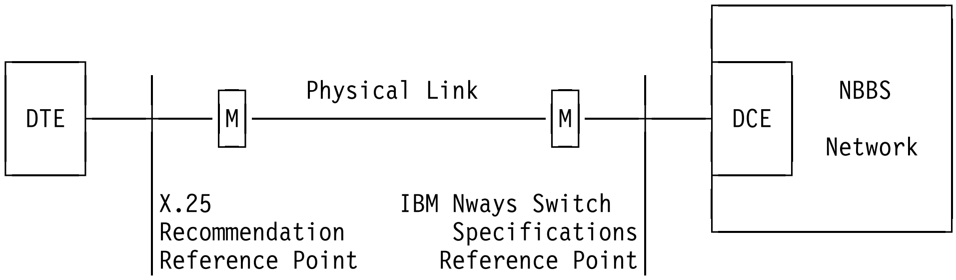
It also supports compatibility with the 1992 version.

Note:

- In this part, portions of ITU-T Recommendation X.25 (Melbourne, November 1988) from the ITU-T VIIIth Plenary Assembly Blue Book, Volume VIII - Fascicle VIII.2 are reproduced, according to the ITU-T copyright notice.
- The ITU-T paragraph numbering has been used to facilitate comparison with the ITU-T Recommendation, which is the authoritative source.

  IBM has made every effort to accurately reproduce the ITU-T Recommendation X.25. However, errors may have been introduced inadvertently. To ensure complete accuracy, you should obtain the Recommendation directly from ITU-T.
- ***Changes to the ITU-T Recommendations, especially Nways Switch-specific text, are indicated by a vertical line in the left margin.***
- Sections of the ITU-T text not applicable to the Nways Switch (such as additional facilities not implemented), are marked "not applicable to the Nways Switch".

A major difference from Recommendation X.25 is that the Nways Switch specifications exclude the physical attachment of DTEs to the Nways Switch nodes. The Nways Switch specifications apply to the junction with the Nways Switch physical port as shown in the following figure:



Note: This example shows an access link with an analog transmission line and a pair of modems (M). The access link can also be a non-switched digital circuit with an X.21 interface.

Overview of the Nways Switch X.25 Functions

The Nways Switch X.25 interface:

- Allows X.25 DTEs to connect through leased lines to an NBBS network
- Supports *Switched virtual circuits* (SVCs)
- Supports the basic mode (modulo 8) operation.

DTEs based on the 1992, 1988, 1984 or 1980 version of the Recommendation can be attached to a Nways Switch node and can communicate through SVCs or PVCs with DTEs based on version 1980, 1984, 1988, or 1992 of X.25.

DTEs can communicate with DTEs attached to the same Nways Switch, or to another Nways Switch.

DTEs can be attached to Nways Switch nodes by non-switched (leased) lines. This manual specifies only the interface for the DTEs attached to a Nways Switch node. However, addressing conventions for communicating with DTEs attached to PSDNs are described in 5.8, "Nways Switch Address Formats" on page 5-28.

Terms and Conventions

In this manual, some ITU-T terms are used that need further explanation, and some ITU-T conventions are used that differ from normal IBM terms and conventions:

- For "virtual call" understand "switched virtual circuit".
- For "network" understand a collection of communicating Nways Switches inside a single addressing scheme (NBBS network).
- For "Administration" understand "network service provider".
- For "subscription" understand the procedure defined by the network service provider to install DTE access links and set the DTE/DCE subscription parameters to consistent values.
- For "octet" read "byte".
- The ITU-T numbering of bits and bytes is used for the description of frames and packets. This numbering is different from the one normally used in IBM documentation.

Part 1. 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

(Geneva, 1976, amended at Geneva, 1980
Malaga-Torremolinos, 1984 and Melbourne, 1988)

The establishment in various countries of public data networks providing packet-switched data transmission services creates a need to produce standards to facilitate international interworking.

The ITU-T, considering:

a. That Recommendation X.1 includes specific user classes of service for data terminal equipments operating in the packet mode, Recommendation X.2 defines user facilities, Recommendation X.10 defines categories of access, Recommendations X.21 and X.21 *bis* define DTE/DCE physical level interface characteristics, Recommendation X.92 defines the hypothetical reference connections for packet-switched data transmission service and Recommendation X.96 defines *call progress* signals;

b. That data terminal equipments operating in the packet mode will send and receive network control information in the form of packets;

c. That certain data terminal equipments operating in the packet mode will use a packet interleaved synchronous data circuit;

d. The desirability of being able to use a single data circuit to a Data Switching Exchange (DSE) for all user facilities;

e. That Recommendation X.2 designates virtual call and permanent virtual circuit services as essential (E) services to be provided by all networks;

f. The need for defining an international Recommendation for the exchange between DTE and DCE of control information for the use of packet-switched data transmission services;

g. That this definition is made in Recommendation X.32 with regard to the access through a public switched telephone network, an integrated services digital network (ISDN), or a circuit switched public data network;

h. That Recommendation X.31 defines the support of packet-mode terminal equipment by an integrated services digital network (ISDN);

i. That, when this Recommendation is used to provide the Network service defined in Recommendation X.213, the physical, link and packet levels correspond to the Physical, Data link and Network layers respectively, as defined in Recommendation X.200;

j. That this Recommendation includes all the features necessary to support the services included in Recommendation X.213, as well as other features; that Recommendation X.223 defines the use of X.25 packet layer protocol to provide the OSI connection mode Network service;

k. That the necessary elements for an interface Recommendation should be defined independently as:

- *Physical level* - the mechanical, electrical, functional and procedural characteristics to activate, maintain and deactivate the physical link between the DTE and the DCE;
- *Link level* - the link access procedure for data interchange across the link between the DTE and the DCE;
- *Packet level* - the packet formats and control procedures for the exchange of packets containing control information and user data between the DTE and the DCE;

Unanimously declares that for public data networks accessed via dedicated circuits by data terminal equipments operating in the packet mode:

1. The mechanical, electrical, functional and procedural characteristics to activate, maintain and deactivate the physical link between the DTE and the DCE should be as specified in Chapter 1, “DTE/DCE Interface Characteristics (Physical Level)” on page 1-1.
2. The link access procedure for data interchange across the link between the DTE and the DCE should be as specified in Chapter 2, “Link Access Procedure Across the DTE/DCE Interface” on page 2-1.
3. The packet level procedures for the exchange of control information and user data at the DTE/DCE interface should be as specified in Chapter 3, “Description of the Packet Layer DTE/DCE Interface” on page 3-1.
4. The procedures for virtual call and permanent virtual circuit services should be as specified in Chapter 4, “Procedures for Virtual Circuit Services” on page 4-1.
5. The format for packets exchanged between the DTE and the DCE should be as specified in Chapter 5, “Packet Formats” on page 5-1.
6. The procedures for optional user facilities should be as specified in Chapter 6, “Procedures for Optional User Facilities (Packet Level)” on page 6-1.
7. The formats for optional user facilities should be as specified in Chapter 7, “Formats for Facility Fields and Registration Fields” on page 7-1.

Chapter 1. DTE/DCE Interface Characteristics (Physical Level)

Nways Switch nodes offer physical interfaces compatible with the following standards:

- V.24/V.28 non-switched up to 19.2 kbps, internal or external clocking
- EIA-232, non-switched up to 38.4 kbps, internal or external clocking
- X.21 non-switched up to 2 048 kbps (internal or external clocking)
- V.35 non-switched up to 2 048 kbps (internal or external clocking)

The specifications of these interfaces are available in the *2220 Nways BroadBand Switch Physical Lines Interface Specifications*, GA33-0379 for the physical interfaces of the LIC511 and LIC522 Line Interface Cards supporting the Nways Switch line attachments.

The physical interface can be declared locked or unlocked at resource definition time; it can also be locked or unlocked through network operator commands. With the Nways Switch, it is not possible to establish test loops through network operator commands. Test loops can be manually activated (if the modem or the X.21 adapter has the appropriate feature).

1.1 Switched Access Support

This support is limited to connections through the Public Switched Telephone Network (PSTN).

1.1.1 Connecting the Access Line by the DTE

The DTE can connect the switched line if the modem adjacent to the DCE port is equipped with an automatic answering function.

The DCE port, when enabled by the network operator, will turn on circuit 108/1, and wait indefinitely for circuit 107 to be turned ON.

The modem is expected to turn circuit 107 ON when the line is connected.

1.1.2 Disconnecting the Access Line by the DTE

When the line is disconnected by the DTE, the modem adjacent to the DCE port is expected to turn circuit 107 OFF.

1.1.3 Connecting the Access Line by the DCE

The DCE port can connect the line if the modem adjacent to the DCE port is equipped with an automatic calling function.

The DCE port, when enabled by the network operator, will turn ON circuit 108/1, which should cause the modem to connect the line. At completion of the connection, the modem is expected to turn circuit 107 ON.

1.1.4 Disconnecting the Access Line by the DTE

When disabled by the network operator, the DCE port will turn circuit 108/1 OFF, which should cause the modem adjacent to the port to disconnect the line.

1.1.5 Link Access Procedure Considerations

The link access procedure used on switched and non-switched lines are identical:

- The transmission facility is duplex.
- The link level addresses are assigned according to the role of the equipment (DTE or DCE).
- No DTE or DCE identification mechanism is provided.

1.1.6 Packet Level Considerations

The packet level procedure used on switched and non-switched lines are identical:

- No identification mechanism is provided.
- The DTE is assigned the subscriber address(es) and the subscription parameters of the DCE port it is connected to, for the duration of the connection.

Chapter 2. Link Access Procedure Across the DTE/DCE Interface

2.1 Scope and Field of Applications

2.1.1

The Link Access Procedures (LAPB and LAP) are described as the Link Level Element and are used for data interchange between a DCE and DTE over a single physical circuit (LAPB and LAP), or optionally over multiple physical circuits (LAPB), operating in user classes of service 8 to 11 as indicated in Recommendation X.1.

The single link procedures (SLPs) described in 2.2, 2.3, and 2.4 (LAPB) and in 2.2, 2.6, and 2.7 (LAP) are used for data interchange over a single physical circuit, conforming to the description given in 1, between a DTE and a DCE.

2.1.2

The single link procedures (SLPs) use the principles and terminology of the high-level data link control (HDLC) procedures specified by the International Organization for Standardization (ISO).

2.1.3

Each transmission facility is duplex.

2.1.4

DCE compatibility of operation with the ISO balanced classes of procedure (Class BA with options 2, 8, and Class BA with options 2, 8, 10) is achieved using the LAPB procedure described in 2.3, and 2.4 in this Recommendation. Of these classes, Class BA with options 2, 8 (LAPB modulo 8) is the basic service, and is available in all networks.

2.1.5

For those networks that choose to support both the basic and extended sequence numbering services, the choice of either basic mode (modulo 8) or extended mode (modulo 128) may be made at subscription time. The choice of the mode employed for each link procedure is independent of all others and of the choice of mode for the corresponding Packet Level procedures. All choices are matters for agreement for a period of time with the Administration.

The Nways Switch supports the basic mode (modulo 8) only.

2.1.6

The Nways Switch offers only the LAPB procedure.

2.2 Framing Aspects

2.2.1 Introduction

All transmissions on an SLP are in frames conforming to one of the formats of Table 2-1 for basic (modulo 8) operation. The flag preceding the address field is defined as the opening flag. The flag following the FCS field is defined as the closing flag.

2.2.2 Flag Sequence

All frames shall start and end with the flag sequence consisting of one 0 bit following by six contiguous 1 bits and one 0 bit. The DTE and DCE shall only send complete eight-bit flag sequences when sending multiple flag sequence (see 2.2.11). A single flag may be used as both the closing flag for one frame and the opening flag for the next frame.

Table 2-1. X.25 Frame Formats - Basic (Modulo 8) Operation

Bit order of transmission:

12345678	12345678	12345678	16 to 1	12345678
Flag	Address	Control	FCS	Flag
F	A	C	FCS	F
01111110	8-bits	8-bits	16-bits	01111110

FCS Frame Check Sequence

Bit order of transmission:

12345678	12345678	12345678		16 to 1	12345678
Flag	Address	Control	Information	FCS	Flag
F	A	C	Info	FCS	F
01111110	8-bits	8-bits	N-bits	16-bits	01111110

FCS Frame Check Sequence

2.2.3 Address Field

The address field shall consist of one octet. The address field identifies the intended receiver of a command frame and the transmitter of a response frame.

| The coding of the address field is described in 2.4.2 (LAPB).

2.2.4 Control Field

| For modulo 8 (basic) operation the control field shall consist of one octet.

| The content of this field is described in 2.3.2 (LAPB).

2.2.5 Information Field

The information field of a frame, when present, follows the control field (see 2.2.4 above) and precedes the frame check sequence (see 2.2.7 below).

See 2.3.4.9, 2.5.2, 2.6.4.8, and 5 for the various coding and groupings of bits in the information field as used in this Recommendation.

See 2.3.4.9, 2.4.8.5, 2.6.4.8, and 2.7.7.5 below with regard to the maximum information field length.

2.2.6 Invalid Frames

| The definition of an invalid frame is described in 2.3.5.3 (LAPB).

2.2.7 Frame Abortion

Aborting a frame is performed by transmitting at least seven contiguous 1 bits (with no inserted 0 bits).

| The Nways Switch does not perform frame abortion: a frame received by the DTE
| containing at least 7 consecutive bits set to 1 can only result from transmission
| errors.

2.2.8 Link Channel States

A link channel as defined here is the means for transmission for one direction.

2.2.8.1 Active Channel State

The DCE incoming or outgoing channel is defined to be in an active condition when it is receiving or transmitting, respectively, a frame, an abortion sequence or interframe time fill.

2.2.8.2 Idle Channel State

The DCE incoming or outgoing channel is defined to be in an idle condition when it is receiving or transmitting, respectively, a continuous 1 state for a period of at least 15 bit times.

See 2.3.5.5 for a description of DCE action when an idle condition exists on its incoming channel for an excessive period of time.

2.3 LAPB Elements of Procedures

2.3.1 Introduction

The LAPB elements of procedures specified below contain the selection of commands and responses relevant to the LAPB link and system configurations described in 2.1 above. Together, 2.2 and 2.3 form the general requirements for the proper management of an LAPB access link.

2.3.2 LAPB Control Field Formats and Parameters

2.3.2.1 Control Field Formats

The control field contains a command or a response, and sequence numbers where applicable.

Three types of control field formats are used to perform numbered information transfer (I format). Numbered supervisory functions (S format) and unnumbered control functions (U format).

The control field formats for basic (modulo 8) operation are depicted in Table 2-2.

Table 2-2. X.25 LAPB Control Field Formats - Basic (Modulo 8) Operation

Control Field Bits	1	2	3	4	5	6	7	8
I Format	0	N(S)			p	N(R)		
S Format	1	0	S	S	P/F	N(R)		
U Format	1	1	M	M	P/F	M	M	M

```
N(S) Transmitter send sequence number (bit 2=low-order bit)
N(R) Transmitter receive sequence number (bit 6=low-order bit)
S    Supervisory function bit
M    Modifier function bit
P/F  Poll bit when issued as a command, final bit when issued as
     a response (1=Poll/Final)
P    Poll bit (1=Poll)
```

2.3.2.1.1 Information Transfer Format - I The I format is used to perform an information transfer. The functions of N(S), N(R) and P are independent; i.e., each I frame has an N(S) and N(R) which may or may not acknowledge additional I frames received by the DCE or DTE and a P bit that may be set to 0 or 1.

2.3.2.1.2 Supervisory Format - S The S format is used to perform data link supervisory control functions such as acknowledge I frames, request retransmission of I frames, and to request a temporary suspension of transmission of I frames. The functions of N(R) and P/F are independent; i.e., each supervisory frame has an N(R) which may or may not acknowledge additional I frames received by the DCE or DTE, and a P/F bit that may be set to 0 or 1.

2.3.2.1.3 Unnumbered Format - U The U format is used to provide additional data link control functions. This format contains no sequence numbers, but does include a P/F bit that may be set to 0 or 1. The unnumbered frames have the same control field length (one octet) in both basic (modulo 8) operation and extended (modulo 128) operation.***:*** The Nways Switch supports only the modulo 8 mode operation.

2.3.2.2 Control Field Parameters

The various parameters associated with the control field are described below.

2.3.2.2.1 Modulus Each I frame is sequentially numbered and may have the value 0 through modulus minus 1 (where "modulus" is the modulus of the sequence numbers). The modulus equals 8 or 128 and the sequence numbers cycle through the entire range.

2.3.2.2.2 Send State Variable V(S): The send state variable V(S) denotes the sequence number of the next in-sequence I frame to be transmitted. V(S) can take on the value 0 through modulus minus 1. The value of V(S) is incremented by I with each successive I frame transmission, but cannot exceed N(R) of the last received I or supervisory frame by more than the maximum number of outstanding I frames (k). The value of k is defined in 2.4.8.6. below.

2.3.2.2.3 Send Sequence Number N(S) Only I frames contain N(S), the send sequence number of transmitted I frames. At the time that an in-sequence I frame is designated for transmission, the value of N(S) is set equal to the value of the send state variable V(S).

2.3.2.2.4 Receive State Variable V(R) The receive state variable V(R) denotes the sequence number of the next in-sequence I frame expected to be received. V(R) can take on the value 0 through modulus minus 1. The value of V(R) is incremented by 1 by the receipt of an error-free, in-sequence I frame whose send sequence number N(S) equals the receive state variable V(R).

2.3.2.2.5 Receive Sequence Number N(R) All I frames and supervisory frames contain N(R), the expected send sequence number of the next received I frame. At the time that a frame of the above types is designated for transmission, the value of N(R) is set equal to the current value of the receive state variable V(R). N(R) indicates that the DCE or DTE transmitting the N(R) has received correctly all I frames numbered up to and including N(R)-1.

2.3.2.2.6 Poll/Final Bit P/F All frames contain P/F, the Poll/Final bit. In command frames the P/F bit is referred to as the P bit. In response frames it is referred to as the F bit.

2.3.3 Functions of the Poll/Final Bit

The Poll bit set to 1 is used by the DCE or DTE to solicit (poll) a response from the DTE or DCE, respectively. The Final bit set to 1 is used by the DCE or DTE to indicate the response frame transmitted by the DTE or DCE, respectively, as a result of the soliciting (poll) command.

The use of the P/F bit is described in 2.4.3 below.

2.3.4 Commands and Responses

| For basic (modulo 8) operation, the commands and response represented in Table
| 2-3 will be supported by the DCE and the DTE.

Table 2-3. X.25 LAPB Commands and Responses - Basic (Modulo 8) Operation

Format	Command	Response	Encoding 1	2	3	4	5	6	7	8
Information transfer	I (information)		0	N(S)			P	N(R)		
Supervisory	RR (receive ready)	RR (receive ready)	1	0	0	0	P/F	N(R)		
	RNR (receive not ready)	RNR (receive not ready)	1	0	1	0	P/F	N(R)		
	REJ (reject)	REJ (reject)	1	0	0	1	P/F	N(R)		
Unnumbered	SABM (set asynchronous balanced mode)		1	1	1	1	P	1	0	0
	DISC(disconnect)		1	1	0	0	P	0	1	0
		DM (discon-nected mode)	1	1	1	1	F	0	0	0
		UA (unnumbe-red acknowl-edgment)	1	1	0	0	F	1	1	0
		FRMR (frame reject)	1	1	1	0	F	0	0	1

For purposes of the LAPB procedures, the supervisory function bit encoding "11" and those encoding of modifier function bits in Table 2-3 are identified as "undefined or not implemented" command and response control field.

The commands and responses in Table 2-3 are defined as follows.

2.3.4.1 Information (I) Command

The function of the information (I) command is to transfer across a data link a sequentially numbered frame containing an information field.

2.3.4.2 Receive Ready (RR) Command and Response

The receive ready (RR) supervisory frame is used by the DCE or DTE to:

1. Indicate it is ready to receive an I frame
2. Acknowledge previously received I frames numbered up to including N(R)-1.

An RR frame may be used to indicate the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same station (DCE or DTE). In addition to indicating the DCE or DTE status, the RR command with the P bit set to 1 may be used by the DCE or DTE to ask for the status of the DTE or DCE, respectively.

In the absence of traffic on the line, the Nways Switch DCE starts optionally an inactivity timer Ti. Ti timeout causes the Nways Switch DCE to send an RR command, with P bit set to 1. In the absence of an RR response from the DTE, the Nways Switch DCE retransmits the RR command, up to N2 times. When the threshold of N2 retries is reached, the Nways Switch DCE enters the disconnected phase.

This mode of operation is also applicable when the Nways Switch port is configured in DTE mode.

2.3.4.3 Receive Not Ready (RNR) Command and Response

The receive not ready (RNR) supervisory frame is used by the DCE or DTE to indicate a busy condition, i.e., temporary inability to accept additional incoming I frames. I frames numbered up to and including N(R) - 1 are acknowledged. I frame N(R) and any subsequent I frames received, if any, are not acknowledged; the acceptance status of these I frames will be indicated in subsequent exchanges.

In addition to indicating the DCE or DTE status, the RNR command with the P bit set to 1 may be used by the DCE or DTE to ask for the status of the DTE or DCE, respectively.

In the absence of traffic on the line, and when in busy state, the Nways Switch DCE starts optionally an inactivity timer Ti. Ti timeout causes the Nways Switch DCE to send an RNR command, with P bit set to 1. In the absence of an RR response from the DTE, the Nways Switch DCE retransmits the RNR command, up to N2 times. When the threshold of N2 retries is reached, the Nways Switch DCE enters the disconnected phase.

This mode of operation is also applicable when the Nways Switch port is configured in DTE mode.

2.3.4.4 Reject (REJ) Command and Response

The reject (REJ) supervisory frame is used by the DCE or DTE to request transmission of I frames starting with the frame numbered N(R). I frames numbered N(R) - 1 and below are acknowledged. Additional I frames pending initial transmission may be transmitted following the retransmitted I frame(s).

Only one REJ exception condition of information transfer may be established at any time. The REJ exception condition is cleared (reset) upon the receipt of an I frame with an N(S) equal to N(R) of the REJ frame.

An REJ frame may be used to indicate the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same station (DCE or DTE). In addition to indicating the DCE or DTE status, the REJ command with the P bit set to 1 may be used by the DCE or DTE to ask for the status of the DTE or DCE, respectively.

2.3.4.5 Set Asynchronous Balanced Mode (SABM) Command

The SABM unnumbered command is used to place the addressed DCE or DTE in an asynchronous balanced mode (ABM) information transfer phase where all command/response control fields will be one octet in length,.

The SABME unnumbered command is used to place the addressed DCE or DTE in an asynchronous balanced mode (ABM) information transfer phase where numbered command/response control fields will be two octets in length, and unnumbered command/response control fields will be one octet in length.

No information field is permitted with the SABM or SABME command. The transmission of an SABM/SABME command indicates the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same station (DCE or DTE). The DCE or DTE confirms acceptance of SABM/SABME [modulo 8 (basic) operation/modulo 128 (extended) operation] command by the transmission at the first opportunity of a UA response. Upon acceptance of this command, the DCE or DTE send state variable V(S) and receive state variable V(R) are set to 0.

Previously transmitted I frames that are unacknowledged when this command is actioned remain unacknowledged. It is the responsibility of a higher level (for example, packet level or MLP) to recover from the possible loss of the contents of such I frames.

Note: The mode of operation of a data link - basic (modulo 8) or extended (modulo 128) - is determined at subscription time and is only changed by going through a new subscription process.

The Nways Switch supports only the basic operation mode.

The Nways Switch, when configured as a DCE does not send SABM or SABME frames to set-up the link. (it does send SABM when configured as a DTE).

It sends an SABM command to reset the link in case of severe congestion situation.

The Nways Switch never sends SABM or SABME frames when configured as a DCE.

2.3.4.6 Disconnect (DISC) Command

The DISC unnumbered command is used to terminate the mode previously set. It is used to inform the DCE or DTE receiving the DISC command that the DTE or DCE sending the DISC command is suspending operation. No information field is permitted with the DISC command. Prior to actioning the DISC command, the DCE or DTE receiving the DISC command confirms the acceptance of the DISC command by the transmission of a UA response. The DTE or DCE sending the DISC command enters the disconnected phase when it receives the acknowledging UA response.

Previously transmitted I frames that are unacknowledged when this command is actioned remain unacknowledged. It is the responsibility of a higher level (for example, Packet Level or MLP) to recover from the possible loss of the contents of such I frames.

The only case where the Nways Switch sends a DISC frame is when a command is received from the network operator deactivating the DTE/DCE interface. The DISC frame is then sent with P bit set to 1.

The Nways Switch does not send DISC frames.

2.3.4.7 Unnumbered Acknowledgment (UA) Response

The UA unnumbered response is used by the DCE or DTE to acknowledge the receipt and acceptance of the mode-setting commands. Received mode-setting commands are not actioned until the UA response is transmitted. The transmission of a UA response indicates the clearance of a busy condition that was reported by the earlier transmission of an RNR frame by that same station (DCE or DTE). No information field is permitted with the UA response.

2.3.4.8 Disconnected Mode (DM) Response

The DM unnumbered response is used to report a status where the DCE or DTE is logically disconnected from the link, and is in the disconnected phase. The DM response may be sent to indicate that the DCE or DTE has entered the disconnected phase without benefit of having received a DISC command, or, if sent in response to the reception of a mode setting command, is sent to inform the DTE or DCE that the DCE or DTE, respectively, is still in the disconnected phase and cannot action the set mode command. No information field is permitted with the DM response.

A DCE or DTE in a disconnected phase will monitor received commands and will react to an SABM/SABME command as outlined in 2.4.4 below, and will respond with the F bit set to 1 to any other command received with the P bit set to 1.

2.3.4.9 Frame Reject (FRMR) Response

The FRMR unnumbered response is used by the DCE or DTE to report an error condition not recoverable by retransmitting of the identical frame: i.e., at least one of the following conditions, which results from the receipt of a valid frame:

1. The receipt of a command or response control field that is undefined or not implemented
2. The receipt of an I frame with an information field which exceeds the maximum established length
3. The receipt of an invalid N(R), or
4. The receipt of a frame with an information field which is not permitted or the receipt of a supervisory or unnumbered frame with incorrect length.

An undefined or not implemented control field is any of the control field encoding that are not identified in Table 2-3.

A valid N(R) must be within the range from the lowest send sequence number N(S) of the still unacknowledged frame(s) to the current DCE send state variable included (or to the current internal variable x if the DCE is in the timer recovery condition as described in 2.4.5.9).

An information field which immediately follows the control field, and consists of 3 octets (modulo 8 (basic) operation, or modulo 128 (extended) operation, respectively), is returned with this response and provides the reason for the FRMR response. These formats are given in Table 2-4.

Table 2-4. X.25 LAPB FRMR Information Field Format - Basic (Modulo 8) Operation

Information field bits

1 2 3 4 5 6 7 8	9	10 11 12	13	14 15 16	17	18	19	20	21	22	23	24
Rejected frame control field	0	V(S)	C/R	V(R)	W	X	Y	Z	0	0	0	0

Rejected frame control field is the control field of the received frame which caused the frame reject.

V(S) is the current send state variable value at the DCE or DTE reporting the rejection condition (Bit 10=low-order bit).

C/R set to 1 indicates the rejected frame was a response. C/R set to 0 indicates the rejected frame was a command.

V(R) is the current receive state variable value at the DCE or DTE reporting the rejection condition (Bit 14=low-order bit).

W set to 1 indicates that the control field received and returned in bits 1 through 8 was undefined or not implemented.

X set to 1 indicates that the control field received and returned in bits 1 through 8 was considered invalid because the frame contained an information field which is not permitted with this frame or is a supervisory of unnumbered frame with incorrect length. Bit W must be set to 1 in conjunction with this bit.

Y set to 1 indicates that the information field received exceeded the maximum established capacity.

Z set to 1 indicates the control field received and returned in bits 1 through 8 contained an invalid N(R).

Bits 9 and 21 to 24 shall be set to 0.

2.3.5 Exception Condition Reporting and Recovery

The error recovery procedures which are available to effect recovery following the detection/occurrence of an exception condition at the Data Link Level are described below. Exception conditions described are those situations which may occur as the result of transmission errors, DCE or DTE malfunction, or operational situations.

2.3.5.1 Busy Condition

The busy condition results when the DCE or DTE is temporarily unable to continue to receive I frames due to internal constraints, for example, receive buffering limitations. In this case an RNR frame is transmitted from the busy DCE or DTE. I frames pending transmission may be transmitted from the busy DCE or DTE prior to or following the RNR frame.

An indication that the busy condition has cleared is communicated by the transmission of a UA (only in response to an SABM/SABME command), RR, REJ, or SABM/SABME (modulo 8/modulo 128) frame.

| The Nways Switch DCE takes into account the clearing of a busy condition of the DTE by any of the methods described above. The Nways Switch DCE clears a busy condition by sending an RR frame.

| The same mode of operation is applicable when the Nways Switch port is configured in DTE mode.

2.3.5.2 N(S) Sequence Error Condition

The information field of all I frames received whose N(S) does not equal the receive state variable V(R) will be discarded.

An N(S) sequence error exception condition occurs in the receiver when an I frame received contains an N(S) which is not equal to the receive state variable V(R) at the receiver. The receiver does not acknowledge (increment its receive state variable) the I frame causing the sequence error, or any I frame which may follow, until an I frame with the correct N(S) is received.

A DCE or DTE which receives one or more valid I frames having sequence errors or subsequent S format frames (RR, RNR, and REJ) shall accept the control information contained in the N(R) field and the P bit to perform link control functions; for example, to receive acknowledgment of previously transmitted I frames and to cause the DCE or DTE to respond (P bit set to 1).

The means specified in 2.3.5.2.1 and 2.3.5.2.2 shall be available for initiating the retransmission of lost or errored I frames following the occurrence of an N(S) sequence error condition.

2.3.5.2.1 REJ Recovery The REJ frame is used by a receiving DCE or DTE to initiate a recovery (retransmitting) following the detection of an N(S) sequence error.***:*** With respect to each direction of transmission on the data link, only one "sent REJ" exception condition from a DCE or DTE, to a DTE or DCE, is established at a time. A "sent REJ" exception condition is cleared when the requested I frame is received.

A DCE or DTE receiving an REJ frame initiates sequential (re-)transmission of I frames starting with the I frame indicated by the N(R) contained in the REJ frame. The retransmitted frames may contain an N(R) and a P bit that are updated from, and therefore different from, the ones contained in the originally transmitted I frames.

2.3.5.2.2 Timeout Recovery If a DCE or DTE, due to a transmission error, does not receive (or receives and discards) a single I frame or the last I frame(s) in a sequence of I frames, it will not detect an N(S) sequence error condition and, therefore, will not transmit an REJ frame. The DTE or DCE which transmitted the unacknowledged I frame(s) shall, following the completion of a system specified timeout period (see 2.4.5.1 and 2.4.5.9 below), take appropriate recovery action to determine at which I frame retransmitting must begin. The retransmitted frame(s) may contain an N(R) and a P bit that is updated from, and therefore different from, the ones contained in the originally transmitted I frame(s).

2.3.5.3 Invalid Frame Condition

Any frame which is invalid will be discarded, and no action is taken as the result of that frame. An invalid frame is defined as one which:

1. Is not properly bounded by two flags.
2. In basic (modulo 8) operation, contains fewer than 32 bits between flags.
3. Contains a Frame Check Sequence (FCS) error.
4. Contains an address other than A or B (for single link operation).

For those networks that are octet aligned, a detection of non-octet alignment may be made at the Data Link Level by adding a frame validity check that requires the number of bits between the opening flag and the closing flag, excluding bits inserted for transparency, to be an integral number of octets in length, or the frame is considered invalid.

| The Nways Switch networks are octet aligned.

2.3.5.4 Frame Rejection Condition

A frame rejection condition is established upon the receipt of an error-free frame with one of the conditions listed in 2.3.4.9 above.

At the DCE or DTE, this frame rejection exception condition is reported by a FRMR response for appropriate DTE or DCE action, respectively. Once a DCE has established such an exception condition, no additional I frames are accepted until the condition is reset by the DTE, except for examination of the P bit. The FRMR response may be repeated at each opportunity, as specified in 2.4.7.3, until recovery is effected by the DTE, or until the DCE initiates its own recovery.

| After it has sent an FRMR response, the Nways Switch waits for the reception of
| an SABM, DISC, or DM frame from the DTE. The reception of other frames cause
| the Nways Switch to repeat the FRMR response.

2.3.5.5 Excessive Idle Channel State Condition on Incoming Channel

Upon detection of an idle channel state condition (see 2.2.12.2) on the incoming channel, the DCE shall wait for a period T3 (see 2.4.8.3) without taking any specific action, waiting for detection of a return to the active channel state (that is, detection of at least one flag sequence). After the period T3, the DCE shall notify the Packet Level of the excessive idle channel state condition, but shall not take any action that would preclude the DTE from establishing the data link by normal link setup procedures.

The Nways Switch does not detect an idle condition on the transmission channel from the adjacent DTE (or adjacent DCE, if configured as DTE), and does not take any action whatsoever for the duration of this idle condition.

Note: Other actions to be taken by the DCE at the Data Link Level upon expiration of period T3 is a subject for further study.

2.4 Description of the LAPB Procedure

2.4.1 LAPB Basic and Extended Modes of Operation

Table 2-3 indicates the command and response control field formats used with the basic (modulo 8) service. The mode setting command employed to initialize (set up) or reset the basic mode is the SABM command.

2.4.2 LAPB Procedure for Addressing

The address field identifies a frame as either a command or a response. A command frame contains the address of the DCE or DTE to which the command is being sent. A response frame contains the address of the DCE or DTE sending the frame.

Multilink operation is not applicable to the Nways Switch.

Frames containing command transferred from the DCE to the DTE will contain the address A for the single operation and address C for the multilink operation.

Frames containing response transferred from the DCE to the DTE will contain the address B for the single link operation and address D for the multilink operation.

Frames containing command transferred from the DTE to the DCE shall contain the address B for the single link operation and address D for the multilink operation.

Frames containing response transferred from the DTE to the DCE shall contain the address A for the single link operation and address C for the multilink operation.

These address are coded as follows:

	Address	1	2	3	4	5	6	7	8
Single link operation	A	1	1	0	0	0	0	0	0
	B	1	0	0	0	0	0	0	0

Multilink operation is not applicable to the Nways Switch.

Note: The DCE will discard all frames received with an address other than A or B (single link operation), or C or D (multilink operation).

2.4.3 LAPB Procedure for the Use of the P/F Bit

The DCE or DTE receiving an SABM/SABME, DISC, supervisory command, or I frame with the P bit set to 1 will set the F bit to 1 in the next response frame it transmits.

The response frame returned by the DCE to an SABM/SABME or DISC command with the P bit set to 1 will be a UA or DM response with the F bit set to 1. The response frame returned by the DCE to an I frame with the P bit set to 1, received during the information transfer phase, will be an RR, REJ, RNR, or FRMR response with the F bit set to 1. The response frame returned by the DCE to a supervisory command with the P bit set to 1, received during the information transfer phase, will be an RR, REJ, RNR or FRMR response with the F bit set to 1. The response frame returned by the DCE to an I frame or supervisory frame with the P bit set to 1, received during the disconnected phase, will be a DM response with the F bit set to 1.

The P bit may be used by the DCE in conjunction with the timer recovery condition (see 2.4.5.9 below).

| The Nways Switch uses the P bit in conjunction with the timer recovery condition as described in 2.4.5.9 below.

Note: Other use of the P bit by the DCE is a subject for further study.

2.4.4 LAPB Procedure for Data Link Setup and Disconnection

2.4.4.1 Data Link Setup

The DCE will indicate that it is able to set up the data link by transmitting continuous flags (active channel state).

Either the DTE or the DCE may initiate link setup. Prior to initiation of link setup, either the DCE or the DTE may initiate link disconnection (see 2.4.4.3) for the purpose of insuring that the DCE and the DTE are in the same phase. The DCE may also transmit an unsolicited DM response to request the DTE to initiate link setup.

| The Nways Switch DCE does not send SABM/SABME frames but uses the DM frame as just described. The DTE/DCE interface is unlocked either at resource definition time or by the network operator. This causes the physical level to be set up. Then the DCE enters the "disconnected" state and issues an unsolicited DM frame (with F-bit set to 0) as described in 2.4.4.4.2, and activates the link channel towards the DTE (transmission of contiguous flags). The DCE is then ready to accept link setup by the DTE as described below.

The DTE shall initiate link setup by transmitting an SABM/SABME command to the DCE. If, upon receipt of the SABM/SABME command correctly, the DCE determines that it can enter the information transfer phase, it will return a UA response to the DTE, will reset its send and receive state variables V(S) and V(R) to zero, and will consider that the link is set up. If, upon receipt of the SABM/SABME command correctly, the DCE determines that it cannot enter the information transfer phase, it will return a DM response to the DTE as a denial to the link setup initialization and will consider that the link is not set up. In order to avoid misinterpretation of the DM response received, it is suggested that the DTE always send its SABM/SABME command with the P bit set to 1. Otherwise, it is not possible to differentiate a DM response intended as a denial to link setup from a DM response that is issued in a separate unsolicited sense as a request for a mode-setting command (as described in 2.4.4.4.2).

| DCE initiated link setup is not applicable to the Nways Switch.. The Nways Switch
| does not send SABM.

2.4.4.2 Information Transfer Phase

After having transmitted the UA response to the SABM/SABME command or having received the UA response to a transmitted SABM/SABME command, the DCE will accept and transmit I and supervisory frames according to the procedures described in 2.4.5.

When receiving the SABM/SABME command while in the information transfer phase, the DCE will conform to the link resetting procedure described in 2.4.7.

2.4.4.3 Data Link Disconnection

The DTE shall initiate a disconnect of the data link by transmitting a DISC command to the DCE. On correctly receiving a DISC command in the information transfer state, the DCE will send a UA response and enter the disconnected phase. On correctly receiving a DISC command in the disconnect phase, the DCE will send a DM response and remain in the disconnect phase. In order to avoid misinterpretation of the DM response received, it is suggested that the DTE always send its DISC command with the P bit set to 1. Otherwise, it is not possible to differentiate a DM response intended as an indication that the DCE is already in the disconnected phase from a DM response that is issued in a separate unsolicited sense as a request for a mode-setting command (as described in 2.4.4.4.2).

The DCE will initiate a disconnect of the data link by transmitting a DISC command to the DTE and starting its Timer T1 (see 2.4.8.1). Upon reception of a UA response from the DTE, the DCE will stop its Timer T1 and will enter the disconnected phase. Upon reception of a DM response from the DTE as an indication that the DTE was already in the disconnected phase, the DCE will stop its Timer T1 and will enter the disconnected phase.

| The only case where the Nways Switch initiates a disconnect is when the network
| operator sends a command deactivating the interface. The DISC frame is then
| sent with P bit set to 1, and a UA response is expected from the DTE. If there is
| no response, DISC will be sent up to N2 times, upon occurrence of timer T1.
| When a UA response is received, or when the N2 retries have been attempted, the
| Nways Switch stops transmitting frames.

The Nways Switch does not send DISC frames. An operator command which deactivate the interface causes the physical layer of the interface to be shut down.

The DCE, having sent the DISC command, will ignore and discard any frames except an SABM/SABME or DISC command, or a UA or DM response received from the DTE. The receipt of an SABM/SABME or DISC command from the DTE will result in a collision situation that is resolved per 2.4.4.5 below.

When the reverse command, activating the interface, is issued by the network operator, the Nways Switch DCE starts sending DM responses, timed by timer T1, with no N2 limit. An SABM command from the adjacent DTE is expected.

When the reverse command, activating the interface, is issued by

2.4.4.4 Disconnected Phase

2.4.4.4.1

After having received a DISC command from the DTE and returned a UA response to the DTE, or having received the UA response to a transmitted DISC command, the DCE will enter the disconnected phase.

| The Nways Switch DTE or DCE port enters the disconnected phase after the reception of a DISC command from the adjacent DCE or DTE, respectively.

| The Nways Switch DTE or DCE port never sends a DISC command.

In the disconnected phase, the DCE may initiate link setup. In the disconnected phase, the DCE will react to the receipt of an SABM/SABME command as described in 2.4.4.1 above and will transmit a DM response in answer to a received DISC command. When receiving any other command (defined, or undefined or not implemented) with the P bit set to 1, the DCE will transmit a DM response with the F bit set to 1. Other frames received in the disconnected phase will be ignored by the DCE.

| The Nways Switch DCE never initiates link setup. In the disconnected state the DCE port will accept an SABM/SABME frame from the DTE (see 2.4.4.4.2).

| In the disconnected state the Nways Switch DTE port will attempt to initiate link setup by sending an SABM/SABME frame to the adjacent DCE.

| The Nways Switch distinguishes two cases, depending on whether the DISC has been sent by the DTE ("DTE disconnected" state) or by the DCE ("operator disconnected" state). The Nways Switch DCE may also transmit a DM frame (for example, after N2 unacknowledged I frames have been sent) and enter the "DCE disconnected state" (see 2.4.4.4.2).

In the disconnected phase, the DCE may initiate link setup. In the disconnected phase, the DCE will react to the receipt of an SABM/SABME command as described in 2.4.4.1 above and will transmit a DM response in answer to a received DISC command. When receiving any other command (defined, or undefined or not implemented) with the P bit set to 1, the DCE will transmit a DM response with the F bit set to 1. Other frames received in the disconnected phase will be ignored by the DCE.

| The Nways Switch DCE never initiates link setup. In the "DTE disconnected" state or in the "DCE disconnected" state, the DCE will accept an SABM/SABME frame from the DTE (see 2.4.4.4.2). In the "operator disconnected" state, the DCE will not accept an SABM/SABME (it replies with a DM frame).

2.4.4.4.2

When the DCE enters the disconnected phase after detecting error conditions as listed in 2.4.6 below, or after an internal malfunction, it may indicate this by sending a DM response rather than a DISC command. In these cases, the DCE will transmit a DM response and start its Timer T1 (see 2.4.8.1 below).

When the Nways Switch DCE detects an error condition, it sends an unsolicited DM frame as described above, enters the disconnected state, and accepts SABM/SABME frames from the adjacent DTE.

The Nways Switch DCE stays in the disconnected state, waiting indefinitely for an SABM/SABME from the DTE or a disabling of the interface by the network operator. No recovery procedure is initiated by the DCE.

Alternatively, after an internal malfunction, the DCE may either initiate a link resetting procedure (see 2.4.7 below) or disconnect the data link (see 2.4.4.3) prior to initiating a link setup procedure (see 2.4.4.1 above).

2.4.4.5 Collision of Unnumbered Commands

Collision situations shall be resolved in the following way:

2.4.4.5.1 If the sent and received unnumbered commands are the same, the DCE and DTE shall send the UA response at the earliest possible opportunity. The DCE shall enter the indicated phase either 1) After receiving the UA response, 2) After sending the UA response, or 3) After timing out waiting for the UA response having sent a UA response. In the case of 2) above, the DCE will accept a subsequent UA response to the mode-setting command it issued without causing an exception condition if received within the timeout interval.

2.4.4.5.2 If the sent and received unnumbered commands are different, the DCE and DTE shall enter the disconnected phase and issue a DM response at the earliest possible opportunity.

2.4.4.6 Collision of DM Response with SABM/SABME or DISC Command

When a DM response is issued by the DCE or DTE as an unsolicited response to request the DTE or DCE, respectively, to issue a mode-setting command as described in 2.4.4.4, a collision between an SABM/SABME or DISC command and the unsolicited DM response may occur. In order to avoid misinterpretation of the DM response received, the DTE always sends its SABM/SABME or DISC command with the P bit set to 1.

2.4.4.7 Collision of DM Responses

A contention situation may occur when both the DCE and the DTE issue a DM response to request a mode-setting command. In this case, the DTE will issue an SABM/SABME command to resolve the contention situation.

2.4.5 LAPB Procedures for Information Transfer

The procedures which apply to the transmission of I frames in each direction during the information transfer phase are described below.

In the following, "number one higher" is in reference to a continuously repeated sequence series, i.e., 7 is 1 higher than 6 and 0 is 1 higher than 7 for modulo 8 series, and 127 is 1 higher than 126 and 0 is 1 higher than 127 for modulo 128 series.

2.4.5.1 Sending I Frames

When the DCE has an I frame to transmit (i.e., an I frame not already transmitted, or having to be retransmitted as described in 2.4.5.6), it will transmit it with an N(S) equal to its current sent state variable V(S), and an N(R) equal to its current receive state variable V(R). At the of the transmission of the I frame, the DCE will increment its send state variable V(S) by 1.

If Timer T1 is not running at the time of transmission of an I frame, it will be started.

If the send state variable V(S) is equal to the last value of N(R) received plus k (where k is the maximum number of outstanding I frames see 2.4.8.6 below), the DCE will not transmit any new I frames, but may retransmit an I frame as described in 2.4.5.6 or 2.4.5.9 below.

When the DCE is in the busy condition, it may still transmit I frames, provided that the DTE is not busy. When the DCE is in the frame rejection condition, it will stop transmitting I frames.

2.4.5.2 Receiving an I Frame

When the DCE is not in a busy condition and receives a valid I frame whose send sequence number N(S) is equal to the DCE receive state variable V(R), the DCE will accept the information field of this frame, increment by one its receive state variable V(R), and act as follows:

a. If the DCE is still not in a busy condition:

   1) If an I frame is available for transmission by the DCE, it may act as in 2.4.5.1 above and acknowledge the received I frame by setting N(R) in the control field of the next transmitted I frame to the value of the DCE receive state variable V(R). Alternatively, the DCE may acknowledge the received I frame by transmitting an RR frame with the N(R) equal to the value of the DCE receive state variable V(R).

   2) If no I frame is available for transmission by the DCE, it will transmit an RR frame with N(R) equal to the value of the DCE receive state variable V(R).

b. If the DCE is now in a busy condition, it will transmit an RNR frame with N(R) equal to the value of the DCE receive state variable V(R) (see 2.4.5.8).

When the DCE is in a busy condition, it may ignore the information field contained in any received I frame.

| When possible, the Nways Switch acknowledges a received I frame using the N(R) field in an I frame transmitted to the DTE.

| The Nways Switch ignores the information field of I frames received when in a busy condition, but takes into account the N(R) value.

2.4.5.3 Reception of Invalid Frames

When the DCE receives an invalid frame (see 2.3.5.3), this frame will be discarded.

2.4.5.4 Reception of Out-of-Sequence I Frames

When the DCE receives a valid I frame whose send sequence number N(S) is incorrect, i.e., not equal to the current DCE receive state variable V(R), it will discard the information field of the I frame and transmit an REJ frame with the N(R) set to one higher than the N(S) of the last correctly received I frame. The REJ frame will be a command frame with the P bit set to 1 if an acknowledged transfer of the retransmitting request is required: otherwise the REJ frame may be a command or a response frame. The DCE will then discard the information field of all I frames received until the expected I frame is correctly received. When receiving the expected I frame, the DCE will then acknowledge the I frame as described in 2.4.5.2 above. The DCE will use the N(R) and P bit information in the discarded I frames as described in 2.3.5.2 above.

| The Nways Switch only sends REJ frames as response frames.

2.4.5.5 Receiving Acknowledgment

When correctly receiving an I frame or a supervisory frame (RR, RNR, or REJ), even in the busy condition, the DCE will consider the N(R) contained in this frame as an acknowledgment for all I frames it has transmitted with an N(S) up to and including the received N(R)-1. The DCE will stop Timer T1 when it correctly receives an I frame or a supervisory frame with the N(R) higher than the last received N(R) (actually acknowledging some I frames), or an REJ frame with an N(R) equal to the last received N(R).

If Timer T1 has been stopped by the receipt of an I, RR, or RNR frame, and if there are outstanding I frames still unacknowledged, the DCE will restart Timer T1. If Timer T1 then runs out, the DCE will follow the recovery procedure (2.4.5.9) with respect to the unacknowledged I frames. If Timer T1 has been stopped by the receipt of an REJ frame, the DCE will follow the retransmitting procedures in 2.4.5.6 below.

2.4.5.6 Receiving an REJ Frame

When receiving an REJ frame, the DCE will set its send state variable V(S) to the N(R) received in the REJ control field. It will transmit the corresponding I frame as soon as it is available or retransmit it in accordance with the procedures described in 2.4.5.1. (Re)transmission will conform to the following procedure:

1. If the DCE is transmitting a supervisory command or response when it receives the REJ frame, it will complete that transmission before commencing transmitting of the requested I frame.
2. If the DCE is transmitting an unnumbered command or response when it receives the REJ frame, it will ignore the request for retransmitting.
3. | The Nways Switch does not abort frames.
4. If the DCE is not transmitting any frame when the REJ frame is received, it will commence transmission of the request I frame immediately.

In all cases, if other unacknowledged I frames had already been transmitted following the one indicated in the REJ frame, then those I frames will be retransmitted by the DCE following the retransmitting of the requested I frame.

Other I frames not yet transmitted may be transmitted following the retransmitted I frames.

If the REJ frame was received from the DTE as a command with the P bit set to 1, the DCE will transmit an RR, RNR, or REJ response with the F bit set to 1 before transmitting or retransmitting the corresponding I frame.

2.4.5.7 Receiving an RNR Frame

After receiving an RNR frame, the DCE may transmit or retransmit the I frame with the send sequence number equal to the N(R) indicated in the RNR frame and start Timer T1, if not already running. If Timer T1 runs out before receipt of a busy clearance indication, the DCE will follow the procedure described in 2.4.5.9 below. In any case, the DCE will not transmit any other I frames before receiving an RR or REJ frame, or before the completion of a link resetting procedure.

Alternatively, after receiving an RNR frame, the DCE may wait for a period of time (for example, the length of the Timer T1) and then transmit a supervisory command frame (RR, RNR, or REJ) with the P bit set to 1, and start Timer T1, in order to determine if there is any change in the receive status of the DTE. The DTE shall respond to the P bit set to 1 with a supervisory response frame (RR, RNR, or REJ) with the F bit set to 1 indicating either continuance of the busy condition (RNR) or clearance of the busy condition (RR or REJ). Upon receipt of the DTE response, Timer T1 is stopped.

The Nways Switch makes use of the second alternative, where the DCE issues an RR command with P bit set to 1 after a period equal to T1. It does so only if there are I frames waiting for acknowledgment on the DCE side.

1. If the response is the RR or REJ response, the busy condition is cleared and the DCE may transmit I frames beginning with the I frame identified by the N(R) in the received response frame.
2. If the response is the RNR response, the busy condition still exists, and the DCE will after a period of time (for example, the length of Timer T1) repeat the enquiry of the DTE receive status.

If Timer T1 runs out before a status response is received, the enquiry process above is repeated. If N2 attempts to get a status response fail (i.e., Timer T1 runs out N2 times), the DCE will initiate a link resetting procedure as described in 2.4.7.2 below or will transmit a DM response to ask the DTE to initiate a link setup procedure as described in 2.4.4.1 and enter the disconnected phase. The value of N2 is defined in 2.4.8.4 below.

If, at any time during the enquiry process, an unsolicited RR or REJ frame is received from the DTE, it will be considered to be an indication of clearance of the busy condition. Should the unsolicited RR or REJ frame be a command frame with the P bit set to 1 the appropriate response frame with the F bit set to 1 must be transmitted before the DCE may resume transmission of I frames. If Timer T1 is running, the DCE will wait for the non-busy response with the F bit set to 1, or will wait for Timer T1 to run out and then either may reinitiate the enquiry process in order to realize a successful P/F bit exchange or may resume transmission of I frames beginning with the I frame identified by the N(R) in the received RR or REJ frame.

When the busy condition is cleared by the DTE, the Nways Switch immediately resumes the transmission of any pending I frames.

2.4.5.8 DCE Busy Condition

When the DCE enters a busy condition, it will transmit an RNR frame at the earliest opportunity. The RNR frame will be a command frame with the P bit set to 1 if an acknowledged transfer of the busy condition indication is required: otherwise the RNR frame may be either a command or a response frame. While in the busy condition, the DCE will accept and process supervisory frames, will accept and process the controls of the N(R) fields of I frames, and will return an RNR response with the F bit set to 1 if it receives a supervisory command or I command frame with the P bit set to 1. To clear the busy condition, the DCE will transmit either an REJ frame or an RR frame, with N(R) set to the current receive state variable V(R), depending on whether or not it discarded information fields of correctly received I frames. The REJ frame or the RR frame or the frame will be a command frame with the P bit set to 1 if an acknowledged transfer of the busy-to-non-busy transition is required, otherwise the REJ frame or the RR frame may be either a command or a response frame.

The Nways Switch may enter a busy condition when the level of resources of the Nways Switch node (buffers) goes under a threshold defined internally.

2.4.5.9 Waiting Acknowledgment

The DCE maintains an internal transmission attempt variable which is set to 0 when the DCE sends a UA response, when the DCE receives a UA response or an RNR command or response, or when the DCE correctly receives an I frame or supervisory frame with the N(R) higher than the last received N(R) (actually acknowledging some outstanding I frames).

If Timer T1 runs out waiting for the acknowledgment from the DTE for an I frame transmitted, the DCE will enter the Timer recovery condition, add one to its transmission attempt variable and set an internal variable x to the current value of its send state variable V(S).

The DCE will restart Timer T1, set its send state variable V(S) to the value of N(R) received from the DTE and retransmit the corresponding I frame with the P bit set to 1, or transmit an appropriate supervisory command frame (RR, RNR, or REJ) with the P bit set to 1.

The Nways Switch makes use of the second method. It issues a supervisory command (an RR command) with the P bit set to 1.

The timer recovery condition is cleared when the DCE receives a valid supervisory frame with the F bit set to 1.

If, while in the timer recovery condition, the DCE correctly receives a supervisory frame with the F bit set to 1 and with the N(R) within the range from its current send state variable V(S) to x included, it will clear the timer recovery condition (including stopping Timer T1) and set its send state variable V(S) to the value of the received N(R), and may then resume with I frame transmission or retransmitting, as appropriate.

If, while in the timer recovery condition, the DCE correctly receives an I or supervisory frame with the P/F bit set to 0 and with a valid N(R) (see 2.3.4.9), it will not clear the timer recovery condition. The value of the received N(R) may be used to update the send state variable V(S).

The Nways Switch accepts the N(R) information of a frame with the F bit set to 0 when it is in timer recovery condition.

If the received supervisory frame with the P/F bit set to 0 is an REJ frame with a valid N(R), the DCE may either immediately initiate (re)transmission from the value of the send state variable V(S), or it may ignore the request for retransmission and wait until the supervisory frame with the F bit set to 1 is received before initiating (re)transmission of frames from the value identified in the N(R) field of the F=1 supervisory frame.

The Nways Switch waits for a supervisory frame with the F bit set to 1 before resuming the transmission of I frames.

If, while in the timer recovery condition, the DCE receives an REJ command with the P bit set to 1, the DCE will respond immediately with an appropriate supervisory response with the F bit set to 1. The DCE may then use the value of the N(R) in the REJ command to update the send state variable V(S), and may either immediately begin (re)transmission from the value N(R) indicated in the REJ frame or ignore the request for retransmitting and wait until the supervisory frame with the F bit set to 1 is received before initiating (re)transmission of I frames from the value identified in the N(R) field of the F=1 supervisory frame.

The Nways Switch waits for a supervisory frame with the F bit set to 1 before resuming the transmission of I frames. An REJ command with the P bit set to 1 does not clear the timer recovery condition.

If Timer T1 runs out in the timer recovery condition, and no I supervisory frame with the P/F bit set to 0 and a valid N(R) has been received, or no REJ command with the P bit set to 1 and with a valid N(R) has been received, the DCE will add one to its transmission attempt variable, restart Timer T1, and either retransmit the I frame sent with the P bit set to 1 or transmit an appropriate supervisory command with the P bit set to 1.

The Nways Switch makes use of the second method. It issues a supervisory command with the P bit set to 1.

If the transmission attempt variable is equal to N2, the DCE will initiate a link resetting procedure as described in 2.4.7.2 below, or will transmit a DM response to ask the DTE to initiate a link setup procedure as described in 2.4.4.1 and enter the disconnected phase. N2 is a system parameter (see 2.4.8.4).

The Nways Switch makes use of the second method. It issues a DM frame and enters the "DCE disconnected" state, where it accepts an SABM/SABME or DISC from the DTE.

Note: Although the DCE may implement the internal variable X, other mechanisms do exist that achieve the identical function.

2.4.6 LAPB Conditions for Data Link Resetting or Data Link Re-Initialization (Data Link Setup)

2.4.6.1

When the DCE receives, during the information transfer phase, a frame which is not invalid (see 2.4.5.3) with one of the conditions listed in 2.3.4.9, the DCE will request the DTE to initiate a link resetting procedure by transmitting an FRMR response to the DTE as described in 2.4.7.3.

2.4.6.2

When the DCE receives, during the information transfer phase, an FRMR response from the DTE, the DCE will either initiate the link resetting procedure itself as described in 2.4.7.2 or return a DM response to ask the DTE to initiate the link setup (initialization) procedure as described in 2.4.4.1. After transmitting a DM response, the DCE will enter the disconnected phase as described in 2.4.4.4.2.

The Nways Switch DCE makes use of the second method. It issues a DM frame and enters the disconnected state, where it accepts an SABM/SABME or DISC from the adjacent DTE.

2.4.6.3

When the DCE receives, during the information transfer phase, a UA response, or an unsolicited response with the F bit set to 1, the DCE may either initiate the link resetting procedure itself as described in 2.4.7.2, or return a DM response to ask the DTE to initiate the link setup (initialization) procedure as described in 2.4.4.1. After transmitting a DM response, the DCE will enter the disconnected phase as described in 2.4.4.2.

The Nways Switch DCE makes use of the second method. It issues a DM frame and enters the disconnected state, where it accepts an SABM/SABME or DISC from the DTE.

2.4.6.4

When the DCE receives, during the information transfer phase, a DM response from the DTE, the DCE will either initiate the link setup (initialization) procedure itself as described in 2.4.4.1, or return a DM response to ask the DTE to initiate the link setup (initialization) procedures as described in 2.4.4.1. After transmitting a DM response, the DCE will enter the disconnected phase as described in 2.4.4.4.2.

The Nways Switch makes use of the second method. It issues a DM frame and enters the disconnected state, where it accepts an SABM/SABME or DISC from the DTE.

2.4.7 LAPB Procedure for Data Link Resetting

2.4.7.1

The link resetting procedure is used to initialize both directions of information transfer according to the procedure described below. The link resetting procedure only applies during the information transfer phase.

2.4.7.2

Either the DTE or the DCE may initiate the link resetting procedure. The link resetting procedure indicates a clearance of a DCE and/or DTE busy condition, if present.

The DTE shall initiate a link resetting by transmitting an SABM/SABME command to the DCE. If, upon receipt of the SABM/SABME command correctly, the DCE determines that it can continue in the information transfer phase, it will return a UA response to the DTE, will reset its send and receive state variable V(S) and V(R) to zero, and will remain in the information transfer phase. If, upon receipt of the SABM/SABME command correctly, the DCE determines that it cannot remain in the information transfer phase, it will return a DM response as a denial to the resetting request and will enter the disconnected phase.

The Nways Switch DCE accepts an SABM/SABME or DISC command from the DTE. The Nways Switch DCE never sends SABM/SABME but issues DM, enters the disconnected state, and accepts an SABM/SABME or DISC from the DTE.

DCE initiated link resetting is not applicable to the Nways Switch.

2.4.7.3

The DCE may ask the DTE to reset the data link by transmitting an FRMR response (see 2.4.6.1 above).

After transmitting an FRMR response, the DCE will enter the frame rejection condition. The frame rejection condition is cleared when the DCE receives or transmits an SABM/SABME or DISC command or a DM response. Any other command received while in the frame rejection condition will cause the DCE to retransmit the FRMR response with the same information field as originally transmitted.

The DCE may start Timer T1 on transmission of FRMR response. If Timer T1 runs out before the reception of an SABM/SABME or DISC command or a DM response from the DTE, the DCE may retransmit the FRMR response, and restart Timer T1. After N2 attempts to get the DTE to reset the link, the DCE may reset the link itself as described in 2.4.7.2. The value of N2 is defined in 2.4.8.4 below.

The FRMR response is repeated by the Nways Switch, up to N2 times, timed by timer T1. After N2 attempts, a DM frame is sent to the DTE and the interface goes into the "DCE disconnected" state.

In the frame rejection condition, I frames and supervisory frames will not be transmitted by the DCE. Also, received I frames and supervisory frames will be discarded by the DCE except for the observance of a P bit set to 1. When an additional FRMR response must be transmitted by the DCE as a result of the receipt of a P bit set to 1 while Timer T1 is running, Timer T1 will continue to run. Upon reception of an FRMR response (even during a frame rejection condition), the DCE will initiate a resetting procedure by transmitting an SABM/SABME command as described in 2.4.7.2, or will transmit a DM response to ask the DTE to initiate the link setup procedure as described in 2.4.4.1 and enter the disconnected phase.

The Nways Switch makes use of the second method. It issues a DM frame and enters the disconnected state, where it accepts an SABM/SABME or DISC from the DTE.

2.4.8 List of LAPB System Parameters

The DCE and DTE system parameters are as follows:

2.4.8.1 Timer T1

The value of the DTE Timer T1 system parameter may be different than the value of the DCE Timer T1 system parameter. These values shall be made known to both the DTE and the DCE, and agreed to for a period of time by both the DTE and the DCE.

The DCE timer T1 may be chosen at subscription time. The corresponding DTE timer T1 is not known by the Nways Switch but should preferably be chosen close to the DCE timer T1.

The period of Timer T1, at the end of which retransmitting of a frame may be initiated (see 2.4.4 and 2.4.5 above for the DCE), shall take into account whether T1 is started at the beginning or the end of transmission of a frame.

The Nways Switch starts timer T1 at the end of the transmission of a frame.

The proper operation of the procedure requires that the transmitter's (DCE or DTE) Timer T1 be greater than the maximum time between transmission of a frame (SABM/SABME, DISC, I or supervisory command, or DM or FRMR response) and the reception of the corresponding frame returned as an answer to that frame (UA, DM or acknowledging frame). Therefore, the receiver (DCE or DTE) should not delay the response or acknowledging frame returned to one of the above frames by more than a value T2, where T2 is a system parameter (see 2.4.8.2).

The DCE will not delay the response or acknowledging frame returned to one above DTE frames by more than a period T2.

2.4.8.2 Parameter T2

The value of the DTE parameter T2 may be different than the value of the DCE parameter T2. These values shall be made know to both the DTE and the DCE, and agreed to for a period of time by both the DTE and the DCE.

The period of parameter T2 shall indicate the amount of time available at the DCE before the acknowledging frame must be initiated in order to ensure its receipt by the DTE or DCE, respectively, prior to Timer T1 running out at the DTE or DCE. T2 < T1.

Note: The period of parameter T2 shall take into account the following timing factors: the transmission time of the acknowledging frame, the propagation time over the access link, the stated processing times at the DCE and the DTE, and the time to complete the transmission of the frame (S) in the DCE or DTE transmit queue that are neither displaceable or modifiable in an orderly manner.

Given a value for Timer T1 for the DTE or DCE, the value of parameter T2 at the DCE or DTE, respectively, must be no larger than T1 minus 2 times the propagation time over the access link, minus the frame processing time at the DCE, minus the frame processing time at the DTE, and minus the transmission time of the acknowledging frame by the DCE or DTE, respectively.

The DCE timer T2 is computed by the Nways Switch, as a function of the timer T1.

2.4.8.3 Timer T3

The timer T3 is not implemented in the Nways Switch DCE. The DTE may consider that T3 has an infinite value.

2.4.8.4 Maximum Number of Attempts to Complete a Transmission N2

The value of the DTE N2 system parameter may be different than the value of the DCE N2 system parameter. These values shall be made known to both the DTE and the DCE, and agreed to for a period of time by both the DTE and the DCE.

The value of N2 shall indicate the maximum number of attempts made by the DCE or DTE to complete the successful transmission of a frame to the DTE or DCE, respectively.

The DCE value of parameter N2 can be chosen at subscription time, independently per access port. The Nways Switch does not act upon the DTE value of the N2 parameter, which is not a parameter of the access port.

2.4.8.5 Maximum Number of Bits in an I Frame N1

The value of the DTE N1 system parameter may be different than the value of the DCE N1 system parameter. These values shall be known to both the DTE and the DCE.

The values of N1 shall indicate the maximum number of bits in an I frame (excluding flags and 0 bits inserted for transparency) that the DCE or the DTE is willing to accept from the DTE or DCE respectively.

In order to allow for universal operation, a DTE should support a value of DTE N1 which is not less than 1090 bits (135 octets). DTE should be aware that the network may transmit longer packets (see 5.2), that may result in a link level problem.

All networks shall offer to a DTE which requires it a value of DCE N1 which is greater than or equal to 2092 bits (259 octets) plus length of the address, control and FCS fields at the DTE/DCE interface, and greater than or equal to the maximum length of the data packets which may cross the DTE/DCE interface plus the length of the address, control and FCS fields at the DTE/DCE interface.

The link level of the Nways Switch accepts frames whose length includes the maximum packet size plus the headers of link and packet levels. Received frames which exceed the N1 length are rejected with an FRMR frame, as described in 2.3.4.9.

2.4.8.6 Maximum Number of Outstanding I Frames K

The value of the DTE K system parameter shall be the same as the DCE K system parameter. This value shall be agreed to for a period of time by both the DTE and DCE.

The value of K shall indicate the maximum number of sequentially numbered I frames that the DTE or DCE may have outstanding (i.e., unacknowledged) at any given time. The value of K shall never exceed seven for Modulo 8 operation, or one hundred twenty seven for Modulo 128 operation. All networks (DCEs) shall support a value of seven. Other values of K (less than and greater than seven) may also be supported by networks (DCEs).

For the Nways Switch, K can be chosen between 1 and 7 with modulo 8.

2.4.8.7 Inactivity Timer Ti

The timer Ti, ***specific to the Nways Switch***, need not be known or implemented by the adjacent DTE or DCE. The Nways Switch starts timer Ti when it is in data transfer phase, has no frame to transmit, and has no outstanding frame (waiting for acknowledgement). This permits checking that the adjacent DTE or DCE stays logically connected with the Nways Switch port, even in the absence of traffic.

The Nways Switch port stops timer Ti when it has a frame to transmit or has received a frame.

Upon a timeout of timer Ti, the Nways Switch sends an RR command with P bit set to 1, which should be acknowledged by the adjacent DTE or DCE with an RR or RNR response, with F bit set to 1.

2.5 Multilink Procedure (MLP) (Subscription-Time Selectable Option)

Multilink procedure (MLP) is not applicable in the Nways Switch environment.

2.6 LAP Elements of Procedure

LAP elements of procedure are not applicable in the Nways Switch environment.

Chapter 3. Description of the Packet Layer DTE/DCE Interface

This and subsequent points of the Recommendation relate to the transfer of packets at the DTE/DCE interface. The procedures apply to packets which are successfully transferred across the DTE/DCE interface.

Each packet to be transferred across the DTE/DCE interface shall be contained within the link level information field which will delimit its length, and only one packet shall be contained in the information field.

| The Nways Switch requires that packets contain an integral number of octets.

| If the Nways Switch receives from the DTE a packet not containing an integral
| number of octets, the frame containing the packet is discarded.

DTEs wishing universal operation on all networks should transmit all packets with data fields containing only an integral number of octets. Full data integrity can only be assured by exchange of octet-oriented data fields in both directions of transmission.

This point covers a description of the packet level interface for virtual call and permanent virtual circuit services.

Procedures for the virtual circuit service (that is, virtual call and permanent virtual circuit services) are specified in Chapter 4, “Procedures for Virtual Circuit Services” on page 4-1. Packet formats are specified in Chapter 5, “Packet Formats” on page 5-1. Procedures and formats for optional user facilities are specified in Chapter 6, “Procedures for Optional User Facilities (Packet Level)” on page 6-1 and Chapter 7, “Formats for Facility Fields and Registration Fields” on page 7-1.

3.1 Logical Channels

To enable simultaneous virtual calls and/or permanent virtual circuits, logical channels are used. Each virtual call or permanent virtual circuit is assigned a logical channel group number (less than or equal to 15) and a logical channel number (less than or equal to 255). For virtual calls, a logical channel group number and a logical channel number are assigned during the call setup phase. The range of logical channels used for virtual calls is agreed with the Administration at the time of subscription to the service (see Appendix A, “Range of Logical Channels Used for Virtual Calls and Permanent Virtual Circuits” on page A-1). For permanent virtual circuits, logical channel group numbers and logical channel numbers are assigned in agreement with the Administration at the time of subscription to the service (see Appendix A, “Range of Logical Channels Used for Virtual Calls and Permanent Virtual Circuits” on page A-1).

3.2 Basic Structure of Packets

Every packet transferred across the DTE/DCE interface consists of at least three octets. These three octets contain a general format identifier, a logical channel identifier and a packet type identifier. Other packet fields are appended as required (see Chapter 5, "Packet Formats" on page 5-1).

Packet types and their use in association with various services are given in Table 3-1.

Table 3-1. X.25 Packet Types and Their Use in Various Services

Packet type		Service	
From DCE to DTE	From DTE to DCE	VC	PVC
CALL SET–UP AND CLEARING (see Note 1)			(b)
Incoming call	Call request	X	
Call connected	Call accepted	X	
Clear indication	Clear request	X	
DCE clear confirmation	DTE clear confirmation	X	
DATA AND INTERRUPT (see Note 2)			
DCE data	DTE data	X	X
DCE interrupt	DTE interrupt	X	X
DCE interrupt confirmation	DTE interrupt confirmation	X	X
FLOW CONTROL AND RESET (see Note 3)			
DCE RR	DTE RR	X	X
DCE RNR	DTE RNR	X	X
	DTE REJ (a)	X	X
Reset indication	DTE request	X	X
DCE reset confirmation	DTE reset confirmation	X	X
RESTART (see Note 4)			
Restart indication	Restart request	X	X
DCE restart confirmation	DTE restart confirmation	X	X
DIAGNOSTIC (see Note 5)			
Diagnostic		X	X
REGISTRATION (a)(see Note 6)			
Registration confirmation		X	X
	Registration request	X	X

(a) Not applicable to the Nways Switch.

(b) The Nways Switch does not support PVCs.

VC Virtual call
PVC Permanent virtual circuit

Notes:

1. See 4.1 and 6.16 for procedures, 5.2 for formats.
2. See 4.3 for procedures and 5.3 for formats.
3. See 4.4 and 6.4 for procedures, 5.4 and 5.7.1 for formats.
4. See 3.3 for procedures and 5.5 for formats.
5. See 3.4 for procedures and 5.6 for formats.
6. See 6.1 for procedures and 5.7.2 for formats.

| The Nways Switch does not offer the packet retransmission additional facility, thus the DTE REJ packet is not handled.

| The Nways Switch does not offer the online registration facility, thus registration request and registration confirmation packets are not handled.

| The Nways Switch supports diagnostic packets.

3.3 Procedure for Restart

The restart procedure is used to initialize or re-initialize the packet level DTE/DCE interface. The restart procedure simultaneously clears all the virtual calls and resets all the permanent virtual circuits at the DTE/DCE interface (see 4.5).

Figure B-1 gives the state diagram which defines the logical relationships of events related to the restart procedure.

Table C-2 specifies actions taken by the DCE on the receipt of packets from the DTE for the restart procedure.

3.3.1 Restart by the DTE

The DTE may at any time request a restart by transferring across the DTE/DCE interface a *restart request* packet. The interface for each logical channel is then in the *DTE restart request* state (r2).

The DCE will confirm the restart by transferring a *DCE restart confirmation* packet and placing the logical channels used for virtual calls in the *ready* state (p1), and the logical channels used for permanent virtual circuits in the *flow control ready* state (d1).

Note: States p1 and d1 are specified in Chapter 4, "Procedures for Virtual Circuit Services" on page 4-1.

The *DCE restart confirmation* packet can only be interpreted universally as having local significance. The time spent in the *DTE restart request* state (r2) will not exceed time-limit T20 (see Appendix D, "Packet Level DCE Timeouts and DTE Time-Limits" on page D-1).

3.3.2 Restart by the DCE

The DCE will indicate a restart by transferring across the DTE/DCE interface a *restart indication* packet. The interface for each logical channel is then in the *DCE restart indication* state (r3). In this state of the DTE/DCE interface, the DCE will ignore all packets except for *restart request* and *DTE restart confirmation.*

The DTE will confirm the restart by transferring a *DTE restart confirmation* packet and placing the logical channels used for virtual calls in the *ready* state (p1), and the logical channels used for permanent virtual circuits in the *flow control ready* state (d1).

The action taken by the DCE when the DTE does not confirm the restart within timeout T10 is given in Appendix D, "Packet Level DCE Timeouts and DTE Time-Limits" on page D-1.

| An Nways Switch node initiates a restart procedure each time the link level is set up or re-initialized. With LAPB, a restart procedure is initiated after each complete exchange of SABM/SABME and UA frames. Moreover, an Nways Switch node also initiates a restart procedure in the cases described in Appendix C, "Actions Taken by the DCE on Receipt of Packets" on page C-1.

3.3.3 Restart Collision

Restart collision occurs when a DTE and a DCE simultaneously transfer a *restart request* and a *restart indication* packet. Under these circumstances, the DCE will consider that the restart is completed. The DCE will not expect a *DTE restart confirmation* packet and will not transfer a *DCE restart confirmation* packet. This places the logical channels used for virtual calls in the *ready* state (p1), and the logical channels used for permanent virtual circuits in the *flow control ready* state (d1).

3.4 Error Handling

Table C-1 specifies the reaction of the DCE when special error conditions are encountered. Other error conditions are discussed in Chapter 4, "Procedures for Virtual Circuit Services" on page 4-1.

3.4.1 Diagnostic Packet

The *diagnostic* packet is used by some networks to indicate error conditions under circumstances where the usual methods of indication (that is, *reset, clear* and *restart* with cause and diagnostic) are inappropriate (see Tables C-1 and D-1). The *diagnostic* packet from the DCE supplies information on error situations which are considered unrecoverable at the packet level of Recommendation X.25; the information provided permits an analysis of the error and recovery by higher levels at the DTE if desired or possible.

A *diagnostic* packet is issued only once per particular instance of an error condition. No confirmation is required to be issued by the DTE on receipt of a *diagnostic* packet.

| The Nways Switch makes use of the diagnostic packet to report error conditions to the DTE, as described above.

Chapter 4. Procedures for Virtual Circuit Services

4.1 Procedures for Virtual Call Service

Figures B-1, B-2, and B-3 show the state diagrams which define the events at the packet level DTE/DCE interface for each logical channel used for virtual calls.

Appendix C gives details of the action taken by the DCE on receipt of packets in each state shown in Appendix B.

The call setup and clearing procedures described in the following points apply independently to each logical channel assigned to the virtual call service at the DTE/DCE interface.

4.1.1 Ready State

If there is no call in existence, a logical channel is in the *ready* state (p1).

4.1.2 Call Request Packet

The calling DTE shall indicate a call request by transferring a *call request* packet across the DTE/DCE interface. The logical channel selected by the DTE is then in the *DTE waiting* state (p2). The *call request* packet includes the called DTE address. The calling DTE address field may also be used.

Notes:

1. A DTE address may be a DTE network address or any other DTE identification agreed for a period of time between the DTE and the DCE.
2. The *call request* packet should use the logical channel in the *ready* state with the highest number in the range which has been agreed with the Administration (see Appendix A). Thus the risk of call collision is minimized.

For the Nways Switch, the DTE is not required to fill the calling DTE address field, which avoids the constraint on the DTE to record its own address. In this case, the calling DTE address is inserted by the Nways Switch node. The DTE is nevertheless allowed to give its own address, or one of its addresses when more than one address has been assigned to that DTE.

The format and the semantics of the addresses that DTEs can handle must be in compliance with the Nways Switch rules and with the addressing scheme of the Nways Switch network which is the responsibility of the network service provider. Possible address formats for the Nways Switch are quoted in 5.8.

4.1.3 Incoming Call Packet

The DCE will indicate that there is an incoming call by transferring across the DTE/DCE interface an *incoming call* packet. This places the logical channel in the *DCE waiting* state (p3).

The *incoming call* packet will use the logical channel in the *ready state* with the lowest number (see Appendix A). The *incoming call* packet includes the calling DTE address. The called DTE address field may also be used.

Note: A DTE address may be a DTE network address or any other DTE identification agreed for a period of time between the DTE and the DCE.

In an incoming call packet, the Nways Switch node gives both the calling DTE address and the called DTE address. The called DTE address must be one of the addresses that have been assigned to that DTE. Possible address formats for the Nways Switch are quoted in 5.8.

The calling address is the address which has been provided by the calling DTE, or inserted by the the Nways Switch node.

4.1.4 Call Accepted Packet

The called DTE shall indicate its acceptance of the call by transferring across the DTE/DCE interface a *call accepted* packet specifying the same logical channel as that of the *incoming call* packet. This places the specified logical channel in the *data transfer* state (p4).

If the called DTE does not accept the call by a *call accepted* packet or does not reject it by a *clear request* packet as described in 4.1.7 within timeout T11 (see Appendix D), the DCE will consider it as a procedure error from the called DTE and will clear the virtual call according to the procedure described in 4.1.8.

4.1.5 Call Connected Packet

The receipt of a *call connected* packet by the calling DTE specifying the same logical channel as that specified in the *call request* packet indicates that the call has been accepted by the called DTE by means of a *call accepted* packet. This places the specified logical channel in the *data transfer* state (p4).

The time spent in the *DTE waiting* state (p2) will not exceed time-limit T21 (see Appendix D).

4.1.6 Call Collision

Call collision occurs when a DTE and DCE simultaneously transfer a *call request* packet and an *incoming call* packet specifying the same logical channel. The DCE will proceed with the *call request* and cancel the *incoming call.*

4.1.7 Clearing by the DTE

At any time, the DTE may indicate clearing by transferring across the DTE/DCE interface a *clear request* packet (see 4.5). The logical channel is then in the *DTE clear request* state (p7). When the DCE is prepared to free the logical channel, the DCE will transfer across the DTE/DCE interface a *DCE clear confirmation* packet specifying the logical channel. The logical channel is then in the *ready* state (p1).

The *DCE clear confirmation* packet can only be interpreted universally as having local significance; however, within some Administrations' networks, clear confirmation may have end-to-end significance. In all cases, the time spent in the *DTE clear request* state (p6) will not exceed time-limit T23 (see Appendix D).

For the Nways Switch, the DCE clear confirmation packet has a local significance. When the DCE receives a DTE clear request, it immediately issues the DCE clear confirmation and forwards the clear request, so that the logical channel returns to state P1 without delay.

It is possible that subsequent to transferring a *clear request* packet the DTE will receive other types of packets, depending upon the state of the logical channel, before receiving a *DCE clear confirmation* packet.

Note: The calling DTE may abort a call by clearing it before it has received a *call connected* or *clear indication* packet.

The called DTE may refuse an incoming call by clearing it as described in this point rather than transmitting a *call accepted* packet as described in 4.1.4.

4.1.8 Clearing by the DCE

The DCE will indicate clearing by transferring across the DTE/DCE interface a *clear indication* packet (see 4.5). The logical channel is then in the *DCE clear indication* state (p7). The DTE shall respond by transferring across the DTE/DCE interface a *DTE clear confirmation packet.* The logical channel is then in the *ready* state (p1).

The action taken by the DCE when the DTE does not confirm clearing within timeout T13 is given in Appendix D.

4.1.9 Clear Collision

Clear collision occurs when a DTE and DCE simultaneously transfer a *clear request* packet and a *clear indication* packet specifying the same logical channel. Under these circumstances the DCE will consider that the clearing is completed. The DCE will not expect a *DTE clear confirmation* packet and will not transfer a *DCE clear confirmation* packet. This places the logical channel in the *ready* state (p1).

4.1.10 Unsuccessful Call

If a call cannot be established, the DCE will transfer a *clear indication* packet specifying the logical channel indicated in the *call request* packet.

4.1.11 Call Progress Signals

The DCE will be capable of transferring to the DTE *clearing call progress* signals as specified in Recommendation X.96.

Clearing call progress signals will be carried in *clear indication* packets which will terminate the call to which the packet refers. The method of coding *clear indication* packets containing *call progress* signals is detailed in 5.2.3.

4.1.12 Data Transfer State

The procedures for the control of packets between DTE and DCE while in the *data transfer* state are contained in 4.3.

4.2 Procedures for Permanent Virtual Circuit Service

This is not applicable to the Nways Switch.

4.3 Procedures for Data and Interrupt Transfer

The data transfer and interrupt procedures described in this section apply independently to each logical channel assigned for virtual calls or permanent virtual circuits existing at the DTE/DCE interface.

Normal network operation dictates that user data in *data* and *interrupt* packets are all passed transparently, unaltered through the network in the case of packet DTE to packet DTE communications. The order of bits in *data* and *interrupt* packets is preserved. Packet sequences are delivered as complete packet sequences. DTE diagnostic codes are treated as described in 5.2.3, 5.4.3, and 5.5.1.

4.3.1 States for Data Transfer

A virtual call logical channel is in the *data transfer* state (p4) after completion of call establishment and prior to a clearing or a restart procedure. A permanent virtual circuit logical channel is continually in the *data transfer* state (p4) except during the restart procedure. *Data, interrupt, flow control* and *reset* packets may be transmitted and received by a DTE in the *data transfer* state of a logical channel at the DTE/DCE interface. In this state, the flow control and reset procedures described in 4.4 apply to data transmission on that logical channel to and from the DTE.

When a virtual call is cleared, *data* and *interrupt* packets may be discarded by the network (see 4.5). In addition, *data, interrupt, flow control* and *reset* packets transmitted by a DTE will be ignored by the DCE when the logical channel is in the *DCE clear indication* state (p7). Hence it is left to the DTE to define DTE to DTE protocols able to cope with the various possible situations that may occur.

4.3.2 User Data Field Length of Data Packets

The standard maximum user data field length is 128 octets.

In addition, other maximum user data field lengths may be offered by Administrations from the following list: 16, 32, 64, 256, 512, 1024, 2048, and 4096 octets. An optional maximum user data field length may be selected for a period of time as the default maximum user data field length common to all virtual calls at the DTE/DCE interface (see 6.9). A value other than the default may be selected for a period of time for each permanent virtual circuit (see 6.9). Negotiation of maximum user data field lengths on a per call basis may be made with the *flow control parameter negotiation* facility (see 6.12).

| The Nways Switch permits a nonstandard default maximum user data field length of between 128 and 4096 octets. For each PVC, a value in the same range can be subscribed to. It may be different from the default value, and different at each end of the PVC.

The user data field of *data* packets transmitted by a DTE or DCE may contain any number of bits up to the agreed maximum.

| **Note:** The Nways Switch networks require the user data field to contain an integral number of octets.

If the user data field in a *data* packet exceeds the locally permitted maximum user data field length, then the DCE will reset the virtual call or permanent virtual circuit with the resetting cause "Local procedure error".

4.3.3 Delivery Confirmation Bit

The setting of the Delivery Confirmation bit (D bit) is used to indicate whether or not the DTE wishes to receive an end-to-end acknowledgement of delivery, for data it is transmitting, by means of the packet receive sequence number P(R) (see 4.4).

Note: The use of the D bit procedure does not obviate the need for a higher level protocol agreed between the communicating DTEs which may be used with or without the D bit procedure to recover from user or network generated resets and clearings.

The calling DTE may, during call establishment, ascertain that the D bit procedure can be used for the call by setting bit 7 in the General Format Identifier of the *call request* packet to 1 (see 5.1.1). Every network or part of the international network will pass this bit transparently. If the remote DTE is able to handle the D bit procedure, it should not regard this bit being set to 1 in the *incoming call* packet as invalid.

Similarly, the called DTE can set bit 7 in the General Format Identifier of the *call accepted* packet to 1. Every network or part of the international network will pass this bit transparently. If the calling DTE is able to handle the D bit procedure, it should not regard this bit being set to 1 in the *call connected* packet as invalid.

The use by DTEs of the above mechanism in the *call request* and *call accepted* packets is recommended but is not mandatory for using the D bit procedure during the virtual call.

4.3.4 More Data Mark

If a DTE or DCE wishes to indicate a sequence of more than one packet, it uses a more data mark (M bit) as defined below.

The M bit can be set to 1 in any *data* packet. When it is set to 1 in a full *data* packet or in a partially full *data* packet also carrying the D bit set to 1, it indicates that more data is to follow. Recombination with the following *data* packet may only be performed within the network when the M bit is set to 1 in a full *data* packet which also has the D bit set to 0.

A sequence of *data* packets with every M bit set to 1 except for the last one will be delivered as a sequence of *data* packets with the M bit set to 1 except for the last one when the original packets having the M bit set to 1 are either full (irrespective of the setting of the D bit) or partially full but have the D bit set to 1.

Two categories of *data* packets, A and B, have been defined as shown in Table 4-1. Table 4-1 also illustrates the network's treatment of the M and D bits at both ends of a virtual call or permanent virtual circuit.

Table 4-1. X.25 Definition of Two Categories of Data Packets and Network Treatment of the M and D Bits

Data packet sent by source DTE				Combining with subsequent packet(s) is performed by the network when possible	Data packet (a) received by destination DTE	
Category	M	D	Full		M	D
B	0 or 1	0	No	No	0 (see Note 1)	0
B	0	1	No	No	0	1
B	1	1	No	No	1	1
B	0	0	Yes	No	0	0
B	0	1	Yes	No	0	1
A	1	0	Yes	Yes (see Note 2)	1	0
B	1	1	Yes	No	1	1

(a) Refers to the delivered *data* packet whose last bit of user data corresponds to the last bit of user data, if any, that was present in the *data* packet sent by the source DTE.

Notes:

1. The originating network will force the M bit to 0.
2. If the *data* packet sent by the source DTE is combined with other packets, up to and including a *category B* packet, the M and D bit settings in the *data* packet received by the destination DTE will be according to that given in the two right-hand columns for the last *data* packet sent by the source DTE that was part of the combination.

4.3.5 Complete Packet Sequence

A complete packet sequence is defined as being composed of a single *category B* packet and all contiguous preceding *category A* packets (if any). *Category A* packets have the exact maximum user data field length with the M bit set to 1 and D bit set to 0. All other *data* packets are *category B* packets.

When transmitted by a source DTE, a complete packet sequence is always delivered to the destination DTE as a single complete packet sequence.

Thus, if the receiving end has a larger maximum user data field length than the transmitting end, then packets within a complete packet sequence will be combined within the network. They will be delivered in a complete packet sequence where each packet, except the last one, has the exact maximum user data field length, the M bit set to 1, and the D bit set to 0. The user data field of the last packet of the sequence may have less than the maximum length and the M and D bits are set as described in Table 4-1.

If the maximum user data field length is the same at both ends, then user data fields of *data* packets are delivered to the receiving DTE exactly as they have been received by the network, except as follows. If a full packet with the M bit set to 1 and D bit set to 0 is followed by an empty packet, then the two packets may be merged so as to become a single *category B* full packet.

| The Nways Switch does not merge a full packet, with the M bit set to 1 and D bit set to 0 with an empty packet, into a single packet when the packet sizes are identical at both ends.

If the last packet of a complete packet sequence transmitted by the source DTE has a data field less than the maximum length, the M bit set to 1 and the D bit set to 0, then the last packet of the complete packet sequence delivered to the receiving DTE will have the M bit set to 0.

If the receiving end has a smaller maximum user data field length than the transmitting end, the packets will be segmented within the network, and the M and D bits will be set by the network as described to maintain complete packet sequences.

4.3.6 Qualifier Bit

In some cases, an indicator may be needed with the user data field to distinguish between two types of information. It may be necessary to differentiate, for example, between user data and control information. An example of such a case is contained in Recommendation X.29.

If such a mechanism is needed, an indicator in the *data* packet header called the Qualifier bit (Q bit) may be used.

The use of the Q bit is optional. If this mechanism is not needed, the Q bit is always set to 0. If the Q bit mechanism is used, the transmitting DTE should set the Q bit so as to have the same value (that is, 0 or 1) in all *data* packets of the same complete packet sequence. A complete packet sequence transferred by the DTE to the DCE in this fashion will be delivered to the distant DTE as a complete packet sequence having the Q bit set in all packets to the value assigned by the transmitting DTE.

If the Q bit is not set by the DTE to the same value in all the *data* packets of a complete packet sequence, the value of the Q bit in any of the *data* packets of the corresponding packet sequence transferred to the distant DTE is not guaranteed by the network. Moreover, some networks may reset the virtual call or permanent virtual circuit as described in Appendix C/X.25.

| The Nways Switch resets the virtual circuit when the Q bit is not set to the same value in a complete packet sequence as described in Appendix C/X.25.

Successive data packets are numbered consecutively (see 4.4.1.1) regardless of the value of the Q bit.

4.3.7 Interrupt Procedure

The interrupt procedure allows a DTE to transmit data to the remote DTE, without following the flow control procedure applying to *data* packets (see 4.4). The interrupt procedure can only apply in the *flow control ready* state (d1) within the *data transfer* state (p4).

The interrupt procedure has no effect on the transfer and flow control procedures applying to the *data* packets on the virtual call or permanent virtual circuit.

To transmit an interrupt, a DTE transfers across the DTE/DCE interface a *DTE interrupt* packet. The DTE should not transmit a second *DTE interrupt* packet until the first one is confirmed with a *DCE interrupt confirmation* packet (see Table C-4). The DCE, after the interrupt procedure is completed at the remote end, will confirm the receipt of the interrupt by transferring a *DCE interrupt confirmation* packet. The receipt of a *DCE interrupt confirmation* packet indicates that the interrupt has been confirmed by the remote DTE by means of a *DTE interrupt confirmation* packet.

The DCE indicates an interrupt from the remote DTE by transferring across the DTE/DCE interface a *DCE interrupt* packet containing the same data field as in the *DTE interrupt* packet transmitted by the remote DTE. A *DCE interrupt* packet is delivered at or before the point in the stream of *data* packets at which the *DTE interrupt* packet was generated. The DTE will confirm the receipt of the *DCE interrupt* packet by transferring a *DTE interrupt confirmation* packet.

4.3.8 Transit Delay of Data Packets

Transit delay is an inherent characteristic of a virtual call or a permanent virtual circuit, common to the two directions of transmission.

This transit delay is the data packet transfer delay as defined in section 3.1 of Recommendation X.135, measured between boundaries B2 and Bn-1, as defined in Figure 2/X.135 (that means, excluding the access lines), with the conditions given in 3.2/X.135, and is expressed in terms of mean value.

In the Nways Switch, the transit delay is the maximum data packet transfer delay required for the virtual circuit. A default transit delay is assigned to the DTE/DCE interface, and is used, in the absence of the *transit delay selection and indication* facility, to compute the path of the virtual circuit across the NBBS network.

Selection of the transit delay on a per call basis may be made by the means of the *transit delay selection and indication* facility (see 6.27, “Transit Delay Selection and Indication” on page 6-11).

4.4 Procedures for Flow Control

Paragraph 4.4 only applies to the *data transfer* state (p4) and specifies the procedures covering flow control of *data* packets and reset on each logical channel used for a virtual call or a permanent virtual circuit.

4.4.1 Flow Control

At the DTE/DCE interface of a logical channel used for a virtual call or permanent virtual circuit, the transmission of *data* packets is controlled separately for each direction and is based on authorizations from the receiver.

On a virtual call or permanent virtual circuit, flow control also allows a DTE to limit the rate at which it accepts packets across the DTE/DCE interface, noting that there is a network-dependent limit on the number of *data* packets which may be in the network on the virtual call or permanent virtual circuit.

4.4.1.1 Numbering of Data Packets

Each *data* packet transmitted at the DTE/DCE interface for each direction of transmission in a virtual call or permanent virtual circuit is sequentially numbered.

The sequence numbering scheme of the packets is performed modulo 8. The packet sequence numbers cycle through the entire range 0 to 7.

The Nways Switch provides the *extended packet sequence numbering* facility (see 6.2) which, if selected, provides a sequence numbering scheme for packets being performed modulo 128. The packet sequence numbering scheme, modulo 8 or 128, is the same for both directions of transmission and is common for all logical channels at the DTE/DCE interface.

Only *data* packets contain this sequence number called the packet send sequence number P(S).

The first *data* packet to be transmitted across the DTE/DCE interface for a given direction of data transmission, when the logical channel has just entered the *flow control ready* state (d1), has a packet send sequence number equal to 0.

4.4.1.2 Window Description

At the DTE/DCE interface, a window is defined for each direction of data transmission of a logical channel used for a virtual call or permanent virtual circuit. The window is the ordered set of W consecutive packet send sequence numbers of the *data* packets authorized to cross the interface.

The lowest sequence number in the window is referred to as the lower window edge. When a virtual call or permanent virtual circuit at the DTE/DCE interface has just entered the *flow control ready* state (d1), the window related to each direction of data transmission has a lower window edge equal to 0.

The packet send sequence number of the first *data* packet not authorized to cross the interface is the value of the lower window edge plus W (modulo 8, or 128 when extended).

The standard window size W is 2 for each direction of data transmission at the DTE/DCE interface. In addition, other window sizes may be offered by Administrations. An optional window size may be selected for a period of time as the default window size common to all virtual calls at the DTE/DCE interface (see 6.10). A value other than the default may be selected for a period of time for each permanent virtual circuit (see 6.10). Negotiation of window sizes on a per call basis may be made with the *flow control parameter negotiation* facility (see 6.12).

The flow control parameter negotiation facility is supported by the Nways Switch.

The Nways Switch permits a default window size of between 1 and 7 (sequence numbering modulo 8). For each PVC, a value in the same range can be selected and may be different from the default value.

4.4.1.3 Flow Control Principles

When the sequence number P(S) of the next *data* packet to be transmitted by the DCE is within the window, the DCE is authorized to transmit this *data* packet to the DTE. When the sequence number P(S) of the next data packet to be transmitted by the DCE is outside the window, the DCE will not transmit a *data* packet to the DTE. The DTE should follow the same procedure.

When the sequence number P(S) of the *data* packet received by the DCE is the next in sequence and is within the window, the DCE will accept this *data* packet. A received *data* packet containing a P(S) that is out of sequence (that is, there is a duplicate or a gap in the P(S) numbering), outside the window, or not equal to 0 for the first *data* packet after entering the *flow control ready* state (d1) is considered by the DCE as a local procedure error. The DCE will reset the virtual call or permanent virtual circuit (see 4.4.3). The DTE should follow the same procedure.

A number (modulo 8, or 128 when extended), referred to as a packet receive sequence number P(R), conveys across the DTE/DCE interface information from the receiver for the transmission of *data* packets. When transmitted across the DTE/DCE interface, a P(R) becomes the lower window edge. In this way, additional *data* packets may be authorized by the receiver to cross the DTE/DCE interface.

The packet receive sequence number, P(R), is conveyed in *data, receive ready* (RR), and *receive not ready* (RNR) packets.

The Nways Switch does not use *RNR* packets to convey P(R) updates. If congestion occurs, the Nways Switch stops reporting P(R) updates, except to acknowledge a data packet holding the D-bit. Then the P(R) conveyed in the *RR* packet just acknowledges this data packet, and not any further ones which could have been sent.

The value of a P(R) received by the DCE must be within the range from the last P(R) received by the DCE up to and including the packet send sequence number of the next *data* packet to be transmitted by the DCE. Otherwise, the DCE will consider the receipt of this P(R) as a procedure error and will reset the virtual call or permanent virtual circuit. The DTE should follow the same procedure.

The receive sequence number P(R) is less than or equal to the sequence number of the next expected *data* packet and implies that the DTE or DCE transmitting P(R) has accepted at least all *data* packets numbered up to and including P(R)-1.

4.4.1.4 Delivery confirmation

When the D bit is set to 0 in a *data* packet having P(S)=p, the significance of the returned P(R) corresponding to that *data* packet (that is, P(R) ≥ p + 1) is a local updating of the window across the packet level interface so that the achievable throughput is not constrained by the DTE to DTE round trip delay across the network(s).

When the D bit is set to 0 in a *data* packet, the returned P(R) corresponding to that *data* packet does not signify that a P(R) has been received from the remote DTE.

When the D bit is set to 1 in a *data* packet having P(S)=p, the significance of the returned P(R) corresponding to that *data* packet (that is, P(R) ≥ p + 1) is an indication that a P(R) has been received from the remote DTE for all data bits in the *data* packet in which the D bit had originally been set to 1.

Notes:

1. A DTE, on receiving a *data* packet with the D bit set to 1, should transmit the corresponding P(R) as soon as possible in order to avoid the possibility of deadlocks (that is, without waiting for further *data* packets). A *data, RR* or *RNR* packet may be used to convey the P(R) (see Note to 4.4.1.6). Likewise, the DCE is required to send P(R) to the DTE as soon as possible from when the P(R) is received from the remote DTE. When the DTE is not currently operating the D bit procedure, the receipt of a *data* packet with the D bit set to 1 may be treated by the DTE as an error condition.
2. If a P(R) for a *data* packet with the D bit set to 1 is outstanding, local updating of the window will be deferred for subsequent *data* packets with the D bit set to 0.

   The Nways Switch does not return immediately an update of the P(R) for all data packets with the D bit set to 0. If the window is less than half-full, an internal timer is started and an update of P(R) will occur when this timer expires. If the window is half-full then the update of P(R) occurs immediately, if no congestion condition exists in the network.
3. P(R) values corresponding to the data contained in *data* packets with the D bit set to 1 need not be the same at the DTE/DCE interfaces at each end of a virtual call or a permanent virtual circuit.
4. If the DTE has sent *data* packets with the D bit set to 0, the DTE does not have to wait for local updating of the window by the DCE before initiating a resetting or clearing procedure.

4.4.1.5 DTE and DCE Receive Ready (RR) Packets

RR packets are used by the DTE or DCE to indicate that it is ready to receive the W data packets within the window starting with P(R), where P(R) is indicated in the *RR* packet.

4.4.1.6 DTE and DCE Receive Not Ready (RNR) Packets

RNR packets are used by the DTE or DCE to indicate a temporary inability to accept additional *data* packets for a given virtual call or permanent virtual circuit. A DTE or DCE receiving an *RNR* packet shall stop transmitting *data* packets on the indicated logical channel, but the window is updated by the P(R) value of the *RNR* packet. The receive not ready situation indicated by the transmission of an *RNR* packet is cleared by the transmission in the same direction of an *RR* packet or by the initiation of a reset procedure.

The transmission of an *RR* packet after an *RNR* packet at the packet level is not to be taken as a demand for retransmission of packets which have already been transmitted.

Note: The *RNR* packet may be used to convey across the DTE/DCE interface the P(R) value corresponding to a *data* packet which had the D bit set to 1 in the case that additional *data* packets cannot be accepted.

The Nways Switch never sends an *RNR* packet. It can accept an *RNR* packet sent from the DTE.

4.4.2 Throughput Characteristics and Throughput Classes

The definitions of throughput and steady state throughput are given in §4 of Recommendation X.135.

A throughput class for one direction of transmission is an inherent characteristic of the virtual call related to the amount of resources allocated to this virtual call. It is a measure of the steady state throughput that can be provided under optimal conditions on a virtual call. However, due to the statistical sharing of transmission and switching resources, it is not guaranteed that the throughput class can be reached 100% of the time.

The relations between throughput class and the throughput parameters and objectives described in Recommendation X.135 require further study. The complete definition of the optimal conditions where the measure of the steady state throughput in relation to throughput class is meaningful also requires further study. Pending the results of these further studies, it cannot be guaranteed or verified that a network supporting a given throughput class value (64 bit/s for instance) offers better performance to its users than a network not supporting that throughput class. However, a network may offer a guarantee to its users on a contractual basis.

The optimal conditions for measurement include the following:

1. The access line characteristics of the local and remote DTEs do not constrain the throughput class;

   Note — In particular, because of the overhead due to the frame and packet headers, when the throughput class corresponding to the user class of service of the DTE is applicable to a virtual call or permanent virtual circuit, a steady state throughput equal to that throughput class can never be reached.

2. The window sizes at the local and remote DTE/DCE interfaces do not constrain the throughput;
3. The traffic characteristics of other logical channels at local and remote DTE/DCE interfaces do not constrain the throughput;
4. The receiving DTE is not flow controlling the DCE such that the throughput class is not attainable;
5. The transmitting DTE sends only *data* packets which have the maximum data field length;
6. The D bit is not set to 1.

The throughput class is expressed in bits per second. The maximum data field length is specified for a virtual call or permanent virtual circuit, and thus the throughput class can be interpreted by the DTE as the number of full *data* packets/second that the DTE/DCE interface.

In the absence of the *default throughput classes assignment* facility (see §6.11), the default throughput classes for both directions of transmission correspond to the user class of service of the DTE but do not exceed the maximum throughput class supported by the network. Negotiation of throughput classes on a per call basis may be made with the *throughput class negotiation* facility (see §6.13).

Note — The sum of the throughput classes of all virtual calls and permanent virtual circuits supported at a DTE/DCE interface may be greater than the data transmission rate of the access line.

| The Nways Switch supports (as a subscription parameter) the default throughput class assignment facility. Default throughput classes must be lower than or equal to the user class of service of the DTE (access link speed).

| The Nways Switch supports also the *throughput class negotiation* facility.

| The Nways Switch uses the throughput class, either assigned at configuration time or requested at call set-up time, to reserve bandwidth within the NBBS network, for the virtual circuit being set-up.

4.4.3 Procedure for Reset

The reset procedure is used to re-initialize the virtual call or permanent virtual circuit and in so doing removes in each direction all *data* and *interrupt* packets which may be in the network (see 4.5). When a virtual call or permanent virtual circuit at the DTE/DCE interface has just been reset, the window related to each direction of data transmission has a lower window edge equal to 0, and the numbering of subsequent *data* packets to cross the DTE/DCE interface for each direction of data transmission shall start from 0.

The reset procedure can only apply in the *data transfer* state (p4) of the DTE/DCE interface. In any other state of the DTE/DCE interface, the reset procedure is abandoned. For example, when a clearing or restarting procedure is initiated, *reset request* and *reset indication* packets can be left unconfirmed.

For flow control, there are three states d1, d2 and d3 within the *data transfer* state (p4). They are *flow control ready* (d1), *DTE reset request* (d2), and *DCE reset indication* (d3) as shown in the state diagram in Figure B-3. When entering state p4, the logical channel is placed in state d1. Table C-4 specifies actions taken by the DCE on the receipt of packets from the DTE.

4.4.3.1 Reset Request Packet

The DTE shall indicate a request for reset by transmitting a *reset request* packet specifying the logical channel to be reset. This places the logical channel in the *DTE reset request* state (d2).

4.4.3.2 Reset Indication Packet

The DCE will indicate a reset by transmitting to the DTE a *reset indication* packet specifying the logical channel being reset and the reason for the resetting. This places the logical channel in the *DCE reset indication* state (d3). In this state, the DCE will ignore *data, interrupt, RR* and *RNR* packets.

4.4.3.3 Reset Collision

Reset collision occurs when a DTE and a DCE simultaneously transmit a *reset request* packet and a *reset indication* packet specifying the same logical channel. Under these circumstances the DCE will consider that the reset is completed. The DCE will not expect a *DTE reset confirmation* packet and will not transfer a *DCE reset confirmation* packet. This places the logical channel in the *flow control ready* state (d1).

4.4.3.4 Reset Confirmation Packets

When the logical channel is in the *DTE reset request* state (d2), the DCE will confirm reset by transmitting to the DTE a *DCE reset confirmation* packet. This places the logical channel in the *flow control ready* state (d1).

The *DCE reset confirmation* packet can only be interpreted universally as having local significance; however, within some Administrations' networks, *reset confirmation* may have end-to-end significance. In all cases the time spent in the *DTE reset request* state (d2) will not exceed time-limit T22 (see Appendix D).

The Nways Switch offers a local significance to the DCE reset confirmation, in that the DCE reset confirmation packet is sent back to the DTE immediately after reception by the DCE of a DTE reset request, while the reset procedure is forwarded to the remote DTE. This is done in compliance with the requirements of 4.5.

When the logical channel is in the *DCE reset indication* state (d3), the DTE will confirm reset by transmitting to the DCE or a *DTE reset confirmation* packet. This places the logical channel in the *flow control ready* state (d1). The action taken by the DCE when the DTE does not confirm the reset within timeout T12 is given in Appendix D.

4.5 Effects of Clear, Reset, and Restart Procedures on the Transfer of Packets

All *data* and *interrupt* packets generated by a DTE (or the network) before initiation by the DTE or the DCE of a clear, reset or restart procedure at the local interface will either be delivered to the remote DTE before the DCE transmits the corresponding indication on the remote interface, or be discarded by the network.

No *data* or *interrupt* packets generated by a DTE (or the network) after the completion of a reset (or for permanent virtual circuits also a restart) procedure at the local interface will be delivered to the remote DTE before the completion of the corresponding reset procedure at the remote interface.

When a DTE initiates a clear, reset or restart procedure at its local interface, all *data* and *interrupt* packets which were generated by the remote DTE (or the network) before the corresponding indication is transmitted to the remote DTE will be either delivered to the initiating DTE before DCE confirmation of the initial clear, reset or restart request, or be discarded by the network.

Data packets waiting in an Nways Switch node for transmission on a DTE access line or on a line to another node are discarded when the restart, clear, or reset procedure is initiated on that node.

Note: The maximum number of packets which may be discarded is a function of network end-to-end delay and throughput characteristics and, in general, has no relation to the local window size. For virtual calls and permanent virtual circuits on which all *data* packets are transferred with the D bit set to 1, the maximum number of packets which may be discarded in one direction of transmission is not larger than the window size of the direction of transmission.

4.6 Effects of the Physical Layer and the Data Link Layer on the Packet Layer

4.6.1 General Principles

In general, if a problem is detected in one layer (physical, data link or packet layer) and can be solved in the layer according to the DCE error recovery procedures provided in this Recommendation without loss or duplication of data the adjacent layers are not involved in the error recovery.

If an error recovery by the DCE implies a possible loss or duplication of data then the higher layer is informed.

The reinitialization of one layer by the DCE is only performed if a problem cannot be solved in this layer.

Changes of operational states of the physical layer and the link layer of the DTE/DCE interface do not implicitly change the state of each logical channel at the packet layer. Such changes when they occur are explicitly indicated at the packet layer by the use of restart, clear or reset procedures as appropriate.

4.6.2 Definition of an out of order condition

In the case of a single link procedure, there is an out of order condition when:

- a failure of the physical and/or data link layer is detected; such a failure is defined as a condition in which the DCE cannot transmit or cannot receive any frame because of abnormal conditions caused by, for instance, a line default between the DTE and the DCE;
- the DCE has received or transmitted a DISC command.

There may be other out of order network-dependant conditions such as: reset of the data link layer, receipt or transmission of a DM response,....

4.6.3 Actions on the packet layer when an out of order condition is detected

When an out of order condition is detected, the DCE will transmit to the remote end:

1. A reset with the cause "Out of order" for each permanent virtual circuit
2. A clear with the cause "Out of order" for each existing virtual call.

4.6.4 Actions on the packet layer during an out of order condition

During an out of order condition:

1. The DCE will clear any incoming virtual call with the cause "Out of order"
2. For any *data* or *interrupt* packet received from the remote DTE on a permanent virtual circuit, the DCE will reset the permanent virtual circuit with the cause "Out of order"
3. A *reset* packet received from the remote DTE on a permanent virtual circuit will be confirmed to the remote DTE by either *reset confirmation* or *reset indication* packet.

4.6.5 Actions on the packet layer when the out of order condition is recovered

When the out of order condition is recovered:

1. the DCE will send a *restart indication* packet with the cause "Network operational" to the local DTE
2. a reset with the cause "Remote DTE operational" will be transmitted to the remote end of each permanent virtual circuit.

Chapter 5. Packet Formats

5.1 General

The possible extension of packet formats by the addition of new fields is for further study.

Note: Any such field:

1. Would only be provided as an addition following all previously defined fields, and not as an insertion between any of the previously defined fields
2. Would be transmitted to a DTE only when either the DCE has been informed that the DTE is able to interpret this field and act upon it, or when the DTE can ignore the field without adversely affecting the operation of the DTE/DCE interface (including charging)
3. Would not contain any information pertaining to a user facility to which the DTE has not subscribed, unless the DTE can ignore the facility without adversely affecting the operation of the DTE/DCE interface (including charging).

Bits of an octet are numbered 8 to 1 where bit 1 is the low order bit and is transmitted first. Octets of a packet are consecutively numbered starting from 1 and are transmitted in this order.

5.1.1 General Format Identifier

The general format identifier field is a four bit binary coded field which is provided to indicate the general format of the rest of the header. The general format identifier field is located in bit positions 8, 7, 6 and 5 of octet 1, and bit 5 is the low order bit (see Table 5-1).

Bit 8 of the general format identifier is used for the Qualifier bit in *data* packets and is set to 0 in all other packets.

Bit 7 of the general format identifier is used for the delivery confirmation procedure in *data* and *call setup* packets and is set to 0 in all other packets.

Bits 6 and 5 are encoded for four possible indications. The third code is used to indicate an extension to an expanded format for a family of general format identifier codes which are a subject of further study. The fourth code is reserved for other applications.

Notes:

1. The DTE must encode the general format identifier (GFI) to be consistent with the modulo 8 packet sequence numbering.
2. It is envisaged that other general format identifier codes could identify alternative packet formats.

5.1.2 Logical Channel Group Number

The logical channel group number appears in every packet except *restart, diagnostic,* and *registration* packets in bit positions 4, 3, 2 and 1 of octet 1. For each logical channel, this number has local significance at the DTE/DCE interface.

This field is binary coded and bit 1 is the low order bit of the logical channel group number. In *restart, diagnostic* and *registration* packets, this field is coded all zeros.

Table 5-1. X.25 General Format Identifier

General format identifier		Octet 1 Bits 8 7 6 5
Call set-up packets	Sequence numbering scheme modulo 8	0 X 0 1
	Sequence numbering scheme modulo 128	0 X 1 0
Clearing, flow control, interrupt, reset, restart, registration, and diagnostic packets	Sequence numbering scheme modulo 8	0 0 0 1
	Sequence numbering scheme modulo 128	0 0 1 0
Data packets	Sequence numbering scheme modulo 8	X X 0 1
	Sequence numbering scheme modulo 128	X X 1 0
General format identifier extension		0 0 1 1
Reserved for other applications		* * 0 0

* Undefined.

Notes:

1. A bit which is indicated as "X" may be set to either 0 or 1 as indicated in the text.
2. Schemes modulo 128 are not supported by the Nways Switch.

5.1.3 Logical Channel Number

The logical channel number appears in every packet except *restart, diagnostic,* and *registration* packets in all bit positions of octet 2. For each logical channel, this number has local significance at the DTE/DCE interface.

This field is binary coded and bit 1 is the low order bit of the logical channel number. In *restart, diagnostic* and *registration* packets, this field is coded all zeros.

5.1.4 Packet Type Identifier

Each packet shall be identified in octet 3 of the packet according to Table 5-2.

The Nways Switch does not support the *online registration* facility, thus *registration request* and *registration confirmation* packets are not

The Nways Switch does not support the *packet retransmission* facility, thus DTE REJ packets are not handled.

When such packets are sent by the DTE, the DCE reacts as indicated in Appendix C (restart, clear, or reset sent to the DTE).

Table 5-2. X.25 Packet Type Identifier

Packet type		Octet 3 Bits
From DCE to DTE	From DTE to DCE	8 7 6 5 4 3 2 1
CALL SET–UP AND CLEARING		
Incoming call	Call request	0 0 0 0 1 0 1 1
Call connected	Call accepted	0 0 0 0 1 1 1 1
Clear indication	Clear request	0 0 0 1 0 0 1 1
DCE clear confirmation	DTE clear confirmation	0 0 0 1 0 1 1 1
DATA AND INTERRUPT		
DCE data	DTE data	X X X X X X X 0
DCE interrupt	DTE interrupt	0 0 1 0 0 0 1 1
DCE interrupt confirmation	DTE interrupt confirmation	0 0 1 0 0 1 1 1
FLOW CONTROL AND RESET		
DCE RR (modulo 8)	DTE RR (modulo 8)	X X X 0 0 0 0 1
DCE RR (modulo 128)	DTE RR (modulo 128) (a)	0 0 0 0 0 0 0 1
DCE RNR (modulo 8)	DTE RNR (modulo 8)	X X X 0 0 1 0 1
DCE RNR (modulo 128)	DTE RNR (modulo 128) (a)	0 0 0 0 0 1 0 1
	DTE REJ (modulo 8) (a)	X X X 0 1 0 0 1
	DTE REJ (modulo 128) (a)	0 0 0 0 1 0 0 1
Reset indication	Reset request	0 0 0 1 1 0 1 1
DCE reset confirmation	DTE reset confirmation	0 0 0 1 1 1 1 1
RESTART		
Restart indication	Restart request	1 1 1 1 1 0 1 1
DCE restart confirmation	DTE restart confirmation	1 1 1 1 1 1 1 1
DIAGNOSTIC		
Diagnostic		1 1 1 1 0 0 0 1
REGISTRATION (a)		
	Registration request (a)	1 1 1 1 0 0 1 1
Registration confirmation (a)		1 1 1 1 0 1 1 1

(a) Not supported by the Nways Switch.

Note: A bit which is indicated as "X" may be set to either 0 or 1 as indicated in the text.

5.2 Call Setup and Clearing Packets

5.2.1 Address Block Format

The call set-up and clearing packets contain an address block. This address block has two possible formats: a non-TOA/NPI address format and a TOA/NPI address format. These two formats are distinguished by bit 8 of the general format identifier (A bit). When the A bit is set to 0, the non-TOA/NPI address format is used. When the A bit is set to 1, the TOA/NPI address format is used.

The non-TOA/NPI address format is supported by all networks. The TOA/NPI address format may be supported by some networks, in particular by those networks wishing to communicate with ISDNs for which the TOA/NPI address format provides insufficient addressing capacity.

| The Nways Switch supports only the non-TOA/NPI address format.

Note — Prior to 1997, packet-mode DTEs operating according to case B of Recommendation X.31 (ISDN virtual circuit bearer service) will be addressed by a maximum 12 digit address from the E.164 numbering plan. After 1996, such a packet-mode DTE may have 15 digit E.164 addresses. TOA/NPI address procedures will be required to address these DTEs. Recommendations E.165 and E.166 provide further guidance.

When transmitting a call set-up or clearing packet, a DCE will use the TOA/NPI address format if the DTE has subscribed to the *TOA/NPI address subscription* facility (see §6.28), the non TOA/NPI address format if it has not.

Note: The *TOA/NPI address subscription* facility is designated in Recommendation X.2 for further study (FS). In addition, there are several technical items associated with this TOA/NPI address format which are for further study.

When transmitting a call set-up or clearing packet, a DTE will use the TOA/NPI address format if the DTE has subscribed to the *TOA/NPI address subscription* facility, the non-TOA/NPI address format if it has not.

When the address format used by one DTE in a call set-up or clearing packet is different from the address format used by the remote DTE, the network (if it supports the TOA/NPI address format) converts from one address format to the other (see §6.2.8).

5.2.1.1 Format of the Address Block When the A Bit is Set to 0 (Non-TOA/NPI Address)

Figure 5-1 illustrates the format of the address block when the A bit is set to 0.

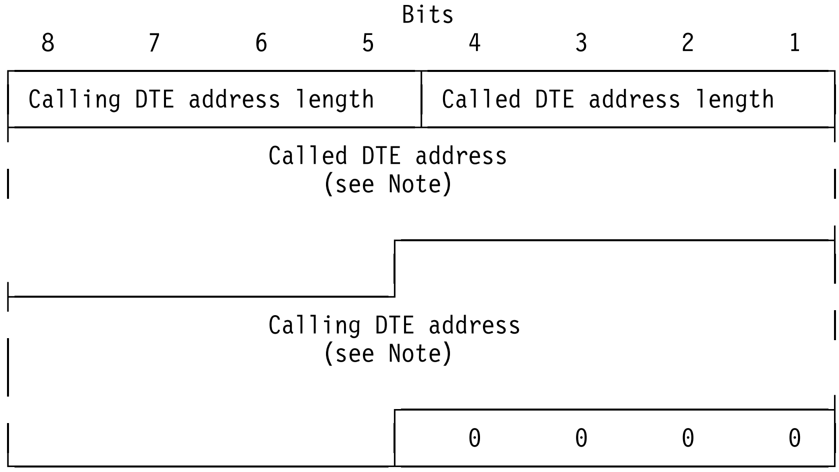


Figure 5-1. Format of the Address Block When the A Bit is set to 0

Note: The figure is drawn assuming the number of address digits present in the called DTE address field is odd and the number of address digits present in the calling DTE address field is even.

5.2.1.1.1 Calling and Called DTE Address Length Fields:

These fields are four bits long each and consist of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each DTE address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

5.2.1.1.2 Called and Calling DTE Address Fields:

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit.

Starting from the high order digit, a DTE address is coded in consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

When present, the calling DTE address field starts on the first semi-octet following the end of the called DTE address field. Consequently, when the number of digits of the called DTE address field is odd, the beginning of the calling DTE address field, when present, is not octet aligned.

When the total number of digits in the called and calling DTE address fields is odd, a semi-octet with zeros in bits 4, 3, 2 and 1 will be inserted after the calling DTE address field in order to maintain octet alignment.

Further information on the coding of called and calling DTE address fields is given in 5.8, "Nways Switch Address Formats" on page 5-28.

Note: These fields may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed as well as the coding of those facilities are for further study.

5.2.1.2 Format of the Address Block When the A Bit is Set to 1 (TOA/NPI Address)

The TOA/NPI address format is not applicable in the Nways Switch environment.

5.2.2 Call Request and Incoming Call Packets

Figure 5-2 illustrates the format of _call request_ and _incoming call_ packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note 1)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier 0	0	0	0	1	0	1	1
4	Calling DTE address length				Called DTE address length			
	DTE address(es) (see Note 2)				0	0	0	0
	Facility length							
	Facilities							
	Call user data							

Figure 5-2. X.25 Call Request and Incoming Call Packet Format

Notes:

1. Coded 0X01 (modulo 8)
2. The figure is drawn assuming the total number of address digits present is odd.

5.2.2.1 General Format Identifier

Bit 7 of octet 1 should be set to 0 unless the mechanism defined in 4.3.3 is used.

5.2.2.2 Address Length Fields

Octet 4 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2, and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

5.2.2.3 Address Field

Octet 5 and the following octets consist of the called DTE address when present, then the calling DTE address when present.

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit.

Starting from the high order digit, the address is coded in octet 5 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The address field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field when necessary.

Note: This field may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed as well as the coding of these facilities are for further study.

5.2.2.4 Facility Length Field

The octet following the address field indicates the length of the facility field in octets. The facility length indicator is binary coded and bit 1 is the low order bit of the indicator.

5.2.2.5 Facility Field

The facility field is present only when the DTE is using an optional user facility requiring some indication in the *call request* and *incoming call* packets.

The coding of the facility field is defined in 6 and 7.

The facility field contains an integral number of octets. The actual maximum length of this field depends on the facilities which are offered by the network. However, this maximum does not exceed 109 octets.

5.2.2.6 Call User Data Field

Following the facility field, the call user data field may be present and has a maximum length of 128 octets when used in conjunction with the *fast select* facility described in 6.16, 16 octets in the other case.

Note: Nways Switch networks require the call user data field to contain an integral number of octets.

When the virtual call is being established between two packet-mode DTEs, the network does not act on any part of the call user data field. See Recommendation X.244.

5.2.3 Call Accepted and Call Connected Packets

Figure 5-3 illustrates the format of _call accepted_ and _call connected_ packets in the basic or extended format.

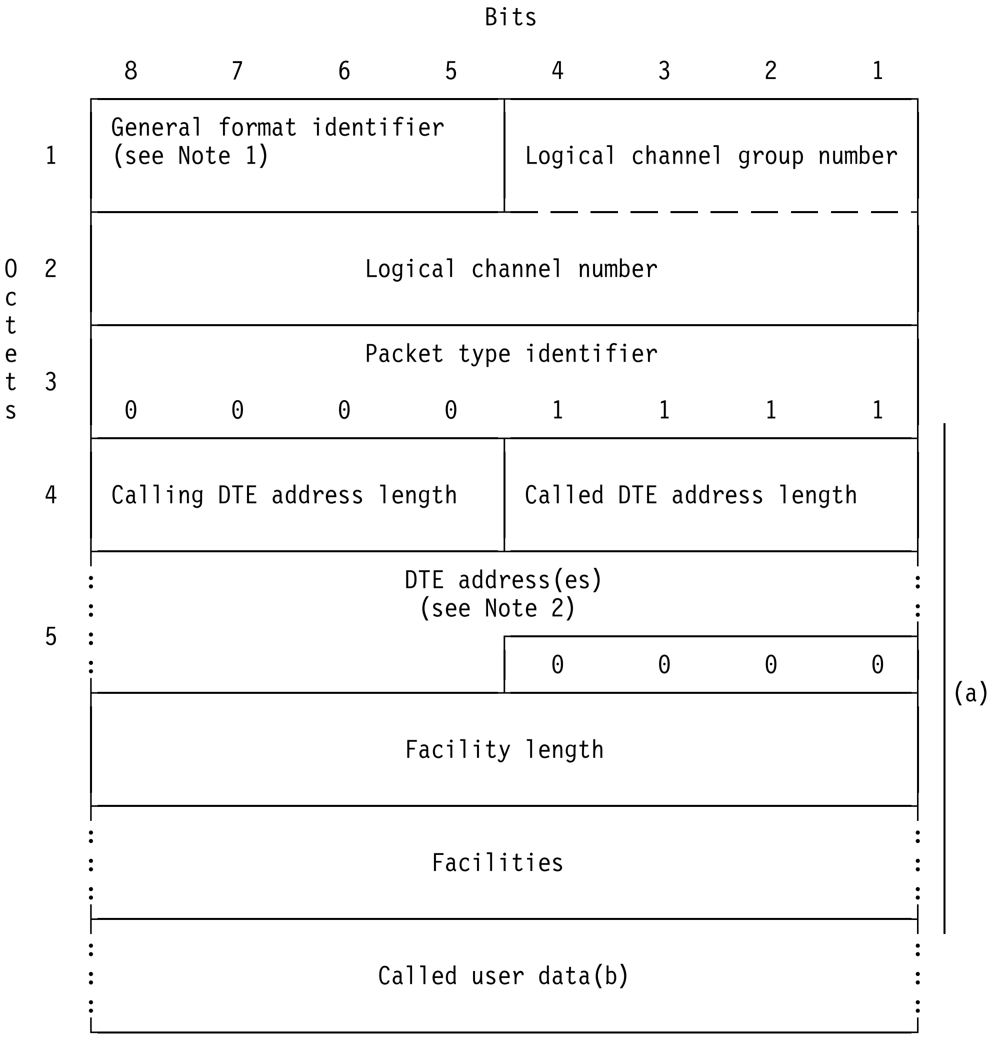


Figure 5-3. X.25 Call Accepted and Call Connected Packet Format

a. These fields are not mandatory in the basic format of _call accepted_ packets (see 5.2.3.1).

b. This field may be present only in the extended format (see 5.2.3.2).

Notes:

1. Coded 0X01 (modulo 8)
2. The figure is drawn assuming the total number of address digits present is odd.

5.2.3.1 Basic Format

5.2.3.1.1 General Format Identifier Bit 7 of octet 1 should be set to 0 unless the mechanism defined in 4.3.3 is used.

5.2.3.1.2 Address Length Fields Octet 4 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

The use of the address length fields in *call accepted* packets is only mandatory when the address field or the facility length field is present.

5.2.3.1.3 Address Field Octet 5 and the following octets consist of the called DTE address when present, then the calling DTE address when present. Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit.***:*** Starting from the high order digit, the address is coded in octet 5 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The address field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field when necessary.

Note: This field may be used for optional addressing facilities such as abbreviated addressing. The optional addressing facilities employed as well as the coding of those facilities is for further study.

5.2.3.1.4 Facility Length Field The octet following the address field indicates the length of the facility field in octets. The facility length indicator is binary coded and bit 1 is the low order bit of the indicator.

The use of the facility length field in *call accepted* packets is only mandatory when the facility field is present.

5.2.3.1.5 Facility Field The facility field is present only when the DTE is using an optional user facility requiring some indication in the *call accepted* and *call connected* packets.

The coding of the facility field is defined in 6 and 7.

The facility field contains an integral number of octets. The actual maximum length of this field depends on the facilities which are offered by the network. However, this maximum does not exceed 109 octets.

5.2.3.2 Extended Format

The extended format may be used only in conjunction with the fast select facility described in 6.16. In this case the called user data field may be present and has a maximum length of 128 octets.

The address length and facility length fields must be present when the call user data field is present.

| The Nways Switch supports the fast select facility.

Note: The Nways Switch network requires the call user data field to contain an integral number of octets.

When the virtual call is being established between two packet-mode DTEs, the network does not act on any part of the called user data field. See Recommendation X.244.

5.2.4 Clear Request and Clear Indication Packets

Figure 5-4 illustrates the format of _clear request_ and _clear indication_ packets, in basic and extended formats.

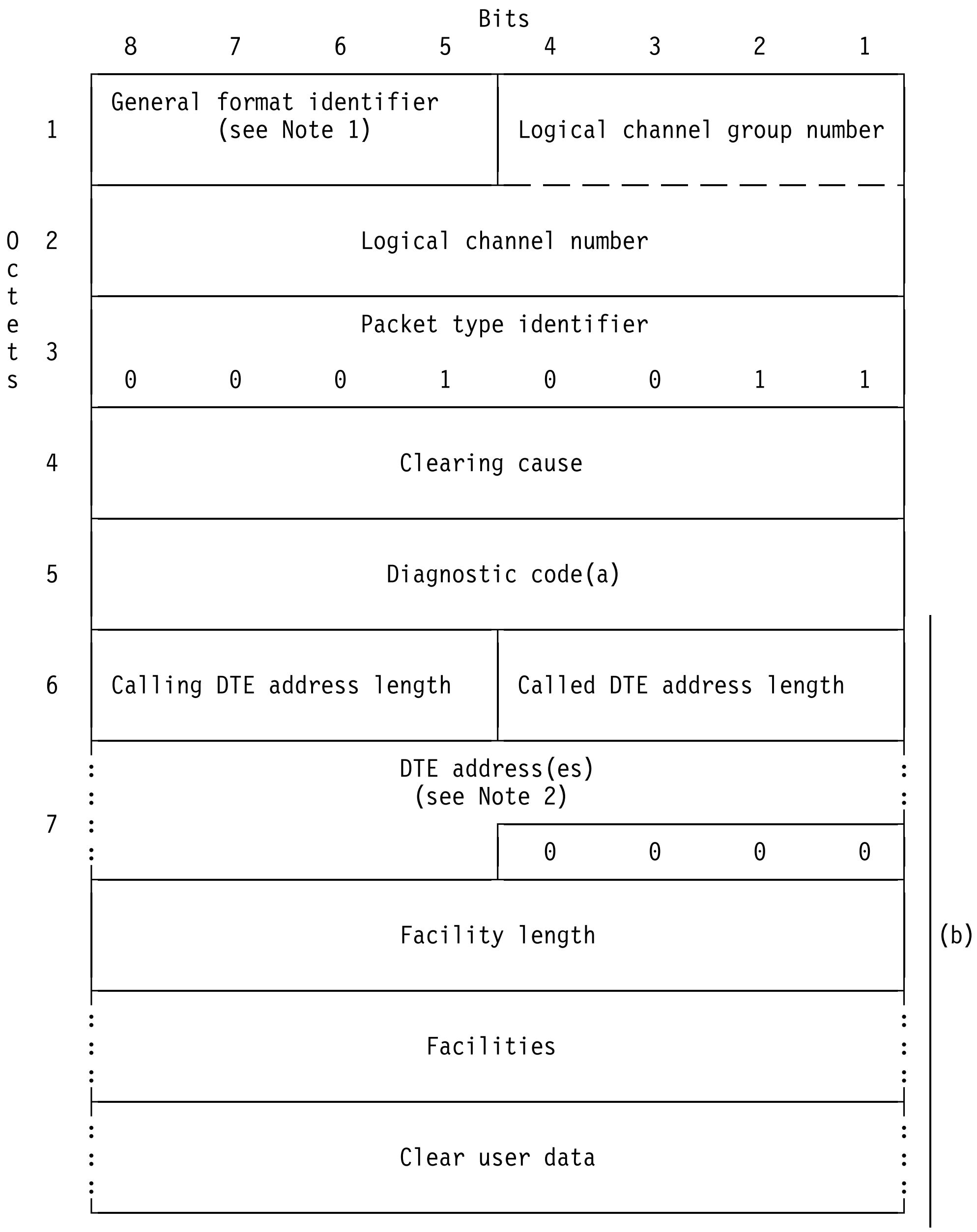


Figure 5-4. X.25 Clear Request and Clear Indication Packet Format

a. This field is not mandatory in the basic format of _clear request_ packets.

b. Used only in the extended format (see 5.2.4.2).

Notes:

1. Coded 0001 (modulo 8)
2. The figure is drawn assuming the total number of address digits present is odd.

5.2.4.1 Basic Format

5.2.4.1.1 Clearing Cause Field Octet 4 is the clearing cause field and contains the reason for the clearing of the call.

In *clear request* packets, the clearing cause field should be set by the DTE to one of the following values:

bits	:	8	7	6	5	4	3	2	1
value	:	0	0	0	0	0	0	0	0
or	:	1	X	X	X	X	X	X	X

where each X may be independently set to 0 or 1 by the DTE.

| See the note Table 5-3 for the values allowed for a DTE attached to an Nways
| Switch node.

The DCE will prevent values of the clearing cause field other than those shown above from reaching the other end of the call by either accepting the *clear request* packet and forcing the clearing cause field to all zeros in the corresponding *clear indication* packet, or considering the *clear request* as an error and following the procedure described in Appendix C.

The coding of the clearing cause field in *clear indication* packets is given in Table 5-3.

Table 5-3. X.25 Coding of Clearing Cause Field in Clear Indication Packet

	Bits
	8 7 6 5 4 3 2 1
DTE originated	0 0 0 0 0 0 0 0
DTE originated(a)	1 X X X X X X X
Number busy	0 0 0 0 0 0 0 1
Out of order	0 0 0 0 1 0 0 1
Remote procedure error	0 0 0 1 0 0 0 1
Reverse charging acceptance not subscribed(b)	0 0 0 1 1 0 0 1
Incompatible destination	0 0 1 0 0 0 0 1
Fast select acceptance not subscribed(b)	0 0 1 0 1 0 0 1
Ship absent(c)	0 0 1 1 1 0 0 1
Invalid facility request	0 0 0 0 0 0 1 1
Access barred	0 0 0 0 1 0 1 1
Local procedure error	0 0 0 1 0 0 1 1
Network congestion	0 0 0 0 0 1 0 1
Not obtainable	0 0 0 0 1 1 0 1
RPOA out of order(b)	0 0 0 1 0 1 0 1

a. When bit 8 is set to 1, the bits represented by Xs are those included by the remote DTE in the clearing or restarting cause field of the *clear* or *restart request* packet respectively.

| Table 5-4 gives the different clearing cause values accepted or generated
| by the Nways Switch, or generated by DTEs in *restart request* packets, and
| delivered on SVCs.

b. May be received only if the corresponding optional user facility is used.

c. Used in conjunction with mobile maritime services.

Table 5-4 summarizes the Nways Switch handling for various combinations of DTEs, X.25 GW's, and Nways Switch parameters.

Note:

- vvvvvvv is bits 7 to 1 of any cause code explicitly shown in Table 5-3. nnnnnnn is any bit value other than vvvvvvv.
- DTE 80 is a DTE attached to the Nways Switch network with parameter "X.25 1980".
  DTE 84 is a DTE attached to the Nways Switch network with parameter "X.25 1984" or later (1988, 1992).
- GW 80 is an X.25 GW towards a PSDN based on the 1980 version of X.25.
  GW 84 is an X.25 GW towards a PSDN based on the 1984 (or later) version of X.25.

Table 5-4. X.25 Nways Switch Handling of Clearing Causes

Source	Valid cause code	Destination			
		DTE 80	DTE 84	GW 80	GW 84
DTE 80 (1)	00000000	00000000	00000000	00000000	00000000
DTE 84 (2)	00000000 10000000	00000000 00000000	00000000 10000000	00000000 00000000	00000000 10000000
IBM Nways Switch	0vvvvvvv	0vvvvvvv	0vvvvvvv	00000000	1vvvvvvv
GW 80 (3)	00000000 0vvvvvvv	00000000 0vvvvvvv	00000000 0vvvvvvv	00000000 00000000	00000000 1vvvvvvv
GW 84	00000000 0vvvvvvv 1vvvvvvv 1nnnnnnn	00000000 0vvvvvvv 0vvvvvvv 0nnnnnnn	00000000 0vvvvvvv 1vvvvvvv 1nnnnnnn	00000000 00000000 00000000 00000000	00000000 1vvvvvvv 1vvvvvvv 1nnnnnnn

1. In principle, DTEs complying with the 1980 version of X.25 should not issue causes with first bit (bit 8) set to 1. This is not checked by the Nways Switch.
2. For compliance with ISO standard 8208.
3. GW defined as X.25 1980 compatible should not transit cause values with bit 8 set to 1. This is not checked by the Nways Switch.

5.2.4.1.2 Diagnostic Code: Octet 5 is the diagnostic code and contains additional information on the reason for the clearing of the call.

In a *clear request* packet, the diagnostic code is not mandatory.

In a *clear indication* packet, if the clearing cause field indicates "DTE originated", the diagnostic code is passed unchanged from the clearing DTE. If the clearing DTE has not provided a diagnostic code in its *clear request* packet, then the bits of the diagnostic code in the resulting *clear indication* packet will all be zero.

When a *clear indication* packet results from a *restart request* packet, the value of the diagnostic code will be that specified in the *restart request* packet, or all zeros in the case where no diagnostic code has been specified in the *restart request* packet.

When the clearing cause field does not indicate "DTE originated", the diagnostic code in a *clear indication* packet is network generated. Appendix E lists the coding for network generated diagnostics. The bits of the diagnostic code are all set to 0 when no specific additional information for the clearing is supplied.

Note: The contents of the diagnostic code field do not alter the meaning of the cause field. A DTE is not required to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE to refuse the cause field.

5.2.4.2 Extended Format

The extended format is used for *clear request* and *clear indication* packets only when the DTE or the DCE needs to use the address field, the facility field and/or the clear user data field in conjunction with one or several optional user facilities described in 6 and 7. The address field is used only when the *called line address modified notification* facility is used in clearing, in response to an *incoming call* or *call request* packet.

When the extended format is used, the diagnostic code field, the address length fields and the facility length field must be present. Optionally, the clear user data field may also be present.

| The extended format can be used by the DTE, in conjunction with the *fast select*
| facility, or with the *call deflection* facility.

5.2.4.2.1 Address Length Fields: Octet 6 consists of field length indicators for the called and calling DTE addresses. Bits 4, 3, 2 and 1 indicate the length of the called DTE address in semi-octets. Bits 8, 7, 6 and 5 indicate the length of the calling DTE address in semi-octets. Each address length indicator is binary coded and bit 1 or 5 is the low order bit of the indicator.

5.2.4.2.2 Address Field: When present, octet 7 and the following octets consist of the called DTE address when present, then the calling DTE address when present.

Each digit of an address is coded in a semi-octet in binary coded decimal with bit 5 or 1 being the low order bit of the digit.

Starting from the high order digit, the address is coded in octet 7 and consecutive octets with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5.

The address field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field when necessary.

5.2.4.2.3 Facility Length Field: The octet following the address field indicates the length of the facility field in octets. The facility length indicator is binary coded and bit 1 is the low order bit of the indicator.

5.2.4.2.4 Facility Field: The facility field is present in the *clear request* or the *clear indication* packet only in conjunction with one or several optional user facilities requiring some indication in this packet.

The coding of the facility field is defined in 6 and 7.

The facility field contains an integral number of octets. The actual maximum length of this field depends on the facilities which are offered by the network. However, this maximum does not exceed 109 octets.

If the _call deflection_ facility is present, then the virtual call is transferred to the address included in the facility (alternate DTE address).

5.2.4.2.5 Clear User Data Field: This field may be present only in conjunction with the fast select facility described in 6.16, and has a maximum length of 128 octets.

When a virtual call has been established or is being cleared between two packets mode DTEs, the network does not act on any part of the clear user data field. See Recommendation X.244.

5.2.5 DTE and DCE Clear Confirmation Packets

Figure 5-5 illustrates the format of the _DTE_ and _DCE clear confirmation_ packets, in the basic or extended format.

The extended format may be used for _DCE clear confirmation_ packets only in conjunction with the _charging information_ facility described in 6.22. It is not used for _DTE clear confirmation_ packet.

Octets	Bits 8	7	6	5	4	3	2	1	
1	General format identifier (see Note)				Logical channel group number				
2	Logical channel number								
3	Packet type identifier: 0	0	0	1	0	1	1	1	
4	Calling DTE address length				Called DTE address length				(a)
5	DTE address(es)								(a)
	Facility length								(a)
	Facilities								(a)

Figure 5-5. X.25 DTE and DCE Clear Confirmation Packet Format

(a) Used only in the extended format of *DCE clear confirmation* packets.

Note: Coded 0001 (modulo 8).

The Nways Switch does not include the charging information facility, thus the extended format for the DCE clear confirmation packet is not used.

5.3 Data and Interrupt Packets

5.3.1 DTE and DCE Data Packets

Figure 5-6 illustrates the format of the _DTE_ and _DCE data_ packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier: Q	D	0	1	Logical channel group number			
2	Logical channel number							
3	P(R)			M	P(S)			0
	User data							

(Modulo 8)

Figure 5-6. X.25 DTE and DCE Data Packet Format

D Delivery confirmation bit
M More data bit
Q Qualifier bit

5.3.1.1 Qualifier (Q) Bit

Bit 8 of octet 1 is the qualifier (Q) bit.

5.3.1.2 Delivery Confirmation (D) Bit

Bit 7 of octet 1 is the delivery confirmation (D) bit.

5.3.1.3 Packet Receive Sequence Number

Bits 8, 7, and 6 of octet 3, are used to indicate the packet receive sequence number P(R). P(R) is binary coded and bit 6 is the low order bit.

5.3.1.4 More Data Bit

Bit 5 in octet 3, is used for the more data mark (M bit): 0 for no more data and 1 for more data.

5.3.1.5 Packet Send Sequence Number

Bits 4, 3, and 2 of octet 3, are used to indicate the packet send sequence number P(S). P(S) is binary coded and bit 2 is the low order bit.

5.3.1.6 User Data Field

Bits following octet 3 contain user data.

Note: Nways Switch networks require the user data field to contain an integral number of octets.

5.3.2 DTE and DCE Interrupt Packets

Figure 5-7 illustrates the format of the _DTE_ and _DCE interrupt_ packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	0	1	1
4	Interrupt user data							

Figure 5-7. X.25 DTE and DCE Interrupt Packet Format

Note: Coded 0001 (modulo 8).

5.3.2.1 Interrupt User Data Field

Octet 4 and any following octets contain the interrupt user data. This field may contain from 1 to 32 octets.

Note: Nways Switch networks require the interrupt user data field to contain an integral number of octets.

5.3.3 DTE and DCE Interrupt Confirmation Packets

Figure 5-8 illustrates the format of the <u>*DTE*</u> and <u>*DCE interrupt confirmation*</u> packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier							
	0	0	1	0	0	1	1	1

Figure 5-8. X.25 DTE and DCE Interrupt Confirmation Packet Format

Note: Coded 0001 (modulo 8).

5.4 Flow Control and Reset Packets

5.4.1 DTE and DCE Receive Ready (RR) Packets

Figure 5-9 illustrates the format of the <u>*DTE*</u> and <u>*DCE RR*</u> packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier				Logical channel group number			
	0	0	0	1				
2	Logical channel number							
3	P(R)			Packet type identifier				
				0	0	0	0	1

(Modulo 8)

Figure 5-9. X.25 DTE and DCE RR Packet Format

5.4.1.1 Packet Receive Sequence Number

Bits 8, 7 and 6 of octet 3, are used for indicating the packet receive sequence number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

5.4.2 DTE and DCE Receive Not Ready (RNR) Packets

Figure 5-10 illustrates the format of the _DTE_ and _DCE RNR_ packets.

Octets	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	General format identifier: 0	0	0	1	Logical channel group number			
2	Logical channel number							
3	P(R)			Packet type identifier: 0	0	1	0	1

(Modulo 8)

Figure 5-10. X.25 DTE and DCE RNR Packet Format

5.4.2.1 Packet Receive Sequence Number

Bits 8, 7 and 6 of octet 3, are used for indicating the packet receive sequence number P(R). P(R) is binary coded and bit 6, or bit 2 when extended, is the low order bit.

5.4.3 Reset Request and Reset Indication Packets

Figure 5-11 illustrates the format of the _reset request_ and _reset indication_ packets.

Octets	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier: 0	0	0	1	1	0	1	1
4	Resetting cause							
5	Diagnostic code(a)							

Figure 5-11. X.25 Reset Request and Reset Indication Packet Format

(a) This field is not mandatory in reset request packets.

Note: Coded 0001 (modulo 8).

5.4.3.1 Resetting Cause Field

Octet 4 is the resetting cause field and contains the reason for the reset.

In *reset request* packets, the resetting cause field should be set by the DTE to one of the following values:

bits	:	8	7	6	5	4	3	2	1
value	:	0	0	0	0	0	0	0	0
or	:	1	X	X	X	X	X	X	X

where each X may be independently set to 0 or 1 by the DTE.

| See the note Table 5-5 for the values permitted for a DTE attached to an Nways
| Switch node.

The DCE will prevent values of the resetting cause field other than those shown above from reaching the other end of the virtual call or permanent virtual circuit by either accepting the *reset request* packet and forcing the resetting cause field to all zeros in the corresponding *reset indication* packet, or considering the reset request as an error and following the procedure described in Appendix C.

The coding of the resetting cause field in a *reset indication* packet is given in Table 5-5.

Table 5-5. X.25 Coding of Resetting Cause Field in Reset Indication Packet

	Bits
	8 7 6 5 4 3 2 1
DTE originated	0 0 0 0 0 0 0 0
DTE originated(a)	1 X X X X X X X
Out of order(b)	0 0 0 0 0 0 0 1
Remote procedure error	0 0 0 0 0 0 1 1
Local procedure error	0 0 0 0 0 1 0 1
Network congestion	0 0 0 0 0 1 1 1
Remote DTE operational(b)	0 0 0 0 1 0 0 1
Network operational(b)	0 0 0 0 1 1 1 1
Incompatible destination	0 0 0 1 0 0 0 1
Network out of order(b)	0 0 0 1 1 1 0 1

a. When bit 8 is set to 1, the bits represented by Xs are those indicated by the remote DTE in the resetting cause field (virtual calls and permanent virtual circuits) or the restarting cause field (permanent virtual circuits only) of the *on* reset *off* or *restart request* packet respectively.

| Table 5-6 describes the different resetting cause values accepted or
| generated by the Nways Switch, or generated by DTEs, in *restart request*
| packets, and delivered on PVCs.

b. Applicable to permanent virtual circuits only.

| Table 5-6 summarizes the Nways Switch handling for various combinations of
| DTEs, X.25 GW's, and Nways Switch parameters.

| **Note:**

| - vvvvvvv is bits 7 to 1 of any cause code explicitly shown in Table 5-5.
| nnnnnnn is any bit value other than vvvvvvv.

- DTE 80 is a DTE attached to the Nways Switch network with parameter "X.25 1980".
  DTE 84 is a DTE attached to the Nways Switch network with parameter "X.25 1984" or later (1988, 1992).
- GW 80 is an X.25 GW towards a PSDN based on the 1980 version of X.25.
  GW 84 is an X.25 GW towards a PSDN based on the 1984 (or later) version of X.25.

Table 5-6. X.25 Nways Switch Handling of Resetting Causes

Source	Valid cause code	Destination			
		DTE 80	DTE 84	GW 80	GW 84
DTE 80 (1)	00000000	00000000	00000000	00000000	00000000
DTE 84 (2)	00000000 10000000	00000000 00000000	00000000 10000000	00000000 00000000	00000000 10000000
IBM Nways Switch	0vvvvvvv	0vvvvvvv	0vvvvvvv	00000000	1vvvvvvv
GW 80 (3)	00000000 0vvvvvvv	00000000 0vvvvvvv	00000000 0vvvvvvv	00000000 00000000	00000000 1vvvvvvv
GW 84	00000000 0vvvvvvv 1vvvvvvv 1nnnnnnn	00000000 0vvvvvvv 0vvvvvvv 0nnnnnnn	00000000 0vvvvvvv 1vvvvvvv 1nnnnnnn	00000000 00000000 00000000 00000000	00000000 1vvvvvvv 1vvvvvvv 1nnnnnnn

1. In principle, DTEs complying with the 1980 version of X.25 should not issue causes with first bit (bit 8) set to 1. This is not checked by the Nways Switch.
2. For compliance with ISO standard 8208.
3. GW defined as X.25 1980 compatible should not transmit cause values with bit 8 set to 1. This is not checked by Nways Switch.

5.4.3.2 Diagnostic Code

Octet 5 is the diagnostic code and contains additional information on the reason for the reset.

In a *reset request* packet the diagnostic code is not mandatory.

In a *reset indication* packet, if the resetting cause field indicates "DTE originated", the diagnostic code has been passed unchanged from the resetting DTE. If the DTE requesting a reset has not provided a diagnostic code in its *reset request* packet, then the bits of the diagnostic code in the resulting *reset indication* packet will all be zeros.

When a *reset indication* packet results from a *restart request* packet, the value of the diagnostic code will be that specified in the *restart request* packet, or all zeros in the case where no diagnostic code has been specified in the *restart request* packet.

When the resetting cause field does not indicate "DTE originated", the diagnostic code in a *reset indication* packet is network generated. Appendix E lists the coding for network generated diagnostics. The bits of the diagnostic code are all set to 0 when no specified additional information for the reset is supplied.

Note: The contents of the diagnostic code field do not alter the meaning of the cause field. A DTE is not required to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE not to accept the cause field.

5.4.4 DTE and DCE Reset Confirmation Packets

Figure 5-12 illustrates the format of the DTE and *DCE reset confirmation* packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				Logical channel group number			
2	Logical channel number							
3	Packet type identifier: 0	0	0	1	1	1	1	1

Figure 5-12. X.25 DTE and DCE Reset Confirmation Packet Format

Note: Coded 0001 (modulo 8).

5.5 Restart Packets

5.5.1 Restart Request and Restart Indication Packets

Figure 5-13 illustrates the format of the *restart request* and *restart indication* packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier							
	1	1	1	1	1	0	1	1
4	Restarting cause							
5	Diagnostic code(a)							

Figure 5-13. X.25 Restart Request and Restart Indication Packet Format

(a) This field is not mandatory in restart request packets.

Note: Coded 0001 (modulo 8).

5.5.1.1 Restarting Cause Field

Octet 4 is the restarting cause field and contains the reason for the restart.

In *restart request* packets, the restarting cause field should be set by the DTE to one of the following values:

Bits	:	8	7	6	5	4	3	2	1
Value	:	0	0	0	0	0	0	0	0
Or	:	1	X	X	X	X	X	X	X

Where each X may be independently set to 0 or 1 by the DTE

The DCE will prevent values of the restarting cause field other than those shown above from reaching the other end of the virtual calls and/or permanent virtual circuits by either accepting the *restart request* packet and forcing the clearing or resetting cause field to all 0s in the corresponding *clear* and/or *reset indication* packets, or considering the restart request as an error and following the procedure described in Appendix C.

The coding of the restarting cause field in the restart indication packets is given in Table 5-7.

Table 5-7. X.25 Coding of the Restarting Cause Field in Restart Indication Packet

	Bits
	8 7 6 5 4 3 2 1
Local procedure error	0 0 0 0 0 0 0 1
Network congestion Network operational Registration/cancellation confirmed (a)	0 0 0 0 0 0 1 1 0 0 0 0 0 1 1 1 0 1 1 1 1 1 1 1

(a) May be received only if the optional *online facility registration* facility is used.

This facility is not supported by the Nways Switch.

5.5.1.2 Diagnostic Code

Octet 5 is the diagnostic code and contains additional information on the reason for the restart.

In a *restart request* packet, the diagnostic code is not mandatory. The diagnostic code, if specified, is passed to the corresponding DTEs as the diagnostic code of a *reset indication* packet for permanent virtual circuits or a *clear indication* packet for virtual calls.

The coding of the diagnostic code field in a *restart indication* packet is given in Appendix E. The bits of the diagnostic code are all set to zero when no specific additional information for the restart is supplied.

Note: The contents of the diagnostic code field do not alter the meaning of the cause field. A DTE is not required to undertake any action on the contents of the diagnostic code field. Unspecified code combinations in the diagnostic code field shall not cause the DTE not to accept the cause field.

5.5.2 DTE and DCE Restart Confirmation Packets

Figure 5-14 illustrates the format of the *DTE* and *DCE restart confirmation* packets.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note)				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier 1	1	1	1	1	1	1	1

Figure 5-14. X.25 DTE and DCE Restart Confirmation Packet Format

Note: Coded 0001 (modulo 8).

5.6 Diagnostic Packet

Figure 5-15 illustrates the format of the *diagnostic* packet.

Octets	Bits 8	7	6	5	4	3	2	1
1	General format identifier (see Note 1)				0	0	0	0
2	0	0	0	0	0	0	0	0
3	Packet type identifier: 1	1	1	1	0	0	0	1
4	Diagnostic code							
5	Diagnostic explanation (see Note 2)							

Figure 5-15. X.25 Diagnostic Packet Format

Notes:

1. Coded 0001 (modulo 8)
2. The figure is drawn assuming the diagnostic explanation field is an integral number of octets in length.

The Nways Switch diagnostic explanation field always contains an integral number of octets.

5.6.1 Diagnostic Code Field

Octet 4 is the diagnostic code and contains information on the error condition which resulted in the transmission of the *diagnostic* packet. The coding of the diagnostic code field is given in Appendix E.

5.6.2 Diagnostic Explanation Field

When the *diagnostic* packet is issued as a result of the reception of an erroneous packet from the DTE (see Tables C-1 and C-2), this field contains the first three octets of header information from the erroneous DTE packet. If the packet contains less than 3 octets, this field contains whatever bits were received.

When the *diagnostic* packet is issued as a result of a DCE timeout (see Tables D-1 and D-2), the diagnostic explanation field contains 2 octets coded as follows:

- Bits 8, 7, 6 and 5 of the first octet contain the general format identifier for the interface.

- Bits 4 to 1 of the first octet and bits 8 to 1 of the second octet are all 0 for expiration of timeout T10 and give the number of the logical channel on which the timeout occurred for expiration of timeout T12 or T13.

5.7 Packets Required for Optional User Facilities

5.7.1 DTE Reject (REJ) Packet for the Packet Retransmission Facility

The packet retransmission facility is not available with the Nways Switch.

5.7.2 Registration Packets for the Online Facility Registration Facility

The online facility registration facility is not available with the Nways Switch.

5.8 Nways Switch Address Formats

5.8.1 Architectural Considerations

At least one DTE address must be assigned to each DTE attached to an Nways Switch network. More than one address can be assigned to a given DTE.

An address is a string of digits, BCD coded, two digits per byte.

The address length must be less than or equal to 15 digits. In a given Nways Switch network, DTEs can be assigned addresses of different length.

5.8.1.1 Subscriber Addresses Definition

At resource definition time, several address formats can be defined for the NBBS network. Each address format is identified by the first digit of the address. A default address format is also defined, which is applicable when the prefix of the called address received in the *call request* packet is not one of the specified prefixes.

An address format defines the main address length. This is the number of digits which are used by the Nways Switch to locate the called subscriber. Additional digits are considered as subaddress, and not used by Nways to determine the node and port housing the called subscriber. Those digits are forwarded with the call packet to the destination port.

Addresses shorter than the defined length are accepted, but in this case all digits are used to determine the location of the subscriber, and no subaddressing is possible.

The Table 5-8 gives an example of address format definition:

Table 5-8. Address formats definition

Prefix	Address length
0	8
1	8
2	4
Default	7

With the above definition:

- addresses starting with the digit ***0*** have an address length of 8 (prefix included).

  The address ***0440072562214*** is searched for using the key ***04400725***. The 5 trailing digits are ignored by Nways (but forwarded to the called party).

  The address ***04400725*** is searched for using the full address as a key.

- addresses starting with the digit ***1*** have an address length of 8 (prefix included).
- addresses starting with the digit ***2*** have an address length of 4 (prefix included).

  The address ***272562214*** is searched for using the key ***2725***.

- addresses starting with a digit different from ***0***, ***1***, or ***2*** have an address length of 7 (prefix included).

5.8.1.2 Subaddressing

The subaddressing capability is provided by the definition of the main address length, as described above. Digits in excess of this length are accepted by the Nways Switch, but considered as a subaddress for the usage of the DTE.

5.8.1.3 Generic Addresses

When several addresses are assigned to a given port, they can be configured as a generic, or partially specified, address.

For this usage, two special characters ***?*** and ***+***, can be used to configure the addresses.

? Matches one decimal digit (0 to 9)

***** Matches any string of digits, including the null string

Examples:

- Configured address ***222+*** is a match for packet addresses ***2223331111***, ***222***, ***222333*** etc....
- Configured address ***111444????*** is a match for packet addresses ***1114440000***, ***1114445555***. It is not a match for packet addresses ***111444*** or ***11144455***.

5.8.1.4 Reserved Addresses

The address ***99999***, is reserved.

5.8.1.5 PNIC

A Private Network Identification Code (PNIC) can be optionally defined for a given NBBS network. The PNIC is of particular interest when several networks are interconnected through X.25 GWs.

When a PNIC is defined, DTEs can use only a Local Terminal Number (LTN) in the calling and called address field. Internally, the network uses a complete Network Terminal Number (NTN), composed of the LTN prefixed by the PNIC.

The effect of the PNIC is as follows:

- calling DTE

- if the calling address is shorter than the configured address length, the network assumes that this calling address is an LTN, and prefixes it with the PNIC.
- if the called address is shorter than the configured address length, the network assumes that this called address is an LTN, and prefixes it with the PNIC.
- if the PNIC part of the called address is different from the network PNIC, the network searches the destination port using this PNIC part (as opposed to the full address). The destination port is normally an X.25 GW.

Therefore a DTE can use the full address format (PNIC + LTN) or only the LTN in the calling and called address fields. If the full address length is longer than the configured address length the trailing digits are considered as subaddress. If the calling DTE uses the local form of the address (LTN), it can append a subaddress to the LTN. However, for proper processing of the address by the network, the combined length of the LTN and subaddress should be smaller than the configured full address length (PNIC + LTN)

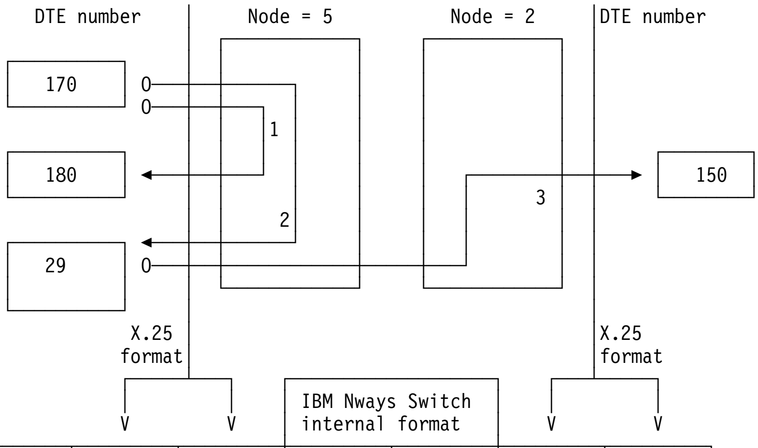
- called DTE
  - the called address delivered to a called DTE is always the called LTN
  - the calling address delivered to a called DTE is:
    - the calling LTN, in case of intra-network call
    - the calling full address (PNIC + LTN), in case of inter-network call

5.8.2 Addressing DTEs within an Nways Switch Network

Figure 5-16 gives examples of address handling within an Nways Switch network.

Example:

- Assuming the addressable elements are:
  - Node = 5 with DTE = 170, 180, 29
  - Node = 2 with DTE = 140, 150.
  - The address length assigned to prefix 1 is 3
  - The address length assigned to prefix 2 is 2



Call	Called DTE address	Calling DTE address	Called DTE address	Calling DTE address	Called DTE address	Calling DTE address
1	180	–	180	170		
2	297	–	297	170		
3	150	297	150	297	150	297

Figure 5-16. Example of Addressing within an Nways Switch Network

Call 1 A local call within node = 5. The calling DTE (170) gives the DTE number of the called DTE (180), Nways Switch inserts the calling address (170).

Call 2 A similar call towards DTE with address 29. The subaddress is 7.

Call 3 The calling DTE indicates a subaddress (7) which is accepted by the Nways Switch, since the main address (29) matches the address configured for the port.

5.8.3 Address Handling at the DTE/DCE Interface

5.8.3.1 Call Request Packet

5.8.3.1.1 Called Address: This address is transmitted unchanged to the called DTE.

If the called address is not included by the calling DTE in the *call request* packet, and if a default called address has been configured, then this default called address is included by the originating DCE in the *call request* packet, and used to route the virtual call. If no default called address has been specified then the call is cleared.

5.8.3.1.2 Calling Address: The calling address (if present in the *call request* packet) is checked against one of the subscriber addresses assigned to this port. The call is cleared when a match is not found.

If the calling address is not included by the calling DTE in the *call request* packet, and if a "Default Calling Address" has been assigned to this port, then this default address is included by the network in the calling address field of the *call request* packet.

If the calling address is not included by the calling DTE in the *call request* packet, and if no "Default Calling Address" has been assigned to this port, then the call is cleared.

5.8.3.2 Call Accepted Packet

The called DTE may or may not insert addresses.

If addresses are inserted by the DTE, they are checked by the network; they must match the addresses received in the *incoming call* packet.

5.8.3.3 Call Connected Packet

The *call connected* packet contains the calling and called DTE addresses which have been included by the called DTE in the *call accepted* packet.

5.8.3.4 Clear Request Packet

The clearing DTE may insert addresses, when using the extended format. No checking is performed by the network.

5.8.3.5 Clear Indication Packet

The *clear indication* packet contains the calling and called DTE addresses which have been included by the clearing DTE in the *clear request* packet.

5.8.3.6 DCE Clear Confirmation

As the charging information facility is not available with the Nways Switch, the DCE clear confirmation packet does not include any address.

5.8.3.7 DTE Clear Confirmation

X.25 (and Nways Switch) does not allow addresses in the DTE clear confirmation packet.

5.9 Compatibility Between 1980, 1984 and 1988 Versions of X.25

The formats of packets at the DTE/DCE interface are basically those of the X.25 Recommendation, 1984/1988/1992 versions. The Nways Switch also supports the DTEs based on the 1980. versions of the Recommendation, by means of a subscription parameter (X.25 version 1980, 1984, 1988 or 1992).

When a DTE subscribes to the 1980 version of X.25, the DCE will issue packets only in the 1980 format; therefore new facilities which require new formats are not passed to the DTE. The design of new facilities in X.25 is, in principle, such that an "old" DTE can continue to be operated without being aware of the content of these facilities.

The following describes how the Nways Switch acts upon DTEs based on the 1984 version of X.25 and those based on the 1980 version.

- The data field of the interrupt packet may be up to 32 bytes with the X.25 1984 version, whereas it is limited to one byte in the 1980 version. In the case where a DTE, which has subscribed to the 1984 version, tries to send an interrupt packet with a data field larger than one byte towards a DTE which has subscribed to the 1980 version, a *Reset Indication* is generated by the network.
- If a "1984 DTE" tries to call a "1980 DTE" with 1984 ITU-T-specified DTE facilities in the facilities field, the call is transmitted to the called DTE.
- The size of the facility field in incoming call and call connected packets will not be greater than 63 octets for "1980 DTEs".

The TOA/NPI address format, specific to X.25 1988, is not supported by the Nways Switch.

Chapter 6. Procedures for Optional User Facilities (Packet Level)

This chapter describes the optional user facilities supported by the Nways Switch. The NBBS network allows transparent transport of unsupported facilities. For this purpose, a parameter ("Transparent Facilities"), defined on a per port basis, need to be set by the Network administrator. When a call packet with an unsupported facility is received on a port with this parameter set to "Yes", the length parameter field is checked, but no further processing takes place, and the call is forwarded.

6.1 Online Facility Registration

The online facility registration facility is not applicable to the Nways Switch.

6.2 Extended Packet Sequence Numbering

The *Extended packet sequence numbering* is not applicable to the Nways Switch.

6.3 D Bit Modification

The D bit modification facility is not applicable to the Nways Switch.

6.4 Packet Retransmission

The packet retransmission facility is not applicable to the Nways Switch.

6.5 Incoming Calls Barred

Incoming calls barred is an optional user facility agreed for a period of time. This facility applies to all logical channels used at the DTE/DCE interface for virtual calls.

This user facility, if subscribed to, prevents incoming virtual calls from being presented to the DTE. The DTE may originate outgoing virtual calls.

It is the responsibility of the network service provider to check that the subscription to this facility by a DTE is consistent with the definition of the ranges of logical channels at the DTE/DCE interface.

Note: Logical channels used for virtual calls retain their full duplex capability.

6.6 Outgoing Calls Barred

Outgoing calls barred is an optional user facility agreed for a period of time. This facility applies to all logical channels used at the DTE/DCE interface for virtual calls.

This user facility, if subscribed to, prevents the DCE from accepting outgoing virtual calls from the DTE. The DTE may receive incoming virtual calls.

It is the responsibility of the network service provider to check that the subscription to this facility by a DTE is consistent with the definition of the ranges of logical channels at the DTE/DCE interface.

Note: Logical channels used for virtual calls retain their full duplex capability.

6.7 One-Way Logical Channel Outgoing

One-way logical channel outgoing is an optional user facility agreed for a period of time. This user facility, if subscribed to, restricts the logical channel use to originating outgoing virtual calls only.

Note: A logical channel used for virtual calls retains its full duplex capability.

The rules according to which logical channel group numbers and logical channel numbers can be assigned to one-way outgoing logical channels for virtual calls are given in Appendix A.

Note: If all the logical channels for virtual calls are one-way outgoing at a DTE/DCE interface, the effect is equivalent to the incoming calls barred facility (see § 6.5, particularly Note 2).

6.8 One-Way Logical Channel Incoming

One-way logical channel incoming is an optional user facility agreed for a period of time. This user facility, if subscribed to, restricts the logical channel use to receiving incoming virtual calls only.

Note: A logical channel used for virtual calls retains its full duplex capability.

The rules according to which logical channel group numbers and logical channel numbers can be assigned to one-way incoming logical channels for virtual calls are given in Appendix A.

Note: If all the logical channels for virtual calls are one-way incoming at a DTE/DCE interface, the effect is equivalent to the outgoing calls barred facility (see § 6.6).

6.9 Non-Standard Default Packet Sizes

Non-standard default packet sizes is an optional user facility agreed for a period of time. This facility, if subscribed to, provides for the selection of default packet sizes from the list of packet sizes supported by the Administration. Some networks may constrain the packet sizes to be the same for each direction of data transmission across the DTE/DCE interface. In the absence of this facility, the default packet sizes are 128 octets.

The Nways Switch does not allow configured packet sizes to be different for each direction of data transmission. However, it allows the negotiated packet sizes to be different for each direction of data transmission, as described in 6.12, “Flow Control Parameter Negotiation” on page 6-4.

Note: In this section, the term "packet sizes" refers to the maximum user data field lengths of *DCE data* and *DTE data* packets.

Values other than the default packet sizes may be negotiated for a virtual call by means of the *flow control parameter negotiation* facility (see 6.12). Values other than the default packet sizes may be agreed for a period of time for each permanent virtual circuit.

6.10 Non-Standard Default Window Sizes

Non-standard default window sizes is an optional user facility agreed for a period of time. This facility, if subscribed to, provides for the selection of default window sizes from the list of window sizes supported by the Administration. Some networks may constrain the default window sizes to be the same for each direction of data transmission across the DTE/DCE interface. In the absence of this facility, the default window sizes are 2.

The Nways Switch does not allow configured window sizes to be different for each direction of data transmission. However, it allows the negotiated window sizes to be different for each direction of data transmission, as described in 6.12, “Flow Control Parameter Negotiation” on page 6-4.

Values other than the default window sizes may be negotiated for a virtual call by means of the *flow control parameter negotiation* facility (see 6.12). Values other than the default window sizes may be agreed for a period of time for each permanent virtual circuit.

6.11 Default Throughput Classes Assignment

Default throughput classes assignment is an optional user facility agreed for a period of time. This facility, if subscribed to, provides for the selection of default throughput classes from the list of throughput classes supported by the Administration. Some networks may constrain the default throughput classes to be the same for each direction of data transmission. In the absence of this facility, the default throughput classes correspond to the user class of service of the DTE (see 7.2.2.2) but do not exceed the maximum throughput class supported by the network.

The default throughput classes are the maximum throughput classes which may be associated with any virtual call at the DTE/DCE interface. Values other than the default throughput classes may be negotiated for a virtual call by means of the *throughput class negotiation facility* (see 6.13). Values other than the default throughput classes may be agreed for a period of time for each permanent virtual circuit.

In the absence of this facility, the Nways Switch assigns the same default throughput classes for each direction of data transmission, as a function of the line speed.

The Nways Switch allows to assign different default throughput classes for each direction of data transmission. The default throughput classes assigned to the calling and called DTE are used by the Nways Switch to reserve bandwidth for the virtual call being set-up, or for the permanent virtual circuit.

6.12 Flow Control Parameter Negotiation

Flow control parameter negotiation is an optional user facility agreed for a period of time which can be used by a DTE for virtual calls. This facility, if subscribed to, permits negotiation on a per call basis of the flow control parameters. The flow control parameters considered are the packet and window sizes at the DTE/DCE interface for each direction of data transmission.

Note: In this section, the term "packet sizes" refers to the maximum user data field lengths of *DCE data* and *DTE data* packets.

In the absence of the *flow control parameter negotiation* facility, the flow control parameters to be used at a particular DTE/DCE interface are the default packet sizes (see 6.9) and the default window sizes (see 6.10).

When the calling DTE has subscribed to the *flow control parameter negotiation* facility, it may request packet sizes and/or window sizes for both directions of data transmission (see 7.2.1 and 7.2.2.1). If particular window sizes are not explicitly requested in a *call request* packet, the DCE will assume that the default window sizes were requested for both directions of data transmission. If particular packet sizes are not explicitly requested, the DCE will assume that the default packet sizes were requested for both directions of data transmission.

When a called DTE has subscribed to the *flow control parameter negotiation* facility, each *incoming call* packet will indicate the packet and window sizes from which DTE negotiation can start. No relationship needs to exist between the packet sizes (P) and window sizes (W) requested in the *call request* packet and those indicated in the *incoming call* packet.

Where the *incoming call* packet indicates the *flow control parameters negotiation* facility, the Nways Switch will indicate values for packet and window sizes to the DTE as follows:

- The packet sizes indicated to the called DTE will be the packet sizes selected by the calling DTE, if any, or the default packet sizes of the calling DTE.
- The window sizes indicated to the called DTE will be the default window sizes of the called DTE.

The called DTE may request window and packet size with facilities in the *call accepted.* packet. The only valid facility requests in the *call accepted* packet, as a function of the facility indications in the *incoming call* packet, are given in Table 6-1 on page 6-5. If the facility request is not made in the *call accepted* packet, the DTE is assumed to have accepted the indicated values (regardless of the default values) for both directions of data transmission.

Table 6-1. Valid Facility Requests in Call Accepted Packets in Response to Facility Indications in Incoming Call Packets	
Facility Indication	**Valid Facility Request**
W(indicated) ≥ 2 W(indicated) = 1	W(indicated) ≥ W(requested) ≥ 2 W(requested) = 1 or 2
P(indicated) ≥ 128 P(indicated) < 128	P(indicated) ≥ P(requested) ≥ 128 128 ≥ P(requested) ≥ P(indicated)

When the calling DTE has subscribed to the *flow control parameter negotiation* facility, every *call connected* packet will indicate the packet and window sizes to be used at the DTE/DCE interface for the call.

The only valid facility indications in the *call connected* packet, as a function of the facility requests in the *call request* packet, are given in Table 6-2.

Table 6-2. Valid Facility Requests in Call Connected Packets in Response to Facility Requests in Call Request Packets	
Facility Request	**Valid Facility Indication**
W(requested) ≥ 2 W(requested) = 1	W(requested) ≥ W(indicated) ≥ 2 W(indicated) = 1 or 2
P(requested) ≥ 128 P(requested) < 128	P(requested) ≥ P(indicated) ≥ 128 128 ≥ P(indicated) ≥ P(requested)

Where the *call connected* packet indicates the *flow control parameter negotiation* facility, the Nways Switch chooses values for packet sizes and window sizes and indicates them to the calling DTE as one of the following:

1. The packet sizes negotiated with the called DTE, if any
2. The default packet sizes of the called DTE, if these sizes comply with the rules shown in Table 6-2.
3. The packet sizes selected by the calling DTE.

The window sizes indicated to the calling DTE will be the window sizes requested by the calling DTE, if any, or the default window sizes of the calling DTE.

the Nways Switch policy in negotiating flow control parameters is to try to get the same packet sizes at both ends. This can still be achieved when the default packet sizes of the calling and the called DTEs are not the same, if at least one of the DTEs has subscribed to the *flow control parameter negotiation* facility.

If only the called DTE has subscribed to the *flow control parameter negotiation* facility, the principle of equal-sized packets at both ends requires that the called DTE accept the values proposed by the network.

If only the calling DTE has subscribed to the *flow control parameter negotiation* facility, the principle of equal-sized packets at both ends requires that the called DTE default packet sizes be one of the following:

1. Identical to the calling DTE packet size
2. Closer to the standard value (128) than to the packet sizes requested by the calling DTE
3. Closer to the standard value (128) than to the calling DTE default packet sizes, if no default packet size has been requested by the calling DTE.

Where packet sizes are the same at both the calling and called DTE, this avoids fragmenting and re-assembling packets, and thus improves performance.

Where the _flow control parameter negotiation_ facility is subscribed, the DCE takes the default window sizes as the basis for negotiation. Different criteria should be chosen for the default window sizes, depending on whether or not the _flow control parameter negotiation_ facility is subscribed.

6.13 Throughput Class Negotiation

Throughput class negotiation is an optional user facility agreed for a period of time which can be used by a DTE for virtual calls. This facility, if subscribed to, permits negotiation on a per call basis of the throughput classes. The throughput classes are considered independently for each direction of data transmission.

Default values are agreed between the DTE and the Administration (see 6.11). The default values correspond to the maximum throughput classes which may be associated with any virtual call at the DTE/DCE interface.

When the calling DTE has subscribed to the _throughput class negotiation_ facility, it may request the throughput classes of the virtual call in the _call request_ packet for both directions of data transmission (see 7.2.1 and 7.2.2.2). If particular throughput classes are not explicitly requested, the DCE will assume that the default values were requested for both directions of data transmission.

When a called DTE has subscribed to the _throughput class negotiation_ facility, each _incoming call_ packet will indicate the throughput classes from which DTE negotiation may start. These throughput classes are lower or equal to the ones selected at the calling DTE/DCE interface, either explicitly, or by default if the calling DTE has not subscribed to the _throughput class negotiation_ facility or has not explicitly requested throughput class values in the _call request_ packet. These throughput classes indicated to the called DTE will also not be higher than the default throughput classes, respectively for each direction of data transmission, at the calling and the called DTE/DCE interfaces. They may be further constrained by internal limitations of the network.

With the Nways Switch, the throughput class indicated in the _incoming call_ packet is either the default throughput class assigned to the port (if the calling DTE has not requested a throughput class) or the throughput class requested by the calling DTE.

The called DTE may request with a facility in the _call accepted_ packet the throughput classes for both directions of transmission. This throughput class request is accepted by the Nways Switch, and indicated to the calling DTE in the _call connected_ packet. However, the Nways Switch does not take this request into account to compute the bandwidth reserved within the NBBS network to the Virtual Circuit being set-up. Whether or not the called DTE makes a throughput class facility request in the _call accepted_ packet, the throughput classes used to compute this bandwidth will be the ones indicated in the _incoming call_ packet.

If the called DTE has not subscribed to the _throughput class negotiation_ facility, the throughput classes finally applying to the virtual call are less than or equal to the ones selected at the calling DTE/DCE interface, and less than or equal to the default values defined at the called DTE/DCE interface.

When the calling DTE has subscribed to the *throughput class negotiation* facility, every *call connected* packet will indicate the throughput classes finally applying to the virtual call.

When neither the calling DTE nor the called DTE has subscribed to the *throughput class negotiation* facility, the throughput classes applying to the virtual call will not be higher than the ones agreed as defaults at the calling and called DTE/DCE interfaces. They may be further constrained to lower values by the network, that is, for international service.

Notes:

1. Since both *throughput class negotiation* and *flow control parameter negotiation* (see 6.12) facilities can be applied to a single call, the achievable throughput will depend on how users manipulate the D bit.
2. Users are cautioned that the choice of too small a window and packet size of a DTE/DCE interface (made by use of the *flow control parameter negotiation* facility) may adversely affect the attainable throughput class of a virtual call.

This is likewise true of flow control mechanisms adopted by the DTE to control data transmission from the DCE.

| The Nways Switch uses the throughput classes requested to the called party, (that
| is, delivered in the *incoming call* packet if the called DTE has subscribed to the
| facility), to reserve bandwidth for the virtual call being set-up, within the NBBS
| network.

6.14 Closed User Group Related Facilities

The set of closed user group (CUG) optional user facilities is not supported by the Nways Switch.

6.15 Bilateral Closed User Group Related Facilities

| The bilateral closed user group facility is not applicable to the Nways Switch.

6.16 Fast Select

Fast select is an optional user facility which may be requested by a DTE for a given virtual call.

DTEs can request the *fast select* facility on a per call basis by means of an appropriate facility request (see 7.2.1 and 7.2.2.10) in a *call request* packet using any logical channel which has been assigned to virtual calls.

The *fast select* facility, if requested in the *call request* packet and if it indicates no restriction on response, allows this packet to contain a call user data field of up to 128 octets, authorizes the DCE to transmit to the DTE, during the *DTE waiting* state, a *call connected* or *clear indication* packet with a called or clear user data field respectively of up to 128 octets, and authorizes the DTE and the DCE to transmit after the call is connected, a *clear request* or a *clear indication* packet, respectively, with a clear user data field of up to 128 octets.

The *fast select* facility, if requested in the *call request* packet and if it indicates restriction on response, allows this packet to contain a call user data field of up to 128 octets and authorizes the DCE to transmit to the DTE, during the *DTE waiting* state, a *clear indication* packet with a clear user data field of up to 128 octets; the DCE would not be authorized to transmit a *call connected* packet.

When a DTE requests the fast select facility in a *call request* packet, the *incoming call* packet should only be delivered to the called DTE if that DTE has subscribed to the *fast select acceptance* facility (see 6.17).

If the called DTE has subscribed to the *fast select acceptance* facility, it will be advised that the *fast select* facility, and an indication of whether or not there is a restriction on the response, has been requested through the inclusion of the appropriate facility (see 7.2.1 and 7.2.2.6) in the *incoming call* packet.

If the called DTE has not subscribed to the *fast select acceptance* facility, an *incoming call* packet with the fast select facility requested will not be transmitted and a *clear indication* packet with the cause "Fast select acceptance not subscribed" will be returned to the calling DTE.

The presence of the *fast select* facility indicating no restriction on response in an *incoming call* packet permits the DTE to issue, as a direct response to this packet, a *call accepted* or *clear request* packet with a called or clear user data field, respectively, of up to 128 octets. If the call is connected, the DTE and the DCE are then authorized to transmit a *clear request* or a *clear indication* packet, respectively, with a clear user data field of up to 128 octets.

Note: For an interim period, some networks may not allow a DTE to transmit any clear user data in a *clear request* packet when the interface is not in *DCE waiting* state.

The presence of the *fast select* facility indicating restriction on response in an *incoming call* packet permits the DTE to issue as a direct response to this packet a *clear request* packet with a clear user data field of up to 128 octets; the DTE would not be authorized to send a *call accepted* packet.

Note: The call user data field, the called user data field and the clear user data field will not be fragmented for delivery across the DTE/DCE interface.

The significance of the *call connected* packet, or the *clear indication* packet with the cause "DTE originated" as a direct response to the *call request* packet with the *fast select* facility, is that the *call request* packet with the data field has been received by the called DTE.

All other procedures of a call in which the *fast select* facility has been requested are the same as those of a virtual call.

6.17 Fast Select Acceptance

Fast select acceptance is an optional user facility agreed for a period of time. This user facility, if subscribed to, authorizes the DCE to transmit to the DTE incoming calls which request the *fast select* facility. In the absence of this facility, the DCE will not transmit to the DTE incoming calls which request the *fast select* facility.

6.18 Reverse Charging

Reverse charging is an optional user facility which may be requested by a DTE for a given virtual call (see 7.2.1 and 7.2.2.6).

6.19 Reverse Charging Acceptance

Reverse charging acceptance is an optional user facility agreed for a period of time for virtual calls. This user facility, if subscribed to, authorizes the DCE to transmit to the DTE incoming calls which request the *reverse charging* facility. In the absence of this facility, the DCE will not transmit to the DTE incoming calls which request the *reverse charging* facility.

6.20 Local Charging Prevention

Local charging prevention is an optional user facility agreed for a period of time for virtual calls. This user facility, when subscribed to, authorizes the DCE to prevent the establishment of virtual calls which the subscriber must pay for by:

1. Not transmitting to the DTE incoming calls which request the *reverse charging* facility, and
2. Insuring that the charges are made to the called party whenever a call is requested by the DTE.

When the party to be charged has not been established for a call request, reverse charging will be enforced by the DCE.

| The Nways Switch enforces reverse charging for call requests when the DTE has
| subscribed to *local charging prevention*, and clears incoming calls with reverse
| charging requested.

| Subscription to *local charging prevention* and *reverse charging acceptance* is not allowed, to avoid conflicts in the processing of *incoming call* packets with *reverse charging* facility requested.

6.21 Network User Identification (NUI) Related Facilities

Network user identification is an optional user facility agreed for a period of time. This facility, if subscribed to, enables the DTE to provide information to the network for billing, security or network management purposes on a per call basis (see 7.2.1 and 7.2.2.7). This information may be provided by the DTE in the *call request* packet or in the *call accepted* packet. It may be used whether or not the DTE has also subscribed to the *local charging prevention* facility (see 6.20). If the DCE determines that the network user identifier is invalid or not present when required by the network, it will clear the call as described in Appendix C.

Network user identification is never transmitted to the remote DTE. The calling DTE address transmitted to the remote DTE in the calling DTE address field should not be inferred from the network user identification transmitted by the DTE in the facility field of the *call request* packet.

6.22 Charging Information

| The charging information facility is not applicable to the Nways Switch.

6.23 ROA Selection

| The ROA selection facility is not applicable to the Nways Switch.

6.24 Hunt Group

Hunt group is an optional user facility agreed for a period of time. This user facility, if subscribed to, distributes incoming calls having an address associated with the hunt group across a designated grouping of DTE/DCE interfaces.

Selection is performed for an incoming virtual call if there is at least one idle logical channel, excluding one-way outgoing logical channels, available for virtual calls on any of the DTE/DCE interfaces in the group. Once a virtual call is assigned to a DTE/DCE interface, it is treated as a regular call.

When virtual calls are placed to a hunt group address in the case specific addresses have also been assigned to the individual DTE/DCE interfaces, the *clear indication* packet (when no *call accepted* packet has been transmitted) or the *call connected* packet transferred to the calling DTE optionally will contain the called address of the selected DTE/DCE interface and the *called line address modified notification* facility (see 6.26) indicating the reason why the called address is different from the one originally requested.

| The *called line address modified notification* facility is not included by the Nways Switch.

| The called address delivered by the Nways Switch in the *incoming call* packet is the address of the Hunt Group.

Virtual calls may be originated by the DTEs on DTE/DCE interfaces belonging to the hunt group; these are handled in the normal manner. In particular, the calling DTE address transferred to the remote DTE in the *incoming call* packet is the hunt group address unless the DTE/DCE interface has a specific address assigned. Permanent virtual circuits may be assigned to DTE/DCE interfaces belonging to the hunt group. These permanent virtual circuits are independent of the operation of the hunt group. Some networks may apply virtual call subscription time user facilities in common to all DTE/DCE interfaces in the hunt group, place a limit on the number of DTE/DCE interfaces in the hunt group, and/or constrain the size of the geographic region that can be served by a single hunt group.

With the Nways Switch, the hunt group is limited to 32 ports. All these ports must be attached to the same Adapter (same LSA3).

When a set of ports is assigned a hunt group address the Nways Switch handles it as follows:

1. The successive calls are distributed across the group of ports in a 'round-robin' fashion: a circular pointer indicates which port the next call will be sent to.
2. If a call cannot be completed on the indicated port, then the Nways Switch attempts to use the next ports of the group, up to the point the entire circular list has been tried. If no call can be completed then the call is cleared.

6.25 Call Redirection and Call Deflection Related Facilities

The set of call redirection and call deflection optional user facilities is not supported by the Nways Switch.

6.26 Called Line Address Modified Notification

The *Called line address modified notification* is not applicable to the Nways Switch.

6.27 Transit Delay Selection and Indication

Transit delay selection and indication is an optional user facility which may be requested by a DTE for a given virtual call. This facility permits selection and indication, on a per call basis, of the transit delay applicable to that virtual call as defined in §4.3.8.

A DTE wishing to specify a desired transit delay in the *call request* packet for a virtual call indicates the desired value (see §§7.2.1 and 7.2.2.13).

The network, when able to do so, should allocate resources and route the virtual call in a manner such that the transit delay applicable to that call does not exceed the desired transit delay.

The *incoming call* packet transmitted to the called DTE and the *call connected* packet transmitted to the calling DTE, will both contain the indication of the transit delay applicable to the virtual call. This transit delay may be smaller than, or equal to, the desired transit delay requested in the *call request* packet.

The Nways Switch transmits the *transit delay selection and indication* facility to the called DTE only when it has subscribed to the *transit delay indication* facility.

The Nways Switch uses the requested transit delay for selecting the path towards the destination DTE or network, within the NBBS network. If a specific transit delay has not been requested by the calling DTE, the Nways Switch uses the default transit delay configured for the calling DTE for path selection purposes.

6.28 TOA/NPI Address Subscription

The TOA/NPI address subscription facility is not applicable to the Nways Switch.

6.29 OSI Priority Related Facilities

6.29.1 OSI Priority Facility

OSI priority is a ITU-T specified DTE facility that may be requested by a DTE for a given virtual call. Three types of priority can be requested:

- Priority of data on connection
- Priority to gain a connection
- Priority to keep a connection.

Moreover, each priority is defined with two sub-parameters:

- The target, available, or selected value for this priority, depending upon packet type
- The lowest acceptable value for this priority.

Target, available, and selected values for a given priority correspond to the phases in priority negotiation. They therefore depend upon the packet type:

- Target value: Value proposed for negotiation by the calling DTE. It is therefore included in a call request packet.
- Available value: Value proposed to the called DTE. It is therefore included in an incoming call packet.
- Selected value: Value finally accepted by the called DTE. It is therefore included in a call accepted packet by the called DTE and transmitted, without change, in a call connected packet to the calling DTE. Selected value is the result of the negotiation.

For further information, refer to G.3.3.3, “Priority Facility” on page G-4.

6.29.1.1 Negotiation of OSI priority

During priority negotiation, each DTE can decrease the values of priority or leave them unchanged. The following relationships should therefore be observed:

Selected value ≤ Available value ≤ Target value

Moreover the target, available, or selected value for a given priority must be greater than or equal to the lowest acceptable value for the same priority:

Target/Available/Selected value ≥ Lowest acceptable value

The Nways Switch does not participate in priority negotiation. It only uses the result of the negotiation. This means that the Nways Switch does not change the target priority of data on connection. In other words:

Available value = Target value

Note: As with any ITU-T specified DTE facility, the priority facility is delivered to a DTE only if it is subscribed as an X.25 1984 or 1988 compatible DTE.

6.29.1.2 Use of OSI Priority by The Nways Switch

The Nways Switch uses OSI priority of data on connection:

- To access the DTE/DCE link towards the destination DTE (if DCE)
- To access a connection towards a destination DTE

However, the Nways Switch does not modify the priority of data on connection, and carries it transparently from DTE to DTE, together with the other possible priorities in the priority facility.

For a given virtual circuit, the priority of data on connection is the same for each direction of data transmission and applies to each packet flowing over this virtual circuit during data transfer phase.

6.29.1.3 OSI Priority at Network Level

A configuration parameter at network level tells the Nways Switch whether or not OSI priority should be used to access the DTE/DCE link. However the priority facility is carried transparently through an NBBS network, whichever value this parameter has.

6.29.2 OSI Priority Subscription Facility

This facility provides for the selection of an OSI priority of data on connection, applicable to each virtual call, when this priority has not been explicitly requested in a call request packet.

When a DTE does not include a priority facility in the call request packet, or includes a priority facility but does not specify any value for priority of data on connection, the OSI priority subscribed value is used.

Because the calling and called DTEs may have subscribed two different values, and priority must be the same along the virtual circuit, an internal negotiation between DCEs is needed, when the two DTEs have not explicitly negotiated priority of data on connection through the priority facility.

The priority of data on connection that results from the internal negotiation and that will apply to access the DTE/DCE link is the lowest of the two subscribed values for OSI priority.

6.29.3 Priority of Packets

The priority of each type of packet is shown in the following list:

Incoming call: priority 2
Call connected: priority 1
Data packet: priority 1
RR or RNR packet: priority 1
Reset indication or reset confirmation: priority 1
Interrupt or interrupt confirmation: priority 1
Clear indication or clear confirmation in data transfer phase: priority 1
Clear indication or clear confirmation in call setup phase: priority 2
Restart indication or restart confirmation: low priority

Diagnostic packet: low priority

Priority 1 means the priority that applies to the virtual circuit as a result of explicit or implicit priority negotiation, either:

- The selected value, if OSI priority was negotiated explicitly by the two DTEs

  or
- The lowest subscribed priority if OSI priority was not negotiated. Refer to 6.29.2, "OSI Priority Subscription Facility" on page 6-13.

Priority 2 means the actual priority of the previous virtual circuit established on the same logical channel. For setup of the first virtual circuit on a logical channel after restart exchange, priority 2 is low.

To summarize, all packets are transmitted with priority 1, when DCEs are in data transfer phase (state P4) or entering or leaving this state. In call setup phase, packets are transmitted with priority 2, which was the priority of the previous virtual circuit. Priority changes at call accepted or call connected time.

The reason why the priority of the previous VC is kept to set up a new call is to avoid changing priority between the end of a call and setup of a new call. This prevents, for example, an incoming call (possibly at a high priority) from being transmitted over the line before clear confirmation at a lower priority. Refer to Figure 6-1.

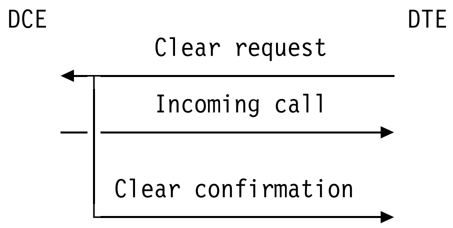


Figure 6-1. Protocol Error Due to a Priority Change

6.29.4 Aging Mechanism

The aging mechanism prevents a packet from remaining in a low priority queue for too long a time.

Each time 255 packets have been dequeued from any queue, this mechanism takes effect. If no packet has been dequeued from the low, normal, or high1 queue since the last aging process, low, normal, and high1 queues are put into the high2 queue, keeping the same order.

Chapter 7. Formats for Facility Fields and Registration Fields

7.1 General

The facility field is present only when a DTE is using an optional user facility requiring some indication in the *call request, incoming call, call accepted, call connected, clear request, clear indication,* or *DCE clear confirmation* packet.

| The registration field is not used in the Nways Switch environment.

The facility/registration field contains one or more facility/registration elements. The first octet of each facility/registration element contains a facility/registration code to indicate the facility or facilities requested/negotiated.

The facility/registration codes are divided into four classes, by making use of bits 8 and 7 of the facility/registration code field, in order to specify facility/registration parameters consisting of 1, 2, 3, or a variable number of octets. The general class coding of the facility/registration code field is shown in Table 7-1.

Table 7-1. X.25 General Class Coding for Facility/Registration Code Fields

Bits	8 7 6 5 4 3 2 1	
Class A	0 0 X X X X X X	For single octet parameter field
Class B	0 1 X X X X X X	For double octet parameter field
Class C	1 0 X X X X X X	For triple octet parameter field
Class D	1 1 X X X X X X	For variable length parameter field

For class D the octet following the facility/registration code indicates the length, in octets, of the facility/registration parameter field. The facility/registration parameter field length is binary coded and bit 1 is the low order bit of this indicator.

The formats for the four classes are shown in Figure 7-1.

```
     Class A                                  Class B

          Bits                                     Bits

      8 7 6 5 4 3 2 1                          8 7 6 5 4 3 2 1
     ┌───────────────┐                        ┌───────────────┐
O  0 │ 0 0 X X X X X X │                 O  0 │ 0 1 X X X X X X │
c    ├───────────────┤                 c    ├───────────────┤
t  1 │ Facility/       │               t  1 │ Facility/       │
e    │ registration    │               e    │ registration    │
t    │ parameter field │               t    │-               -│
     └───────────────┘                    2 │ parameter field │
                                            └───────────────┘

     Class C                                  Class D

          Bits                                     Bits

      8 7 6 5 4 3 2 1                          8 7 6 5 4 3 2 1
     ┌───────────────┐                        ┌───────────────┐
O  0 │ 1 0 X X X X X X │                 O  0 │ 1 1 X X X X X X │
c    ├───────────────┤                 c    ├───────────────┤
t  1 │ Facility/       │               t  1 │ Facility/       │
e    │ registration    │               e    │ registration    │
t    │-               -│               t    │ parameter field │
   2 │ parameter       │                    │ length          │
     │-               -│                    ├───────────────┤
   3 │ field           │                  2 │ Facility/       │
     └───────────────┘                      │ registration    │
                                            │ parameter field │
                                            └───────────────┘
```

Figure 7-1. X.25 Facility/Registration Element General Format

The facility/registration code field is binary coded and, without extension, provides for a maximum of 64 facility/registration codes for classes A, B and C and 63 facility/registration codes for class D giving a total of 255 facility/registration codes.

Facility/registration code 11111111 is reserved for extension of the facility/registration code. The octet following this octet indicates an extended facility/registration code having the format A, B, C, and D as defined above. Repetition of facility/registration code 11111111 is permitted and additional extensions thus result.

This code is not supported by the Nways Switch, which clears the call with cause "Invalid Facility Request" and diagnostic "Facility Code Not Allowed" (decimal 65).

The coding of the facility/registration parameter field is dependent on the facility being requested/negotiated.

A facility/registration code may be assigned to identify a number of specific facilities, each having a bit in the parameter field indicating facility requested/facility not requested. In this situation, the parameter field is binary encoded with each bit position relating to a specific facility. A 0 indicates that the facility related to the particular bit is not requested and a 1 indicates that the facility related to the particular bit is requested. Parameter bit positions not assigned to a specific facility are set to zero. If none of the facilities represented by the facility/registration code is requested for a virtual call or for online facility registration, the facility/registration code and its associated parameter field need not be present.

In addition to the facility/registration codes defined in 7, other codes may be used for:

- Non-X.25 facilities (the Nways Switch does not offer non-X.25 facilities)
- ITU-T-specified DTE facilities as described in Appendix G of this Recommendation *(call setup, clear request*, and *clear indication* packets).

Facility/registration markers, consisting of a single octet pair, are used to separate requests for X.25 facilities as defined in 6 and 7 from other categories as defined above, and, when several categories of facilities are simultaneously present, to separate these categories from each other.

The first octet of the marker is a facility/registration code field and is set to zero. The second octet is a facility/registration parameter field.

The facility/registration parameter field of a marker is set to zero when the marker precedes requests for:

- Registration codes specific to the local network *(registration* packets)
- Non-X.25 facilities provided by the network in case of intranetwork calls *(call setup* packets)
- Non-X.25 facilities provided by the network to which the calling DTE is connected, in case of internetwork calls *(call setup* packets).

The facility parameter field of a marker is set to all ones when the marker precedes requests for non-X.25 facilities provided by the network to which the called DTE is connected, in case of internetwork calls *(call setup* packets).

The facility parameter field of a marker is set to 00001111 when the marker precedes requests for ITU-T-specified DTE facilities.

All networks will support the facility markers with a facility parameter field set to all ones or to 00001111.

DTEs should not use a facility marker with a facility parameter field set to all ones in case of intranetwork calls. However, if a DTE uses such a marker in an intranetwork call, the DCE is not obliged to clear the call, and the marker, with the corresponding facility requests, may be transmitted to the remote DTE.

In this situation, the Nways Switch does not clear the call, and the marker with the corresponding facility request is transmitted to the remote DTE.

Facility/registration codes for X.25 facilities and for the other categories of facilities may be simultaneously present. However, requests for X.25 facilities must precede the other requests, and requests for ITU-T-specified DTE facilities must follow the other requests.

A call request issued by a DTE attached to an Nways Switch node may include a:

- Request for X.25 facilities.
- Request for non-X.25 facilities provided by the network to which the called DTE is connected.
- Request for ITU-T-specified DTE facilities.

However, the maximum size of the last two categories of requests (if any), including the separating marker between these two categories (if any), must be less than or equal to 58 octets.

The coding of ITU-T-specified DTE facilities should comply with the description in Appendix G. However, the DCE is not required to verify that compliance. If the network verifies that compliance and finds an error, it may clear the call with the cause "Invalid facility request". The ITU-T-specified DTE facilities are otherwise passed unchanged by public data networks between the two packet-mode DTEs.

7.2 Coding of Facility Field in Call Setup and Clearing Packets

The coding of the facility code field and the format of the facility parameter field are the same in the various *call setup* and *clearing* packets in which they are used.

7.2.1 Coding of the Facility Code Fields

Tables 7-2, 7-3 gives the coding of the facility code fields and the packet types in which they may be present.

Table 7-2. X.25 Coding of the Facility Code Field

Facility	Packet types in which it may be used							Facility code
	Call Req.	Inc. Call	Call Accept.	Call Conn.	Clear Req.	Clear Ind.	DCE Clear Confirm.	Bits 8 7 6 5 4 3 2 1
Flow control parameter negotiation	X	X	X	X				
—packet size								0 1 0 0 0 0 1 0
—window size								0 1 0 0 0 0 1 1
Basic throughput class negotiation	X	X	X	X				0 0 0 0 0 0 1 0
Extended throughput class negotiation	X	X	X	X				0 1 0 0 1 1 0 0
Closed user group selection	X	X						
—basic format								0 0 0 0 0 0 1 1
—extended format	(1)							0 1 0 0 0 1 1 1
Closed user group with outgoing access selection	X	X						
—basic format								0 0 0 0 1 0 0 1
—extended format	(2)							0 1 0 0 1 0 0 0
Bilateral closed user group selection	X (2)	X (2)						0 1 0 0 0 0 0 1
Reverse charging	X	X						0 0 0 0 0 0 0 1
Fast select selection	X	X						
NUI selection	X		X					1 1 0 0 0 1 1 0
Charging information								
—requesting service	X		X					0 0 0 0 0 1 0 0
—receiving information						X	X	
.monetary unit								1 1 0 0 0 1 0 1
.distance								Further study
.segment count						(2)	(2)	1 1 0 0 0 0 1 0
.call duration	(2)		(2)					1 1 0 0 0 0 0 1

Table 7-3. X.25 Coding of the Facility Code Field

Facility	Packet types in which it may be used							Facility code
	Call Req.	Inc. Call	Call Accept.	Call Conn.	Clear Req.	Clear Ind.	DCE Clear Confirm.	Bits 8 7 6 5 4 3 2 1
RPOA selection —basic format —extended format	X (2)							0 1 0 0 0 1 0 0 1 1 0 0 0 1 0 0
Call deflection					X			1 1 0 1 0 0 0 1
Call redirection notification		X						1 1 0 0 0 0 1 1
Called line address modified notification				X		X		0 0 0 0 1 0 0 0
Transit delay selection and indication	X	X		X				0 1 0 0 1 0 0 1
Marker	X	X	X	X	X	X	X	0 0 0 0 0 0 0 0
Reserved for extension								1 1 1 1 1 1 1 1

Notes:

1. Only the basic format is supported by the Nways Switch.
2. Not supported by the Nways Switch.

7.2.2 Coding of the Facility Parameter Fields

7.2.2.1 Flow Control Parameter Negotiation Facility

7.2.2.1.1 Packet Size: The packet size for the direction of transmission from the called DTE is indicated in bits 4, 3, 2, and 1 of the first octet of the facility parameter field. The packet size for the direction of transmission from the calling DTE is indicated in bits 4, 3, 2, and 1 of the second octet. Bits 8, 7, 6, and 5 of each octet must be zero.

The four bits indicating each packet size are binary coded and express the logarithm base 2 of the number of octets of the maximum packet size.

Networks may offer values from 4 to 12, corresponding to packet sizes of 16, 32, 64, 128, 256, 512, 1024, 2048, or 4096, or a contiguous subset of these values. All administrations will provide a packet size of 128.

The Nways Switch permits packet sizes of between 128 and 4096 octets.

7.2.2.1.2 Window Size: The window size for the direction of transmission from the called DTE is indicated in bits 7 to 1 of the first octet of the facility parameter field. The window size for the direction of transmission from the calling DTE is indicated in bits 7 to 1 of the second octet. Bit 8 of each octet must be zero.

The bits indicating each window size are binary coded and express the size of the window. A value of zero is not allowed. The ranges of contiguous values allowed by a network for calls with normal numbering and extended numbering are network dependent. All administrations will provide a window size of 2.

The Nways Switch permits window sizes of between 1 and 7 (modulo 8).

7.2.2.2 Throughput Class Negotiation Facility

7.2.2.2.1 Basic Throughput Class Negotiation Facility: The throughput class for the direction of data transmission from the called DTE is indicated in bits 8, 7, 6 and 5. The 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 in Table 7-4.

Table 7-4. X.25 Coding of Throughput Classes

Basic Throughput Class Negotiation Facility

Bits: 4 3 2 1 or Bits: 8 7 6 5	Throughput class (bits/s)
0 0 0 0	Reserved
0 0 0 1	Reserved
0 0 1 0	Reserved
0 0 1 1	75
0 1 0 0	150
0 1 0 1	300
0 1 1 0	600
0 1 1 1	1 200
1 0 0 0	2 400
1 0 0 1	4 800
1 0 1 0	9 600
1 0 1 1	19 200
1 1 0 0	48 000
1 1 0 1	64 000
1 1 1 0	128 000 (1)
1 1 1 1	192 000 (1)

Note:

1. Values specific to X.25 1992

7.2.2.2.2 Extended Throughput Class Negotiation Facility: The throughput class for the direction of data transmission from the called DTE is indicated in bits 6 to 1 of the first octet of the facility parameter field. The throughput class for the direction of data transmission from the calling DTE is indicated in bits 6 to 1 of the second octet. Bits 8 and 7 of each octet must be set to 0 and are reserved for future allocation.

The bits indicating each throughput class are binary coded and correspond to throughput classes as indicated in Table 7-5.

Note:

basic throughput class negotiation and *extended throughput class negotiation* facilities should never be present simultaneously at the DTE/DCE interface.

Table 7-5. X.25 Coding of Throughput Classes

Extended Throughput Class Negotiation Facility

Bits: 8 7 6 5 4 3 2 1	Throughput class (bits/s)
0 0 0 0 0 0 0 0	Reserved
0 0 0 0 0 0 0 1	Reserved
0 0 0 0 0 0 1 0	Reserved
0 0 0 0 0 0 1 1	75
0 0 0 0 0 1 0 0	150
0 0 0 0 0 1 0 1	300
0 0 0 0 0 1 1 0	600
0 0 0 0 0 1 1 1	1 200
0 0 0 0 1 0 0 0	2 400
0 0 0 0 1 0 0 1	4 800
0 0 0 0 1 0 1 0	9 600
0 0 0 0 1 0 1 1	19 200
0 0 0 0 1 1 0 0	48 000
0 0 0 0 1 1 0 1	64 000
0 0 0 0 1 1 1 0	128 000
0 0 0 0 1 1 1 1	192 000
0 0 0 1 0 0 0 0	256 000
0 0 0 1 0 0 0 1	320 000
0 0 0 1 0 0 1 0	384 000
0 0 0 1 0 0 1 1	448 000
0 0 0 1 0 1 0 0	512 000
0 0 0 1 0 1 0 1	576 000
0 0 0 1 0 1 1 0	640 200
0 0 0 1 0 1 1 1	704 000
0 0 0 1 1 0 0 0	768 000
0 0 0 1 1 0 0 1	832 000
0 0 0 1 1 0 1 0	896 000
0 0 0 1 1 0 1 1	960 000
0 0 0 1 1 1 0 0	1024 000
0 0 0 1 1 1 0 1	1088 000
0 0 0 1 1 1 1 0	1152 000
0 0 0 1 1 1 1 1	1216 000
0 0 1 0 0 0 0 0	1280 000
0 0 1 0 0 0 0 1	1344 000
0 0 1 0 0 0 1 0	1408 000
0 0 1 0 0 0 1 1	1472 000
0 0 1 0 0 1 0 0	1536 000
0 0 1 0 0 1 0 1	1600 000
0 0 1 0 0 1 1 0	1664 000
0 0 1 0 0 1 1 1	1728 000
0 0 1 0 1 0 0 0	1792 000
0 0 1 0 1 0 0 1	1856 000
0 0 1 0 1 0 1 0	1920 000
0 0 1 0 1 0 1 1	1984 000
0 0 1 0 1 1 0 0	2048 000
Other values	Reserved

7.2.2.3 Closed User Group Selection Facility

7.2.2.3.1 Basic Format: The index to the closed user group selected for the virtual call is in the form of two decimal digits. Each digit is coded in a semi-octet in binary coded decimal with bit 5 being the low order bit of the first digit and bit 1 being the low order bit of the second digit.

Indexes to the same closed user group at different DTE/DCE interfaces may be different.

7.2.2.3.2 Extended Format: The maximum number of closed user groups a DTE can subscribe to with the Nways Switch is 10, thus the extended format is not permitted.

7.2.2.4 Closed User Group with Outgoing Access Selection Facility

Closed user group with outgoing access selection facility is not applicable in the Nways Switch environment.

7.2.2.5 Bilateral Closed User Group Selection Facility

The bilateral closed user group selection facility is not applicable to the Nways Switch.

7.2.2.6 Reverse Charging and Fast Select Facilities

The coding of the facility parameter field is:

Bit 1 = 0 for reverse charging not requested
Bit 1 = 1 for reverse charging requested.
Bit 8 = 0 and bit 7 = 0 or 1 for fast select not requested
Bit 8 = 1 and bit 7 = 0 for fast select requested with no restriction on response
Bit 8 = 1 and bit 7 = 1 for fast select requested with restriction on response

Note: Bits 6, 5, 4, 3, and 2 may be assigned to other facilities in the future; presently, they are set to 0.

7.2.2.7 Network User Identification Facility

The octet following the facility code field indicates the length, in octets, of the facility parameter field. The following octets contain the network user identification, in a format determined by the network administration.

7.2.2.8 Charging Information Facility

The charging information facility is not applicable to the Nways Switch.

7.2.2.9 RPOA Selection Facility

The RPOA selection facility is not applicable to the Nways Switch.

7.2.2.10 Call Deflection Selection Facility

The octet following the facility code indicates the length, in octets, of the facility parameter field and has the value $n + 2$, where n is the number of octets necessary to hold the called address of the DTE to which the call is to be deflected (the alternative DTE).

The first octet of the facility parameter field indicates the reason for the DTE deflecting the call. The coding of this octet is:

bits:	8	7	6	5	4	3	2	1
or	1	1	X	X	X	X	X	X

Note — Each X may be independently set to 0 or 1 by the called DTE and is passed transparently to the DTE to which the call is deflected. If bits 8 and 7 are not set to 1 by the called DTE, they are forced to this value by the DCE.

The second octet indicates the number of semi-octets in the alternative DTE address. This address length indicator is binary coded and bit 1 is the low order bit. Its value is limited to 15 when the A bit is set to 0 (see §5.2.1), to 17 when the A bit is set to 1.

The following octets contains the alternative DTE address, using coding which corresponds to the coding of the called DTE address field in the address block. When the number of semi-octets of the alternative DTE address is odd, a semi-octet with zeros in bits 4, 3, 2 and 1 will be inserted after the last semi-octet in order to maintain octet alignment.

7.2.2.11 Call Redirection or Call Deflection Notification Facility

The octet following the facility code field indicates the length, in octets, of the facility parameter field and has the value *n* + 2, where is the number of octets necessary to hold the originally called DTE address.

The first octet of the facility parameter field indicates the reason for the call redirection or call deflection. The coding of this octet is given in Table 7-6.

Table 7-6. Coding of the reason in the call redirection or call deflection notification facility parameter field

Cause field	**Bits** **8 7 6 5 4 3 2 1**
Originally called DTE busy	0 0 0 0 0 0 0 1
Call distribution within a hunt group[a]	0 0 0 0 0 1 1 1
Originally called DTE out of order	0 0 0 0 1 0 0 1
Systematic call redirection	0 0 0 0 1 1 1 0
Call deflection by the originally called DTE[b]	0 0 0 0 1 1 1 1
	1 1 x x x x x x

| **a** Not implemented by the Nways Switch.

b The Xs are those set by the originally called DTE in the *call deflection selection* facility (see §7.2.2.10).

The second octet indicates the number of semi-octets in the originally called DTE address. This address length indicator is binary coded and bit 1 is the low order bit. Its value is limited to 15 when the A bit is set to 0 (see §5.2.1), to 17 when the A bit is set to 1.

The following octets contain the originally called DTE address. When both the calling DTE and the alternative DTE have subscribed to the *TOA/NPI address subscription* facility (see §6.2.8), or when none of them have subscribed to this facility, the originally called DTE address is coded identically to the called DTE address field in the *call request* packet. When these conditions are not satisfied, the network converts from one address format to the other (see §5.2.1). When the number of semi-octets of the originally added DTE address is odd, a semi-octet with zeros in bits 4, 3, 2 and 1 will be inserted after the last semi-octet in order to maintain octet alignment.

7.2.2.12 Called Line Address Modified Notification Facility

The coding of the facility parameter field for *called line address modified notification* is given in Table 7-7.

Table 7-7. Coding of the parameter field for called line address modified facility	
Cause field	**Bits** **8 7 6 5 4 3 2 1**
Call redirection due to originally called DTE busy	0 0 0 0 0 0 0 1
Call distribution within a hunt group[1]	0 0 0 0 0 1 1 1
Call redirection due to originally called DTE out of order	0 0 0 0 1 0 0 1
Call redirection due to prior request from originally called DTE for systematic call redirection	0 0 0 0 1 1 1 1
Called DTE originated[1]	1 0 x x x x x x
Call deflection by the originally called DTE[a]	1 1 x x x x x x

| **1** Not implemented by the Nways Switch.

a The Xs are those set by the originally called DTE in the *call deflection selection* facility (see §7.2.2.10).

7.2.2.13 Transit Delay Selection and Indication Facility

This parameter is two octets. Transit delay is expressed in milliseconds, binary coded, with bit 8 of octet 1 being the high order bit and bit 1 of octet 2 being the low order bit. The expressed transit delay may have a value from 0 to 65 534 (all bits set to 1 but the low order bit).

Note — During the interim period when this optional user facility is not yet supported by all networks, the transit delay indicated in the *call connected* packet transmitted to the calling DTE should have a value of 65 535 (all ones) when either a transit network involved in the virtual call or the destination network does not support this facility. So, this value should be interpreted by the calling DTE as an indication that the actual transit delay cannot be transmitted to it.

7.3 Coding of the Registration Code Field of Registration Packets

| The coding of the registration code field of registration packets is not applicable to
| the Nways Switch.

Part 2. Appendixes to Recommendation X.25

Appendix A. Range of Logical Channels Used for Virtual Calls and Permanent Virtual Circuits

In the case of a single logical channel DTE, logical channel 1 will be used.

For each multiple logical channel DTE/DCE interface, a range of logical channels will be agreed upon with the Administration according to Figure A-1.

```
            LCN
    ________________
            |
         0  |
         1  |  ┐
            |  │ Permanent virtual circuits
            |  ┘
            |
       LIC  |  ┐                              ┐
            |  │ One way    (see Note 2)      │
            |  │ incoming                     │
       HIC  |  ┘                              │
                                              │
       LTC  |  ┐                              │
            |  │ Two way                      │  Virtual calls
       HTC  |  ┘                              │
                                              │
       LOC  |  ┐                              │
            |  │ One way    (see Note 2)      │
            |  │ outgoing                     │
       HOC  |  ┘                              ┘

      4095  |
    ________|_______
```

Figure A-1. X.25 Range of Logical Channels

LCN Logical channel number
LIC Lowest incoming channel
HIC Highest incoming channel
LTC Lowest two-way channel
HTC Highest two-way channel
LOC Lowest outgoing channel
HOC Highest outgoing channel

Logical channels 1 to LIC-1: range of logical channels which may be assigned to permanent virtual circuits.

Logical channels LIC to HIC: range of logical channels which are assigned to one-way incoming logical channels for virtual calls (see 6.8).

Logical channels LTC to HTC: range of logical channels which are assigned to two-way logical channels for virtual calls.

Logical channels LOC to HOC: range of logical channels which are assigned to one-way outgoing logical channels for virtual calls (see 6.7).

Logical channels HIC+1 to LTC-1, HTC+1 to LOC-1, and HOC+1 to 4095 are non-assigned logical channels.

Notes:

1. The reference to the number of logical channels is made according to a set of contiguous numbers from 0 (lowest) to 4095 (highest) using 12 bits made up of the 4 bits of the logical channel group number (see 5.1.2) and the 8 bits of the logical channel number (see 5.1.3). The numbering is binary coded using bit positions 4 through 1 of octet 1 followed by bit positions 8 through 1 of octet 2 with bit 1 of octet 2 as the low order bit.

2. All logical channel boundaries are agreed with the Administration for a period of time.

   For the Nways Switch, the assigned logical channels *within a logical channel group* must be consecutive (no gaps). A particular range of logical channels can extend over more than one logical channel group.

   Permanent virtual circuits are individually assigned, from 1 to LTC-1, and are not necessarily consecutive.

3. With the Nways Switch, not all logical channels within the range for permanent virtual circuits are necessarily assigned at subscription time. Moreover, a logical channel assigned to a permanent virtual circuit can be active or not depending on whether the permanent virtual circuit has been activated or not by an appropriate operator command, as described in Section 4-2.
   The maximum number of logical channels and their ranges are necessarily part of the configuration of the Nways Switch node. However, the assignment of logical channels can be modified through appropriate operator commands that enable or disable logical channels.

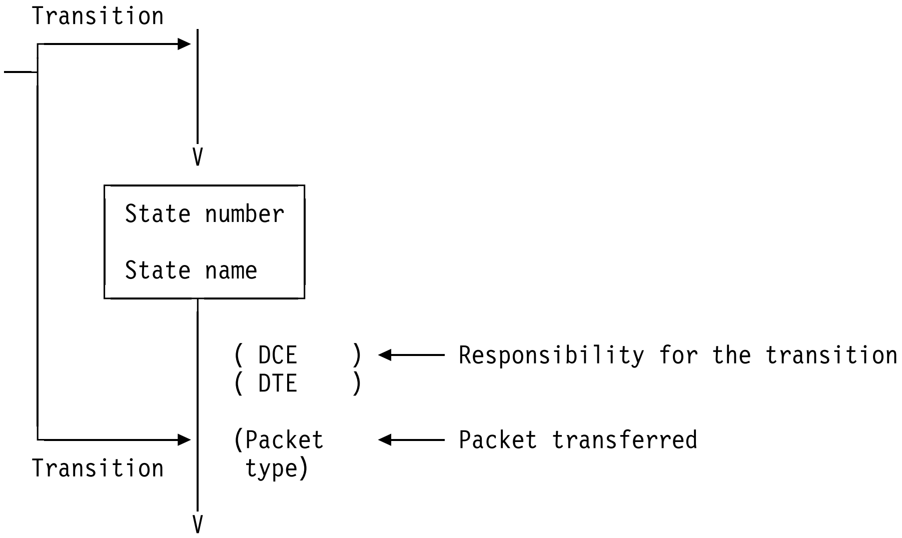
4. In the absence of permanent virtual circuits, logical channel 1 is available for LIC. In the absence of permanent virtual circuits and one-way incoming logical channels, logical channel 1 is available for LTC. In the absence of permanent virtual circuits, one-way incoming logical channels and two-way logical channels, logical channel 1 is available for LOC.

5. The DCE search algorithm for a logical channel for a new incoming call will be to use the lowest logical channel in the ready state in the range of LIC to HIC and LTC to HTC.

6. In order to minimize the risk of call collision, the DTE search algorithm is suggested to start with the highest numbered logical channel in the ready state. The DTE could start with the two-way logical channel or one-way outgoing logical channel ranges.

Appendix B. Packet Level DTE/DCE Interface State Diagrams

B.1 Symbol Definition of the State Diagrams



Notes:

1. Each state is represented by a box wherein the state name and number are indicated.
2. Each state transition is represented by an arrow. The responsibility for the transition (DTE or DCE) and the packet that has been transferred is indicated beside that arrow.

B.2 Order Definition of the State Diagrams

For the sake of clarity, the normal procedure at the interface is described in a number of small state diagrams. In order to describe the normal procedure fully, it is necessary to allocate a priority to the different figures and to relate a higher order diagram with a lower one. This has been done by the following means:

- The figures are arranged in order of priority with Figure B-1 (restart) having the highest priority and subsequent figures having lower priority. Priority means that when a packet belonging to a higher order diagram is transferred, that diagram is applicable and the lower order one is not.
- The relation with a state in a lower order diagram is given by including that state inside an ellipse in the higher order diagram.

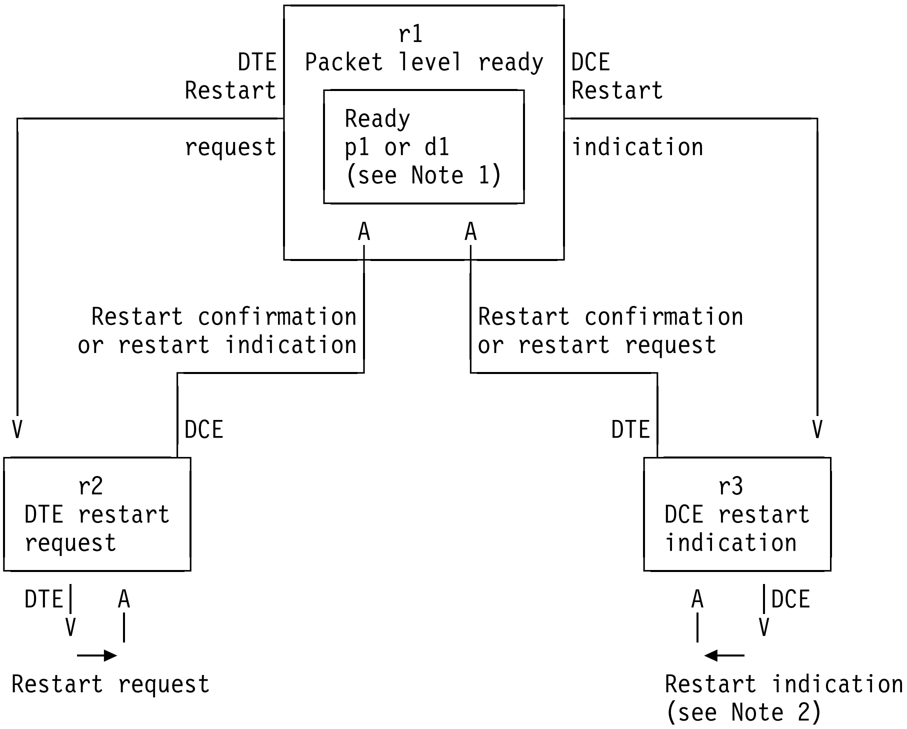
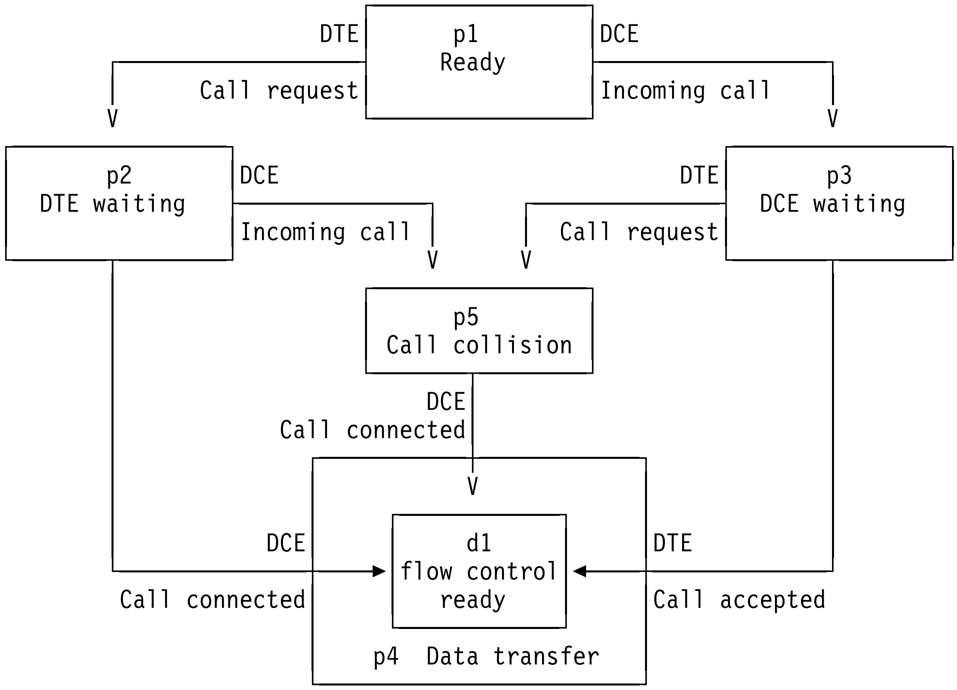


Figure B-1. X.25 Diagram of States for the Transfer of Restart Packets

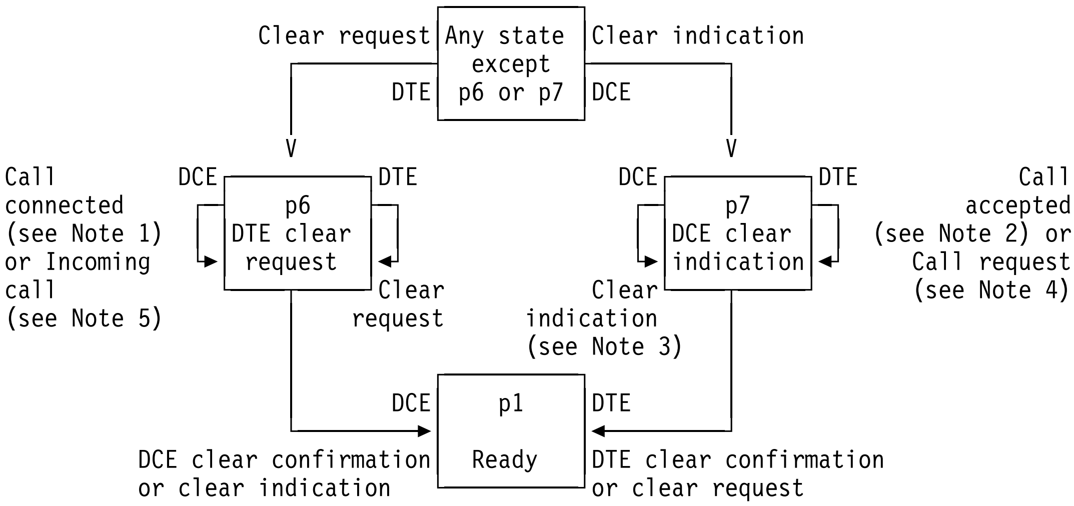
Notes:

1. State p1 for virtual calls or state d1 for permanent virtual circuits.
2. This transition may take place after timeout T10.

For the Nways Switch, the DCE state r2 is transient, as the DCE will immediately send a restart confirmation just after a restart request has been received. Moreover, the DCE will send a restart indication each time the link level is set up or reset.



a) Call setup phase



b) Call clearing phase
State

Figure B-2. X.25 Diagram of States for the Transfer of Call Setup and Call Clearing Packets within the Packet Level Ready (r1)

Notes:

1. This transition is possible only if the previous state was DTE Waiting (p2).
2. This transition is possible only if the previous state was DCE Waiting (p3).
3. This transition may take place after timeout T13.
4. This transition is possible only if the previous state was Ready (p1) or DCE Waiting (p3).
5. This transition is possible only if the previous state was ready (p1) or DTE Waiting (p2).

For the Nways Switch, the DCE state p6 is transient, as the DCE will immediately send a clear confirmation just after a clear request has been received from the DTE (the clear confirmation has local significance).

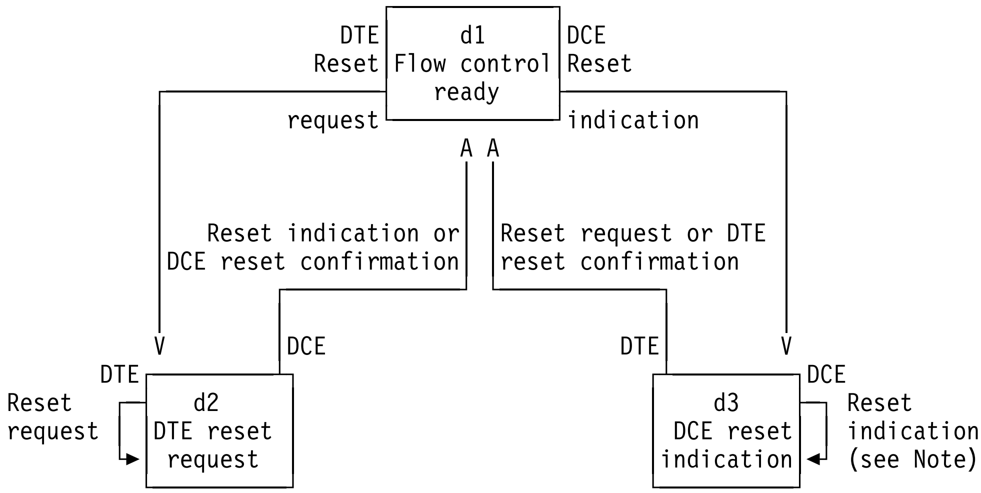


Figure B-3. X.25 Diagram of States for the Transfer of Reset Packets within the Data Transfer (p4) State

Note: This transition may take place after timeout T12.

For the Nways Switch, the DCE state d2 is transient, as the DCE will immediately send a reset confirmation just after a reset request has been received from the DTE (the reset confirmation has local significance).

Appendix C. Actions Taken by the DCE on Receipt of Packets

C.1 Introduction

This annex specifies the actions taken by the DCE on receipt of packets in a given state of the packet level DTE/DCE interface as perceived by the DCE.

It is presented as a succession of chained tables.

The following rules are valid for all these tables:

1. There may be more than one error associated with a packet. The network will stop normal processing of a packet when an error is encountered. Thus only one diagnostic code is associated with an error indication by the DCE. The order of packet decoding and checking on networks is not standardized.
2. For those networks which are octet aligned, the detection of a non-integral number of octets may be made at the frame or packet level. In this annex, only those networks which are octet aligned and detect the non-integral number of octets at the packet level are concerned with the considerations about octet alignment.

   Nways Switch networks are octet aligned and the detection of packets not including an integral number of octets is performed at link level.
3. In each table, the actions taken by the DCE are indicated in the following way:
   - DISCARD: the DCE discards the received packet and takes no subsequent action as a direct result of receiving that packet; the DCE remains in the same state.
   - DIAG # x: the DCE discards the received packet and, for networks which implement the *diagnostic* packet, transmits to the DTE a *diagnostic* packet containing the diagnostic # x. The state of the interface is not changed.

     Nways Switch networks make use of the diagnostic packet.
   - NORMAL or ERROR: the corresponding action is specified after each table.
4. Appendix E gives a list of the diagnostic codes which may be used.

C.2 Special Cases

Table C-1. X.25 Special Cases

Packet from the DTE	Any state
Any packet with packet length shorter than 2 octets, including link level valid I-frame containing no packet	DIAG # 38
Any packet with invalid general format identifier (GFI)	DIAG # 40
Any packet with unassigned logical channel	DIAG # 36
Any packet with correct GFI and assigned logical channel, or with correct GFI and bits 1 to 4 of octet 1 and bits 1 to 8 of octet 2 equal to 0	(See Table C-2)

C.3 Restart and Registration Procedure

Table C-2. X.25 Action Taken by the DCE: Restart and Registration Procedure

State of the interface as perceived by the DCE → / Packet from the DTE ↓	Packet level ready r1	DTE restart request r2	DCE restart indication r3
Restart request	NORMAL (r2)	DISCARD	NORMAL (r1)
DTE restart confirmation	ERROR (r3) # 17	ERROR (r3) # 18	NORMAL (r1)
Data, interrupt, call set-up and clearing, flow control or reset	(see Note)	ERROR (r3) # 18	DISCARD
Restart request, DTE restart confirmation or registration request with bits 1 to 4 of octet 1 or bits 1 to 8 of octet 2 unequal to zero	(see Note)	ERROR (r3) # 41	DISCARD
Packet having a packet type identifier which is shorter than 1 octet	(see Note)	ERROR (r3) # 38	DISCARD
Packet having a packet type identifier which is undefined or not supported by the DCE (that is, reject or registration packet)	(See Note)	ERROR (r3) # 33	DISCARD
Packet other than restart request, DTE restart confirmation and registration request with bits 1 to 4 of octet 1 and bits 1 to 8 of octet 2 equal to zero	DIAG # 36	DIAG # 36	DIAG # 36
Registration request	NORMAL (r1)	NORMAL (r2)	NORMAL (r3)

X.25 Action Taken by the DCE on Receipt of Packets in a Given State of the Packet Level DTE/DCE Interface as Perceived by the DCE: Restart and Registration Procedure.

Note: See Table C-3 for logical channels assigned to virtual calls, see Table C-4 for logical channels assigned to permanent virtual circuits.

| If the Nways Switch receives a registration packet from a normal DTE in state r1, it handles it as an ERROR (r3) # 33. It issues a restart indication, cause "local procedure error" and diagnostic "unidentifiable packet".

ERROR (r3) # x:

The DCE discards the received packet, indicates a restarting by transmitting to the DTE a *restart indication* packet, with the cause "Local procedure error" and the diagnostic # x, and enters state r3. If connected through a virtual call, the distant DTE is also informed of the restarting by a *clear indication* packet, with the cause "Remote procedure error" (same diagnostic). In the case of a permanent virtual circuit, the distant DTE will be informed by a *reset indication* packet, with the cause "Remote procedure error" (same diagnostic).

NORMAL (r1):

Provided none of the following error conditions has occurred, the action taken by the DCE follows the procedure as defined in 3 and 6.1, and the DTE/DCE interface enters state r1:

a. If a *restart request* packet or *DTE restart confirmation* packet received in state r3, or a *registration request* packet received in state r2 or r3, exceeds the maximum permitted length, is too short or is not octet aligned (see rule 2 in the introduction of this annex), the DCE will invoke the ERROR # 39, # 38 or # 82 procedure, respectively.

   Registration request packets are not applicable to the Nways Switch.

   Nways Switch networks accept a cause field different from "DTE originated" in the *restart request* packet received in state r3.

b. If a *restart request* or a *registration request* packet received in state r1 exceeds the maximum permitted length, is too short or is not octet aligned (see rule 2 in the introduction of this annex), the DCE shall invoke the DIAG # 39, # 38, or # 82 procedure, respectively.

   Nways Switch networks accept a cause field different from "DTE originated" in the *restart request* packet received in state r1.

c. If a *registration request* packet is received from the DTE when the *on-line facility registration* facility is supported by the DCE but not subscribed by the DTE, the DCE shall transmit to the DTE a *registration confirmation* packet with the cause "Local procedure error", the diagnostic # 42, and no registration field.

If a *registration request* packet modifying one or more of the facilities which can take effect only when all logical channels used for virtual calls are in state p1 (see Annex F) is received when it is possible to make the modification, the DCE shall transmit a *restart indication* packet with the cause "Registration/cancellation confirmed" and diagnostic # 0 and enter state r3, if there is one or more logical channels assigned to permanent virtual circuits. This action ensures that the permanent virtual circuits are reset so that all of the negotiated facilities can take effect properly.

C.4 Call Setup and Clearing

Table C-3. X.25 Action Taken by the DCE: Call Setup and Clearing

State of the interface as perceived by the DCE → / Packet from the DTE with logical channel assigned to virtual call ↓	Packet level ready r1						
	Ready p1	DTE waiting p2 (see Note 3)	DCE waiting p3 (see Note 2)	Data transfer p4	Call collision p5 (see Notes 2 and 3)	DTE clear request p6	DCE clear indication p7
Call request	NORMAL (p2)	ERROR (p7) # 21	NORMAL (p5)	ERROR (p7) # 23	ERROR (p7) # 21	ERROR (p7) # 25	DISCARD
Call accepted	ERROR (p7) # 20	ERROR (p7) # 21	NORMAL (p4)	ERROR (p7) # 23	ERROR (p7) # 21	ERROR (p7) # 25	DISCARD
Clear request	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	NORMAL (p6)	DISCARD	NORMAL (p1)
DTE clear confirmation	ERROR (p7) # 20	ERROR (p7) # 21	ERROR (p7) # 22	ERROR (p7) # 23	ERROR (p7) # 21	ERROR (p7) # 25	NORMAL (p1)
Data, interrupt, reset, or flow control	ERROR (p7) # 20	ERROR (p7) # 21	ERROR (p7) # 22	(See Note 4)	ERROR (p7) # 21	ERROR (p7) # 25	DISCARD
Restart request, DTE restart confirmation, or registration request with bits 1 to 4 of octet 1 or bits 1 to 8 of octet 2 unequal to zero	ERROR (p7) # 41	ERROR (p7) # 41	ERROR (p7) # 41	(See Note 4)	ERROR (p7) # 41	ERROR (p7) # 41	DISCARD
Packets having a packet type identifier which is shorter than one octet	ERROR (p7) # 38	ERROR (p7) # 38	ERROR (p7) # 38	(See Note 4)	ERROR (p7) # 38	ERROR (p7) # 38	DISCARD
Packets having a packet type identifier which is undefined or not supported by the DCE (i.e., reject or registration packet)	ERROR (p7) # 33	ERROR (p7) # 33	ERROR (p7) # 33	(See Note 4)	ERROR (p7) # 33	ERROR (p7) # 33	DISCARD

X.25 Action Taken by the DCE on Receipt of Packets in a Given State of the Packet Level DTE/DCE Interface as Perceived by the DCE: Call Setup and Clearing on Logical Channel Assigned to Virtual Call (See Note 1).

Notes:

1. On permanent virtual circuit, only state P4 exists and the DCE takes no action except those specified in Table C-4.
2. This state does not exist in the case of an outgoing one-way logical channel (as perceived by the DTE).
3. This state does not exist in the case of an incoming one-way logical channel (as perceived by the DTE).
4. See Table C-4.

ERROR (p7) # x:

The DCE discards the received packet, indicates a clearing by transmitting to the DTE a *clear indication* packet, with the cause "Local procedure error" and the diagnostic # x, and enters state p7. If connected through a virtual call, the distant DTE is also informed of the clearing by a *clear indication* packet, with the cause "Remote procedure error" (same diagnostic).

NORMAL (pi):

Provided none of the following error conditions has occurred, the action taken by the DCE follows the procedures as defined in 4 and the DTE/DCE interface enters state p1. In all the cases specified hereunder, the DCE will transmit to the DTE a *clear indication* with the appropriate cause and diagnostic, and enter state p7. If connected through a virtual call, the distant DTE is also informed of the clearing by a *clear indication* packet with the cause "Remote procedure error" (same diagnostic).

C.4.1 Call Request Packet

Error condition	Cause	Specific Diagnostics (see Note 3 of Appendix E)
1 Packet not octet aligned (see rule 2 in the introduction of this annex)	Local procedure error	# 82 (1)
2 Incoming one-way logical channel (as perceived by the DTE)	Local procedure error	# 34
3 Address contains a non-BCD digit	Local procedure error	# 67, 68
4 Invalid calling DTE address (see Note)	Local procedure error	# 68
5 Invalid called DTE address (see Note)	Local procedure error or not obtainable	# 67 # 67

Note: Possible reasons for invalid address include:

- Prefix digit no supported
- National address smaller than national address format permits
- National address larger than national address format permits
- DNIC less than four digits, etc.

In the case of the Nways Switch, invalid addresses are addresses which do not comply with the rules given in 5.8 or which do not comply with the addressing scheme established by the network service provider.

Error condition	Cause	Specific Diagnostics (see Note 3 of Appendix E)
6 Value of the facility length field greater than 109	Local procedure error	# 69
7 No combination of facilities could equal facility length	Local procedure error	# 69
8 Facility length larger than remainder of packet	Local procedure error	# 38
9 Facility code not allowed	Invalid facility request	# 65
10 Facility value not allowed or invalid	Invalid facility request	# 66
11 Invalid network user identification	Invalid facility request	# 66
12 Network user identification facility expected by the DCE and not provided by the DTE	Local procedure error	# 84 (1)
13 Facility values conflicts (for example, a particular combination not supported)	Invalid facility request	# 66
14 ITU-T specified DTE facility code or parameter not allowed or invalid	Invalid facility request	# 77
15 Packet too short	Local procedure error	# 38
16 Address length larger than remainder of packet	Local procedure error	# 39
17 Call user data larger than 16 or 128 in case of fast select facility	Local procedure error	# 39
18 Class coding of the facility corresponding to a length of parameter larger than remainder of packet	Local procedure error	# 69
19 Facility code repeated	Local procedure error	# 73

If the virtual call cannot be established by the network, the DCE should use a call progress signal and diagnostic code among the following.

Error condition	**Cause**	**Specific Diagnostics (see Note 3 of Appendix E)**
20 Unknown number	Not obtainable	# 67
21 Incoming call barred	Access barred	# 70
22 Closed user group protection	Access barred	# 65
23 Ship absent	Ship absent	# 0
24 Reverse charging rejected	Reverse charging acceptance not subscribed	# 0
25 Fast select rejected	Fast select acceptance not subscribed	# 0
26 Called DTE out of order	Out of order	# 0 # greater than 127
27 No logical channel available	Number busy	# 71
28 Call collision	Number busy	# 71, 72
29 RPOA out of order	RPOA out of order	# 0
30 The remote DTE/DCE interface or the transit network does not support a function or a facility requested	Incompatible destination	# 0
Note: Precise definition of error condition 30 necessitates further study and should take into account the possible non-support of the virtual call service (only permanent virtual circuit) by the destination DTE.		
31 Procedure error at the remote DTE/DCE interface	Remote procedure error	(see b. and c. below and Annex D)
32 Temporary network congestion or fault condition within the network	Network congestion	# 0, # 122 # greater than 127

Note:

1. No generated by the Nways Switch

C.4.2 Call Accepted Packet

Error condition	Cause	Specific Diagnostics (see Note 3 of Appendix E)
1 Packet not octet aligned (see rule 2 in the introduction of this annex)	Local procedure error	# 82 (1)
2 Address contains a non-BCD digit	Local procedure error	# 67, 68
3 Invalid calling DTE address (see Note under 1)	Local procedure error	# 68
4 Invalid called DTE address (see Note under 1)	Local procedure error	# 67
5 Value of the facility length field greater than 109	Local procedure error	# 69
6 No combination of facilities could equal facility length	Local procedure error	# 69
7 Facility length larger than remainder of packet	Local procedure error	# 38
8 Facility code not allowed	Invalid facility request	# 65
9 Facility value not allowed or invalid	Invalid facility request	# 66
10 Invalid network user identification	Invalid facility request	# 66
11 Network user identification facility expected by the DCE and not provided by the DTE	Local procedure error	# 84 (1)
12 Facility values conflicts (for example, a particular combination not supported)	Invalid facility request	# 66
13 Address length larger than remainder of packet	Local procedure error	# 38
14 Called user data larger than 128 (if fast select facility requested)	Local procedure error	# 39
15 Called user data present (if fast select facility not requested)	Local procedure error	# 39
16 Class coding of the facility corresponding to a length of parameter field larger than remainder of packet	Local procedure error	# 69
17 Facility code repeated	Local procedure error	# 73
18 The incoming call packet indicated fast select with restriction on response	Local procedure error	# 42
19 DTE facility code or parameter not allowed or invalid	Invalid facility request	# 77

Some networks may invoke the ERROR # 74 procedure if the address length fields are not equal to 0 in the *call accepted* packet, except when the *called line address modified notification* facility is present in the facility field.

The behavior of an Nways Switch network regarding addresses is given in 5.8.

Note:

1. No generated by the Nways Switch

C.4.3 Clear Request Packet

Error condition	**Cause**	**Specific Diagnostics (see Note 3 of Appendix E)**
1 Packet not octet aligned (see rule 2 in the introduction of this annex)	Local procedure error	# 82 (1)
2 Packet too short	Local procedure error	# 38
3 Packet length incorrectly larger than 5 octets	Local procedure error	# 39
4 Calling DTE address length field not set to zero (at any time); called DTE address length field not set to zero except when the called line address modified notification facility is present in clearing a call in state p3	Local procedure error	# 74
5 Invalid called DTE address when the called line address modified notification facility is present in clearing a call in state p3 (see Note under 1)	Local procedure error	# 67
6 Value of the facility length field greater than 109	Local procedure error	# 69
7 Clear user data larger than 128 (if fast select facility requested)	Local procedure error	# 39
8 Clear user data present (if fast select facility not requested)	Local procedure error	# 39
9 No combination of facilities could equal facility length	Local procedure error	# 69
10 Facility length larger than remainder of packet	Local procedure error	# 38
11 Facility code not allowed	Invalid facility request	# 65
12 Facility value not allowed or invalid	Invalid facility request	# 66
13 Class coding of the facility corresponding to a parameter field length larger than remainder of packet	Local procedure error	# 69
14 Facility code repeated	Local procedure error	# 73

Nways Switch networks invoke the ERROR # 81 procedure when the clearing cause field is not "DTE originated" in the *clear request packet* (except from an X.25 GW).

Note:

1. No generated by the Nways Switch

C.4.4 DTE Clear Confirmation Packet

Error condition	Cause	Specific Diagnostics (see Note 3 of Appendix E)
1 Packet not octet aligned (see rule 2 in the introduction of this annex)	Local procedure error	# 82 (1)
2 Packet length greater than 3 octets	Local procedure error	# 39

Note:

1. No generated by the Nways Switch

C.5 Data Transfer

Table C-4. X.25 Action Taken by the DCE: Data Transfer (Flow Control and Reset)

State of the interface as perceived by the DCE → / Packet from the DTE with assigned logical channel ↓	Data transfer p4		
	Flow control ready d1	DTE reset request d2	DCE reset indication d3
Restart request	NORMAL (d2)	DISCARD	NORMAL (d1)
DTE reset confirmation	ERROR (d3) # 27	ERROR (d3) # 28	NORMAL (d1)
Data, interrupt, or flow control	NORMAL (d1)	ERROR (d3) # 28	DISCARD
Restart request, DTE restart confirmation or registration request with bits 1 to 4 of octet 1 or bits 1 to 8 of octet 2 unequal to zero	ERROR (d3) # 41	ERROR (d3) # 41	DISCARD
Packet having a packet type identifier which is shorter than 1 octet	ERROR (d3) # 38	ERROR (d3) # 38	DISCARD
Packet having a packet type identifier which is undefined or not supported by the DCE (that is, reject or registration packet)	ERROR (d3) # 33	ERROR (d3) # 33	DISCARD
Invalid packet type on a permanent virtual circuit	ERROR (d3) # 35	ERROR (d3) # 35	DISCARD
Reject packet not subscribed	ERROR (d3)) # 37	ERROR (d3) # 37	DISCARD

X.25 Action Taken by the DCE on Receipt of Packets in a Given State of the Packet Level DTE/DCE Interface as Perceived by the DCE: Data Transfer (Flow Control and Reset) on Assigned Logical Channels. ERROR (d3) # x:

The DCE discards the received packet, indicates a reset by transmitting to the DTE a *reset indication* packet, with the cause "Local procedure error" and the diagnostic # x, and enters state d3. The distant DTE is also informed of the reset by a *reset indication* packet, with the cause "Remote procedure error" (same diagnostic).

NORMAL (d1):

Provided none of the following error conditions or special situations has occurred, the actions taken by the DCE follow the procedure as defined in 4:

a. If the packet exceeds the maximum permitted length, is too short, is not octet aligned (see rule 2 in the introduction of this annex), the DCE will invoke the ERROR # 39, # 38, # 82 procedure, respectively.

b. Nways Switch networks accept a resetting cause field different from "DTE originated" in a *reset request* packet.

c. Nways Switch networks invoke the ERROR # 83 procedure, when the Q bit is not set to the same value within a complete packet sequence.

d. If the P(S) or P(R) received is not valid, the DCE will invoke the ERROR # 1 or # 2 procedure respectively.

e. The DCE will consider the receipt of a *DTE interrupt confirmation* packet which does not correspond to a yet unconfirmed *DCE* interrupt packet as an error and will invoke the ERROR # 43 procedure. The DCE will consider a *DTE on* interrupt *off* packet received before a previous *DTE interrupt* packet has been confirmed as an error, and will invoke the ERROR # 44 procedure.

f. If the network has a temporary inability to handle data traffic for a permanent virtual circuit (see 4.2), and if the packet is an *on* data, interrupt, flow control *off* or *reset request* packet received in state d1, the DCE shall transmit to the DTE a *reset indication* packet with the cause "Network out of order" and enter state d3 *(data, interrupt* or *flow control,* packet) or d1 *(reset request* packet).

Appendix D. Packet Level DCE Timeouts and DTE Time-Limits

D.1 DCE Timeouts

Under certain circumstances this Recommendation requires the DTE to respond to a packet issued from the DCE within a stated maximum time.

Table D-1, D-2 covers these circumstances and the actions that the DCE will initiate upon the expiration of that time.

The timeout values used by the DCE will never be less than those indicated in Table D-1, D-2.

The Nways Switch makes use of the timeout values indicated in Table D-1, D-2. These values are defined by the network service provider.

In table D-1, D-2, it is indicated that under certain cases of no response from the DTE (case of permanent virtual circuit), the DCE *may* issue a remote procedure error condition at the remote DTE/DCE interface; that is not the case for the Nways Switch. However, if the remote DTE tries to send data, interrupt, or flow control packets while a retransmission procedure is performed at the local DTE/DCE interface, then the remote DCE will issue a remote procedure error condition at each attempt from the remote DTE.

D.2 DTE Time-Limits

Under certain circumstances, this Recommendation requires the DCE to respond to a packet from the DTE within a stated maximum time. Table D-3 gives these maximum times. The actual DCE response times should be well within the specified time-limits. The rare situation where a time-limit is exceeded should only occur when there is a fault condition.

To facilitate recovery from such fault conditions, the DTE may incorporate timers. The time-limits given in Table D-3 are the lower limits of the times a DTE should allow for proper operation. A time-limit longer than the values shown may be used. Suggestions on possible DTE actions upon expiration of the time-limits are given in Table D-3.

Notes:

1. A DTE may use a time shorter than the value given for T21 in Table D-3. This may be appropriate when the DTE knows the normal response time of the called DTE to an incoming call. In this case, the timer should account for the normal maximum response time of the called DTE and the estimated maximum call setup time.
2. The Nways Switch makes use of the diagnostic packet each time this possibility is quoted in Tables D-1 and D-2.

Table D-1. X.25 DCE Timeouts (First Time)						
Timeout Number	**Timeout Value**	**Started when**	**State of the Logical Channel**	**Normally Terminated when**	**Actions to Be Taken the First Time the Timeout Expires**	
					Local Side	**Remote Side**
T10	60 s	DCE issues a restart indication	r3	DCE leaves the r3 state (that is, the restart confirmation or restart request is received)	DCE remains in r3, signals a restart indication (local procedure error # 52) again, and restarts timeout T10	For permanent virtual circuits, DCE may enter the d3 state signaling a reset indication (remote procedure error # 52)
T11	180 s	DCE issues an incoming call	p3	DCE leaves the p3 state (that is, the call accepted, clear request or call request is received)	DCE enters the p7 state signaling a clear indication (local procedure error # 49)	DCE enters the p7 state signaling a clear indication (remote procedure error # 49)
T12	60 s	DCE issues a reset indication	d3	DCE leaves the d3 state (that is, the reset confirmation or reset request is received)	DCE remains in d3, signals a reset indication (local procedure error # 51) again, and restarts timeout T12	DCE may enter the d3 state signaling a reset indication (remote procedure error # 51)
T13	60 s	DCE issues a clear indication	p7	DCE leaves the p7 state (that is, the clear confirmation or clear request is received)	DCE remains in p7, signals a clear indication (local procedure error # 50) again, and restarts timeout T13	

Table D-2 (Page 1 of 2). X.25 DCE Timeouts (Second Time)						
Timeout Number	**Timeout Value**	**Started when**	**State of the Logical Channel**	**Normally Terminated when**	**Actions to Be Taken the Second Time the Timeout Expires**	
					Local Side	**Remote Side**
T10	60 s	DCE issues a restart indication	r3	DCE leaves the r3 state (that is, the restart confirmation or restart request is received)	DCE enters the r1 state and may issue a diagnostic packet (# 52)	For permanent virtual circuits, DCE may enter the d3 state signaling a reset indication (remote procedure error # 52)
T11	180 s	DCE issues an incoming call	p3	DCE leaves the p3 state (that is, the call accepted, clear request or call request is received)		

Table D-2 (Page 2 of 2). X.25 DCE Timeouts (Second Time)						
Timeout Number	**Timeout Value**	**Started when**	**State of the Logical Channel**	**Normally Terminated when**	**Actions to Be Taken the Second Time the Timeout Expires**	
					Local Side	**Remote Side**
T12	60 s	DCE issues a reset indication	d3	DCE leaves the d3 state (that is, the reset confirmation or reset request is received)	For virtual calls, DCE enters the p7 state signaling a clear indication (local procedure error # 51). For permanent virtual circuits DCE enters the d1 state and may issue a diagnostic packet (# 51)	For virtual calls, DCE enters the p7 state signaling a clear indication (remote procedure error # 51). For permanent virtual circuits DCE enters the d3 state signaling a reset indication (remote procedure error # 51)
T13	60 s	DCE issues a clear indication	p7	DCE leaves the p7 state (that is, the clear confirmation or clear request is received)	DCE enters the p1 state and may issue a diagnostic packet (# 50)	

Table D-3. X.25 DTE Time-Limits					
Timeout Number	**Timeout Value**	**Started when**	**State of the Logical Channel**	**Normally Terminated when**	**Preferred Action to Be Taken when the Timeout Expires**
T20	180 s	DTE issues a restart request	r2	DTE leaves the r2 state (i.e. the restart confirmation or restart indication is received)	To retransmit the restart request (see Note 1)
T21	200 s	DTE issues a call request	p2	DTE leaves the p2 state (for example the call connected, clear indication or incoming call is received)	To transmit a clear request
T22	180 s	DTE issues a reset request	d2	DTE leaves the d2 state (for example the reset confirmation or reset indication is received)	For virtual calls, to retransmit the reset request or to transmit a clear request. For permanent virtual call circuits, to retransmit the reset request (see note 2)
T23	180 s	DTE issues a clear request	p6	DTE leaves the p6 state (for example the clear confirmation or clear indication is received)	To retransmit the clear request (see Note 2)

Notes:

1. After unsuccessful retries, recovery decisions should be taken at higher levels.
2. After unsuccessful retries, the logical channel should be considered out of order. The restart procedure should only be invoked for recovery if reinitialization of all logical channels is acceptable.

Appendix E. Coding of X.25 Network Generated Diagnostic Fields

This appendix describes the coding of X.25 network generated diagnostic fields in clear reset and restart indication, registration confirmation, and diagnostic packets.

Some of the diagnostics described here are not generated by an Nways Switch network. Some of them can be received by DTEs attached to an Nways Switch node only when the Nways Switch network is connected to a PSDN through the X.25 GW function.

In principle, when there is no ambiguity about the cause of the clear, reset, or restart, the Nways Switch avoids using generic codes.

Some Nways Switch specific diagnostics are added to the ITU-T list when no relevant code is available. These codes are chosen from the value 128, upwards, as required by the Recommendation.

Only network generated diagnostic fields are described here. Diagnostic codes associated to cause codes X'00' or B'1xxx xxxx', which are DTE generated, are described in the relevant DTE documentation.

Table E-1. X.25 Coding of X.25 Network Generated Diagnostic Fields

Diagnostics	Bits 8 7 6 5 4 3 2 1	Hexa-decimal	Decimal
No additional information	0 0 0 0 0 0 0 0	00	0
Invalid P(S)	0 0 0 0 0 0 0 1	01	1
Invalid P(R)	0 0 0 0 0 0 1 0	02	2
	0 0 0 0 1 1 1 1	0F	15
Packet type invalid	0 0 0 1 0 0 0 0	10	16
For state r1	0 0 0 1 0 0 0 1	11	17
For state r2	0 0 0 1 0 0 1 0	12	18
For state r3	0 0 0 1 0 0 1 1	13	19
For state p1	0 0 0 1 0 1 0 0	14	20
For state p2	0 0 0 1 0 1 0 1	15	21
For state p3	0 0 0 1 0 1 1 0	16	22
For state p4	0 0 0 1 0 1 1 1	17	23
For state p5	0 0 0 1 1 0 0 0	18	24
For state p6	0 0 0 1 1 0 0 1	19	25
For state p7	0 0 0 1 1 0 1 0	1A	26
For state d1	0 0 0 1 1 0 1 1	1B	27
For state d2	0 0 0 1 1 1 0 0	1C	28
For state d3	0 0 0 1 1 1 0 1	1D	29
	0 0 0 1 1 1 1 1	1F	31
Packet not allowed	0 0 1 0 0 0 0 0	20	32
Unidentifiable packet	0 0 1 0 0 0 0 1	21	33
Call on one—way logical channel	0 0 1 0 0 0 1 0	22	34
Invalid packet type on a permanent virtual circuit	0 0 1 0 0 0 1 1	23	35
Packet on unassigned logical channel	0 0 1 0 0 1 0 0	24	36
Reject not subscribed to	0 0 1 0 0 1 0 1	25	37
Packet too short	0 0 1 0 0 1 1 0	26	38
Packet too long	0 0 1 0 0 1 1 1	27	39
Invalid general format identifier	0 0 1 0 1 0 0 0	28	40
Restart or registration packet with non—zero in bits 1 to 4 of octet 1, or bits 1 to 8 of octet 2	0 0 1 0 1 0 0 1	29	41
Packet type not compatible with facility	0 0 1 0 1 0 1 0	2A	42
Unauthorized interrupt confirmation	0 0 1 0 1 0 1 1	2B	43
Unauthorized interrupt	0 0 1 0 1 1 0 0	2C	44
Unauthorized reject	0 0 1 0 1 1 0 1	2D	45
	0 0 1 0 1 1 1 1	2F	47
Time expired	0 0 1 1 0 0 0 0	30	48
For incoming call	0 0 1 1 0 0 0 1	31	49
For clear indication	0 0 1 1 0 0 1 0	32	50
For reset indication	0 0 1 1 0 0 1 1	33	51
For restart indication	0 0 1 1 0 1 0 0	34	52
	0 0 1 1 1 1 1 1	3F	63

Table E-2. X.25 Coding of X.25 Network Generated Diagnostic Fields (Continued)

Diagnostics	Bits	Hexa-decimal	Decimal
	8 7 6 5 4 3 2 1		
Call set—up, call clearing or registration problem	0 1 0 0 0 0 0 0	40	64
Facility/registration code not allowed	0 1 0 0 0 0 0 1	41	65
Facility parameter not allowed	0 1 0 0 0 0 1 0	42	66
Invalid called address	0 1 0 0 0 0 1 1	43	67
Invalid calling address	0 1 0 0 0 1 0 0	44	68
Invalid facility/registration length	0 1 0 0 0 1 0 1	45	69
Incoming call barred	0 1 0 0 0 1 1 0	46	70
No logical channel available	0 1 0 0 0 1 1 1	47	71
Call collision	0 1 0 0 1 0 0 0	48	72
Duplicate facility requested	0 1 0 0 1 0 0 1	49	73
Non zero address length	0 1 0 0 1 0 1 0	4A	74
Non zero facility length (5)	0 1 0 0 1 0 1 1	4B	75
Facility not provided when expected	0 1 0 0 1 1 0 0	4C	76
Invalid ITU-T-specified DTE facility (5)	0 1 0 0 1 1 0 1	4D	77
Max number of call redirections or deflections exceeded	0 1 0 0 1 1 0 1	4E	78
	0 1 0 0 1 1 1 1	4F	79
Miscellaneous	0 1 0 1 0 0 0 0	50	80
Improper cause code from DTE	0 1 0 1 0 0 0 1	51	81
Not aligned octet (5)	0 1 0 1 0 0 1 0	52	82
Inconsistent Q bit setting (5)	0 1 0 1 0 0 1 1	53	83
NUI problem (5)	0 1 0 1 0 1 0 0	54	84
	0 1 0 1 1 1 1 1	5F	95
Not assigned	0 1 1 0 0 0 0 0	60	96
	0 1 1 0 1 1 1 1	6F	111
International problem	0 1 1 1 0 0 0 0	70	112
Remote network problem	0 1 1 1 0 0 0 1	71	113
International protocol problem	0 1 1 1 0 0 1 0	72	114
International link out of order	0 1 1 1 0 0 1 1	73	115
International link busy	0 1 1 1 0 1 0 0	74	116
Transit network facility problem (5)	0 1 1 1 0 1 0 1	75	117
Remote network facility problem	0 1 1 1 0 1 1 0	76	118
International routing problem (5)	0 1 1 1 0 1 1 1	77	119
Temporary routing problem (5)	0 1 1 1 1 0 0 0	78	120
Unknown called DNIC	0 1 1 1 1 0 0 1	79	121
Maintenance action (see Note 4, 5)	0 1 1 1 1 0 1 0	7A	122
	0 1 1 1 1 1 1 1	7F	127

Table E-3. X.25 Coding of X.25 Network Generated Diagnostic Fields (Continued)

Diagnostics	Bits 8 7 6 5 4 3 2 1	Hexa-decimal	Decimal
IBM Nways Switch specific			128
Adapter packet buffers depletion	1 0 0 0 0 0 0 1	81	129
Adapter common memory depletion	1 0 0 0 0 0 1 0	82	130
Service connection set-up failure	1 0 0 0 0 0 1 1	83	131
Data connection set-up failure	1 0 0 0 0 1 0 0	84	132
Service connection congestion	1 0 0 0 0 1 0 1	85	133
Data connection congestion	1 0 0 0 0 1 1 0	86	134
Service connection failure	1 0 0 0 0 1 1 1	87	135
Data connection failure / bandwidth increase request failure	1 0 0 0 1 0 0 0	88	136
Reverse bandwidth increase request failure	1 0 0 0 1 0 0 1	89	137
Remote adapter packet buffer depletion	1 0 0 0 1 0 1 0	8A	138
Remote adapter common memory depletion	1 0 0 0 1 0 1 1	8B	139
Adapter internal queues congestion	1 0 0 0 1 1 0 0	8C	140
Remote adapter internal queues congestion	1 0 0 0 1 1 0 1	8D	141
Access line down	1 0 0 1 1 0 0 0	98	152
Access line not configured	1 0 0 1 1 1 0 1	9D	157
	1 1 1 1 1 1 1 1	FF	255

Notes:

1. Not all diagnostic codes need apply to a specific network, but those used are as coded in the table.
2. A given diagnostic need not apply to all packet types (i.e., *reset indication, clear indication, restart indication, registration confirmation,* and *diagnostic* packets).
3. The first diagnostic in each grouping is a generic diagnostic and can be used in place of the more specific diagnostics within the grouping. The decimal 0 diagnostic code can be used in situations where no additional information is available.
4. This diagnostic may also apply to a maintenance action within a national network.
5. Not generated by the Nways Switch.

Appendix F. Applicability of the Online Facility Registration Facility to Other Facilities

The applicability of the online facility registration facility to other facilities is not applicable to the Nways Switch.

Appendix G. ITU-T-Specified DTE Facilities to Support the OSI Network Service

G.1 Introduction

The facilities described in this Appendix are intended to support end-to-end signalling required by the OSI Network service. They follow the ITU-T-specified DTE facility marker defined in §5.1. These facilities are passed unchanged between the two packet mode DTEs involved.

The Nways Switch accepts any of the ITU-T-specified DTE facilities, and delivers them unchanged to the called DTE.

Procedures for use of these facilities by DTEs are specified in ISO 82080. Subsequent provision of X.25 facilities to be acted on by public data networks is for further study. Coding of the facilities in this Appendix is defined here in order to facilitate a consistent facility coding scheme in such future evolution.

G.2 Coding of the Facility Code Fields

Table G-1 gives the coding of the facility code field for each ITU-T-specified DTE facility and the packet types in which they may be present. These facilities are conveyed after the ITU-T-specified DTE facility marker.

Table G-1. Coding of the Facility Code Field

Facility	**Packet types in which the facility may be used**						**Facility code**
	CRQ	**INC**	**ACC**	**CCN**	**CLR**	**CLI**	**Bits** **8 7 6 5 4 3 2 1**
Calling address extension	x	x			x[1]		1 1 0 0 1 0 1 1
Called address extension	x	x	x	x	x[1]	x	1 1 0 0 1 0 0 1
QoS negotiation							
minimum throughput class	x	x			x[1]		0 0 0 0 1 0 1 0
end-to-end transit delay	x	x	x	x	x[1]		1 1 0 0 1 0 1 0
Priority	x	x	x	x	x[1]		1 1 0 1 0 0 1 0
Protection	x	x	x	x	x[1]		1 1 0 1 0 0 1 1
Expedited data negotiation	x	x	x	x	x[1]		0 0 0 0 1 0 1 1

1 Only when the *call deflection selection* facility is used (see §6.25.2.2).

CRQ	Call request	CCN	Call connected
INC	Incoming call	CLR	Clear request
ACC	Call accepted	CLI	Clear indication
DCC	DCE clear confirmation	QOS	Quality of service

G.3 Coding of the Facility Parameter Field

G.3.1 Calling Address Extension Facility

The octet following the facility code field indicates the length of the facility parameter field. It has a value of $n + 1$, where n is the number of octets necessary to hold the calling address extension. The facility parameter field follows the length and contains the calling address extension.

The first octet of the facility parameter field indicates, in bits 8 and 7, the use of the calling address extension, as shown in Table G-2.

Table G-2. Coding of bits 8 and 7 in the first octet of the calling extension facility parameter field

Bits		**Use of calling address extension**
8	**7**	
0	0	To carry a calling address assigned according to Recommendation X.213/ISO 8348 AD2
0	1	Reserved
1	0	Other (to carry a calling address not assigned according to Recommendation X.213/ISO 8348 AD2)
1	1	Reserved

Bits 6, 5, 4, 3, 2 and 1 of this octet indicate the number of semi-octets (up to a maximum of 40) in the calling address extension. This address length indicator is binary coded, where bit 1 is the low-order bit.

The following octets contain the calling address extension.

If bits 8 and 7 of the first octet of the facility parameter field are coded '00', the following octets are coded using the preferred binary encoding (PBE) defined in Recommendation X.213. Starting from the high-order digit of the Initial Domain Part (IDP), the address is coded in octet 2 and consecutive octets of the facility parameter field. Each digit, with padding digits applied as necessary, is coded in a semi-octet in binary coded decimal, where bit 5 or 1 is the low-order bit of the digit. In each octet, the higher-order bit is coded in bits 8, 7, 6 and 5. The Domain Specific Part (DSP) of the calling OSI NSAP follows the IDP and is coded in decimal or binary, according to the PBE. For example, if the syntax of the DSP is decimal, each digit is coded in binary coded decimal (with the same rules applying to the DSP as to the IDP above). If the syntax of the DSP is binary, each octet of the calling address extension contains an octet of the DSP.

If bits 8 and 7 of the first octet of the facility parameter field are coded '10', each digit of the calling address extension is coded 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 address is coded in octet 2 and consecutive octets of the facility parameter field with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5. When necessary, the facility parameter field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field.

G.3.2 Called Address Extension Facility

| The octet following the facility code field indicates the length of the facility parameter field in octets. It has a value of $n + 1$, where n is the number of octets necessary to hold the called address extension. The facility parameter field follows the length and contains the calling address extension.

The first octet of the facility parameter field indicates, in bits 8 and 7, the use of the called address extension, as shown in Table G-3.

Table G-3. Coding of bits 8 and 7 in the first octet of the called extension facility parameter field

Bits		Use of called address extension
8	**7**	
0	0	To carry a called address assigned according to Recommendation X.213/ISO 8348 AD2
0	1	Reserved
1	0	Other (to carry a called address not assigned according to Recommendation X.213/ISO 8348 AD2)
1	1	Reserved

| Bits 6, 5, 4, 3, 2, and 1 of this octet indicate the number of semi-octets (up to a maximum of 40) in the called address extension. This address length indicator is binary coded, where bit 1 is the low-order bit.

The following octets contain the called address extension.

If bits 8 and 7 of the first octet of the facility parameter field are coded ‘00’, the following octets are coded using the preferred binary encoding (PBE) defined in Recommendation X.213. Starting from the high-order digit of the Initial Domain Part (IDP), the address is coded in octet 2 and consecutive octets of the facility parameter field. Each digit, with padding digits applied as necessary, is coded in a semi-octet in binary coded decimal, where bit 5 or 1 is the low-order bit of the digit. In each octet, the higher-order bit is coded in bits 8, 7, 6 and 5. The Domain Specific Part (DSP) of the called OSI NSAP follows the IDP and is coded in decimal or binary, according to the PBE. For example, if the syntax of the DSP is decimal, each digit is coded in binary coded decimal (with the same rules applying to the DSP as to the IDP above). If the syntax of the DSP is binary, each octet of the called address extension contains an octet of the DSP.

If bits 8 and 7 of the first octet of the facility parameter field are coded ‘10’, each digit of the called address extension is coded 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 address is coded in octet 2 and consecutive octets of the facility parameter field with two digits per octet. In each octet, the higher order digit is coded in bits 8, 7, 6 and 5. When necessary, the facility parameter field shall be rounded up to an integral number of octets by inserting zeros in bits 4, 3, 2 and 1 of the last octet of the field.

G.3.3 Quality of Service Negotiation Facilities

G.3.3.1 Minimum Throughput Class Facility

The minimum throughput class for the direction of data transmission from the calling DTE is indicated in bits 4, 3, 2 and 1. The minimum throughput class for the direction of data transmission from the called DTE is indicated in bits 8, 7, 6 and 5.

The four bits indicating each throughput class are binary coded and correspond to throughput classes as indicated in Table 7-4.

G.3.3.2 End-to-end Transit Delay Facility

The octet following the facility code field indicates the length in octets of the facility parameter field and has the value 2, 4 or 6.

The first and second octets of the facility parameter field contain the cumulative transit delay. The third and fourth octets are optional and, when present, contain the requested end-to-end transit delay. If the third and fourth octets are present, then the fifth and sixth octets are also optional. The fifth and sixth octets, when present, contain the maximum acceptable end-to-end transit delay. The optional octets are not present in *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.

G.3.3.3 Priority Facility

The octet following the facility code field indicates the length, in octets, of the facility parameter field. This may take the value 1, 2, 3, 4, 5 or 6.

The first, second and third octets of the facility parameter field contain the target (*call request* packet), available (*incoming call* packet) or selected (*call accepted* and *call connected* packets) values for the priority of data on connection, priority to gain a connection and priority to keep a connection, respectively. The fourth, fifth and sixth octets of the facility parameter field in *call request* and *incoming call* packets contain the lowest acceptable values for the priority of data on connection, priority to gain a connection and priority to keep a connection, respectively. When the facility is present in *call request* and *incoming call* packets, octets 2 through 6 of the facility parameter field are optional. For example, if the only values to be specified are the target and lowest acceptable values for priority to gain a connection, then the facility parameter field will contain at least 5 octets with octets 1, 3 and 4 containing the value ‘unspecified’, and octets 2 and 5 containing the specified values. When the facility is present in the *call accepted* and *call connected* packets, octets 2 and 3 are optional.

The potential range of specified values for each sub-parameter is 0 (lowest priority) to 254 (highest priority). The value 255 (1111 1111) indicates ‘unspecified’.

| For priority of data on connection, the Nways Switch supports only range from 0
| (lowest priority) to 14 (highest priority) and the value 255 (‘unspecified’).

| These priorities are mapped onto two priorities used internally by the Nways
| Switch, according to the following figure:

OSI Priority	IBM Nways Switch Priority
0 to 3	Low
4 to 254	High

Figure G-1. Nways Switch Priority Scheme

G.3.3.4 Protection Facility

The octet following the facility code indicates the length, in octets, of the facility parameter field.

The two highest order bits of the first octet (i.e., bits 8 and 7) of the facility parameter field specify the protection format code as indicated in Table G-4.

Table G-4. Coding of the Two Highest Order Bits in the First Octet of the Protection Format Code

Bits		Protection format code
8	**7**	
0	0	Reserved
0	1	Source address specific
1	0	Destination address specific
1	1	Globally unique

The remaining six bits of the octet are reserved and must be set to zero.

The second octet of the facility parameter field specifies the length *n*, in octets, (*incoming call* packet) or selected (*call accepted* and *call connected* packets) protection level. The actual value is placed in the following *n* octets. Optionally, the *n* + 3 octet of the facility parameter field specifies the length *m*, in octets, of the lowest acceptable protection level in call request and incoming call packets. The actual value is placed in the following *m* octets. The optional octets are not present in *call accepted* and *call connected* packets.

Note — The values of *n* and *m* are bounded firstly by the overall length of the facility (first octet), and secondly by each other.

G.3.4 Expedited Data Negotiation Facility

The coding of the facility parameter field is:

Bit 1 = 0 for no use of expedited data
Bit 1 = 1 for use of expedited data.

Note — Bits 8, 7, 6, 5, 4, 3 and 2 may be assigned to other facilities in the future; presently, they are set to zero.

Appendix H. Index

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