GC30-3189-1
File No. S370-30

Program Product

IBM X.25 NCP Packet Switching Interface General Information

Program Number 5668-981
Releases 2, 3, 3.1, 3.2, 4, and 4.1

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This is a major revision of and obsoletes GC30-3189-0. This edition applies to Release 2, 3, 3.1, 3.2, 4, and 4.1 of X.25 NCP Packet Switching Interface Program Product 5668-981, and to all subsequent releases and modifications unless otherwise indicated in new editions or Technical Newsletters. Changes are made periodically to the information herein; before using this publication in connection with the operation of IBM systems, consult the latest *IBM System/370 and 4300 Processors Bibliography*, GC20-0001, for the editions that are applicable and current.

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Preface

This publication introduces the IBM X.25 NCP Packet Switching Interface. It is intended for managers, system designers, or anyone involved in making decisions about data communication in an organization.

This manual briefly presents packet-switched data networks and the X.25 Interface to packet switching. The X.25 NCP Packet Switching Interface offers SNA users the ability to use communications facilities that support the CCITT X.25 Interface (Geneva 1980).

Readers of this book need not be familiar with X.25 or packet switching, but should be familiar with SNA concepts and products, as described in *Systems Network Architecture Concepts and Products*, GC30-3072.

Contents

Figures

Chapter 1. Introduction

This chapter introduces the IBM X.25 NCP Packet Switching Interface program product. The program product allows SNA users to communicate over packet-switched data networks that have interfaces complying with Recommendation X.25 (Geneva 1980) of the International Telegraph and Telephone Consultative Committee (CCITT). It allows SNA host processors to communicate with SNA equipment or with non-SNA equipment over such networks.

Releases 2, 3, 3.1, and 3.2 of the program run on the IBM 3705-II or 3705-80 Communications Controller. Releases 4 and 4.1 run on the IBM 3725 Communication Controller. All releases run under the control of ACF/NCP. The program is designed to permit SNA commands and data to be transmitted through an X.25 network.

Before we describe the IBM program product, we will first present (1) packet-switched data networks and (2) the X.25 interface to packet-switched data networks.

Overview of Packet-Switched Data Networks

A packet-switched data network (PSDN) carries messages that have been divided into segments called packets over circuits that are shared by many network users. It is an alternative to networks made up of circuits that are dedicated to pairs of users. In a PSDN each packet of a user's data is transmitted separately across the network, in contrast to large continuous streams of data being sent.

A packet-switched data network consists of switching nodes and high speed transmission links between these nodes. Data Terminal Equipment (DTE) is the standard term used for a communicating device that is the origin or destination of data flowing in the network. A DTE might be a host processor, a cluster controller, or a terminal. The DTE is connected to Data Circuit-Terminating Equipment (DCE), which connects the user's equipment to the PSDN. A DCE is usually provided by the network and is located on the same premises as the DTE.

Function of Packet Switching

Packet switching is the method of data transport used in these networks. Every user's data is segmented into packets that include data and a header. The header specifies control functions and an implied destination address.

Packets of data from many users may be dynamically routed, over shared network facilities, and sent to their destinations. When the data reaches its destination, the packets are ordered (placed in the proper sequence) and the data from the packets is combined into messages for the receiving end.

Circuit-Switched Compared to Packet-Switched Data Networks

Circuit-switched data networks provide a dedicated point-to point circuit between two devices that are connected to the network. In other words, the communicating devices have exclusive use of the dedicated physical circuit while they are connected to each other over the network. Other users are restricted from that circuit until the communicating devices are disconnected from each other. See Figure 1-1 on page 1-2.

In a packet-switched data network, no users have exclusive use of any physical circuit. Data is sent across the network in fixed length packets.

Note: A packet need not be filled to the maximum length.

Packets from various users are transmitted at the same time. If a particular circuit is too crowded or not working, then data is simply re-routed to a different circuit. Figure 1-2 on page 1-3 shows how physical circuits are shared by many DTEs in a packet-switched data network.

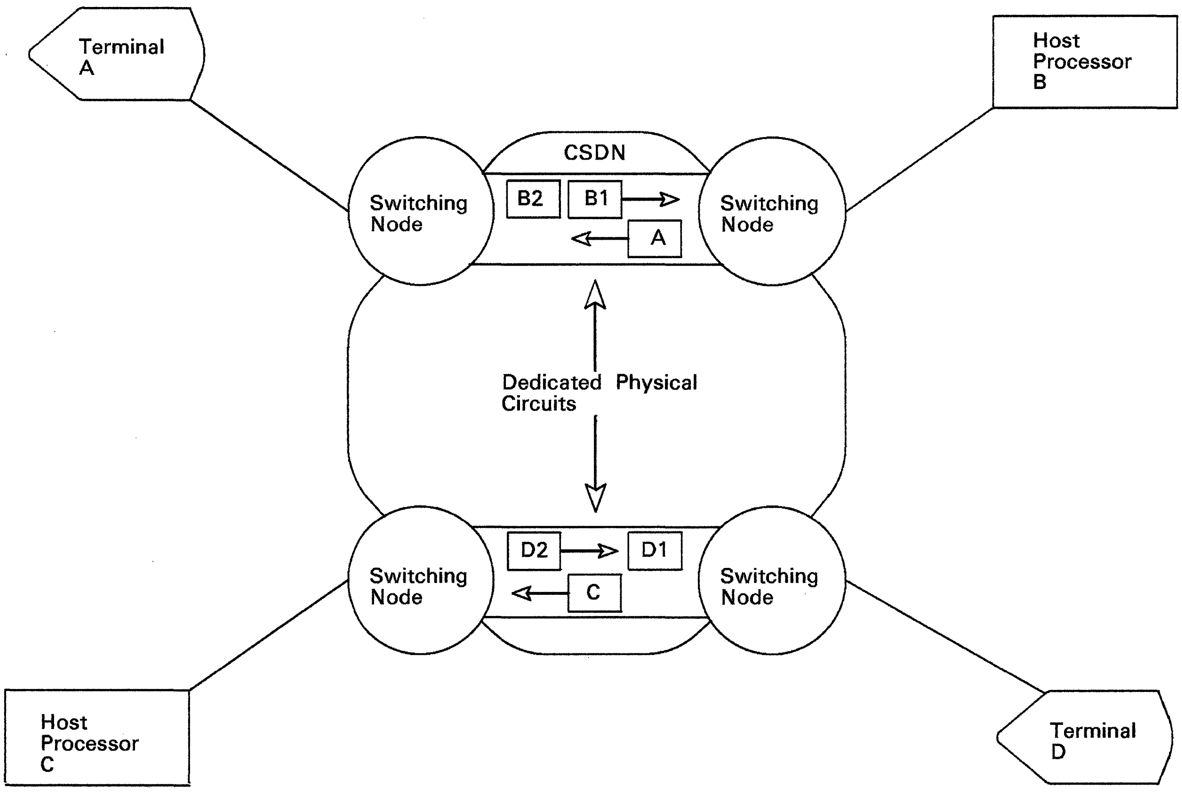

Figure 1-1. Circuit-Switched Data Network (CSDN)

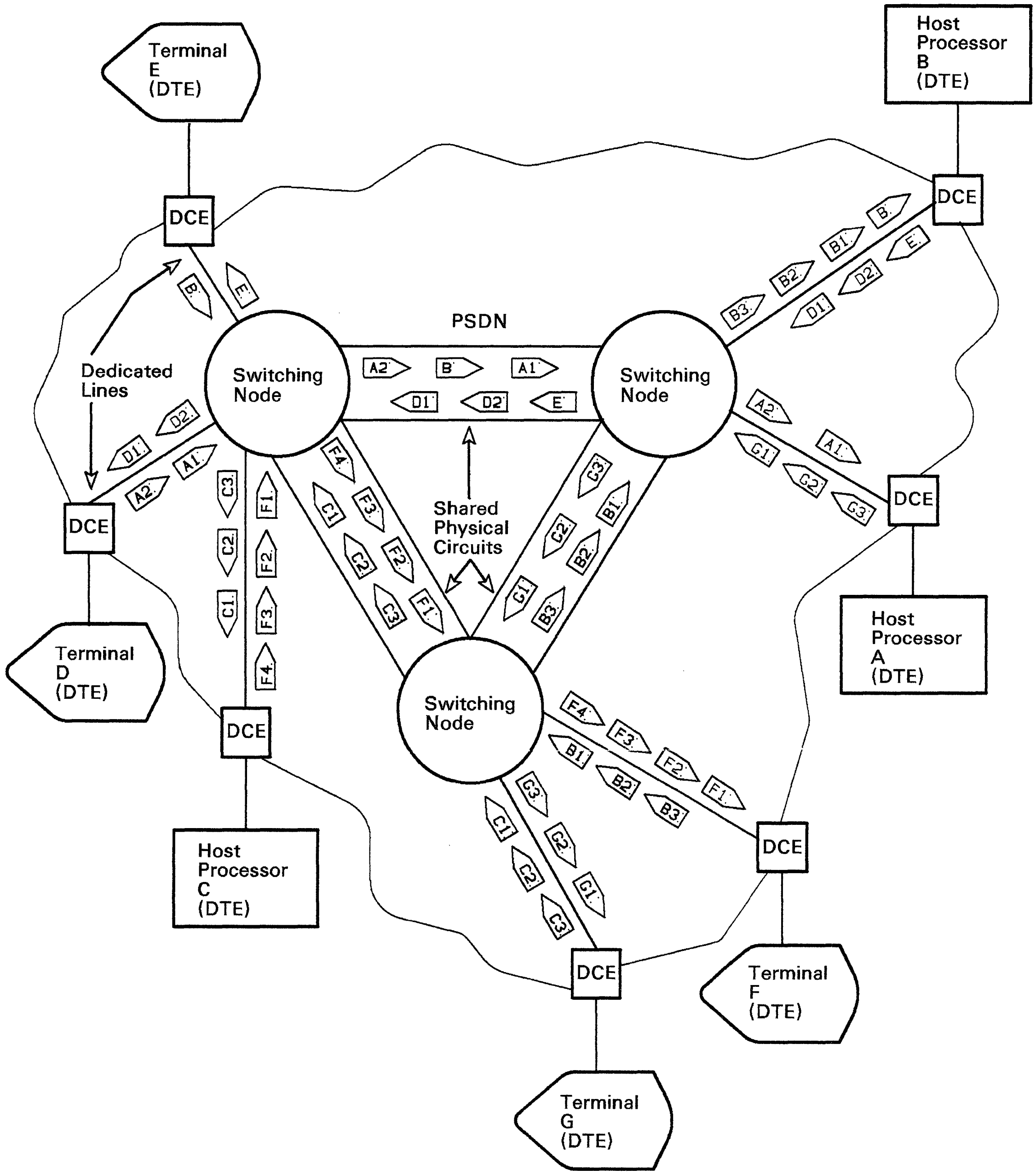

Figure 1-2. Transfer of Packets over a PSDN

The X.25 Interface to Packet-Switched Data Networks

Recommendation X.25

X.25 has been defined by the International Telegraph and Telephone Consultative Committee (CCITT) as the standard interface between customer-provided DTEs and the network DCE for packet-switched network services.

Recommendation X.25 is documented in the *CCITT Yellow Book Volume VIII-Fascicle VIII.2 Recommendations X.1-X.29.*

X.25 as a DTE/DCE Interface

Many organizations that offer telecommunications services to the general public have either implemented, or plan to implement, PSDNs with a DTE/DCE interface based on CCITT Recommendation X.25. Several private PSDNs have also adopted versions of the X.25 DTE/DCE interface.

Levels of X.25

The X.25 interface defines how a user's data enters and leaves the network. See Figure 1-3 on page 1-5. CCITT Recommendation X.25 defines three levels of the DTE/DCE interface that suppliers of PSDNs use as a design guide for X.25 functions.

1. Physical Level

   The physical level defines the control of the physical circuit between a user DTE and a network DCE. The control functions include activating, maintaining, and deactivating the physical circuit between the communicating device (DTE) and the network entry point (DCE).

2. Link Level

   The link level uses the link access procedure to ensure that data and control information are accurately exchanged over the physical circuit between the DTE and DCE. Its functions include data formatting and the first level of recovery procedures.

3. Packet Level

   The packet level protocol defines how user data and control information are structured into packets to be presented to the network. It also specifies the manner in which calls between DTEs are established, maintained, and cleared. The packet level protocol accommodates both permanent and switched virtual circuits, which are defined later in this chapter.

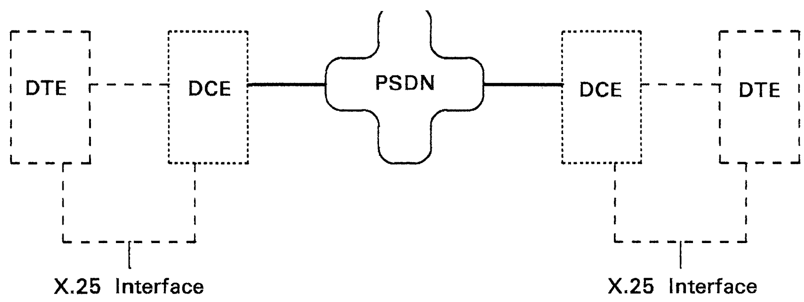

Figure 1-3. The X.25 DTE/DCE Interface

Concepts of X.25

The Frame

The **frame** is the link level vehicle for transmitting commands, responses, or packets over the physical circuit between a DTE and an adjacent DCE. The frame contains control information, user data, or both. It is delimited by flags at each end of the frame.

There are three types of frames. Two types, supervisory and unnumbered, carry only link-control information. The other type of frame, called information or I-frame, carries one packet of data or one packet of control information over a circuit between a DTE and DCE. Figure 1-4 shows a frame.

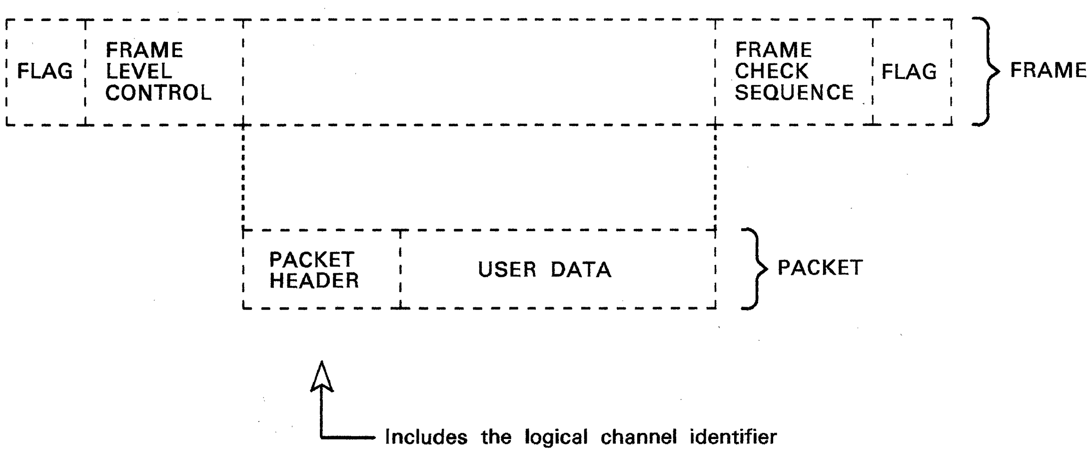

Figure 1-4. Frame and Packet

The Packet

A **packet** is the basic unit of information that is transmitted through the network. Each data packet contains a header and user data. The header includes a logical channel identifier, which is described later in this section.

In addition to data packets, various control packets can be sent (1) from a communicating device (DTE) to the adjacent network DCE or (2) from the DCE to a DTE. For example, when a DCE is ready to receive data from a DTE, the DCE may send a Receive Ready packet to the DTE, indicating that it is ready to receive data. Then the DTE may send a data packet to the DCE, which will send the packet through the network. If the DCE is not ready to receive data, it may send a Receive Not Ready packet to the DTE. These same types of packets can be sent from a network DCE on the other side of the network to its adjacent DTE, which will receive the data.

To speed up data transmission, a DTE does not need to wait for an acknowledgment response from the DCE for each packet it sends. (Nor does a DCE need to wait for acknowledgment from a DTE for each packet it sends.) Several packets can be sent before an acknowledgment response is sent. A *window* is used to allow a DTE to send a specified number of packets before it receives an acknowledgment response. The term *window size* is given to this specified number of packets. For example, if the window size is two, then a DTE can send a maximum of two packets before receiving an acknowledgment response.

Virtual Circuits

In a packet-switched network, no real end-to-end physical transmission channels are assigned to a DTE. However, a logical end-to-end transmission channel, called a *virtual circuit*, makes the network appear to provide a dedicated, point-to-point circuit between two communicating DTEs.

Virtual circuits are accessed by DTEs through the logical channel identifier specified in the packet headers. The virtual circuit is set up between two DTEs by the PSDN. Each DTE is given a logical channel identifier, which it uses to access that virtual circuit.

The logical channel identifier may be different at each DTE interface for the same logical connection.

The network and the DTE share the job of controlling the flow of data. This control restricts the sender from flooding either the network or the receiver with data it cannot handle.

A virtual circuit is set up by the network to maintain an association between a pair of source and destination addresses. According to the needs of the user, the virtual circuit can be set up to act like a switched circuit or a permanent circuit.

Switched Virtual Circuit

A switched virtual circuit is a temporary association between two DTEs. It is initiated by one DTE making a call request to the network.

Note: Outside IBM the term virtual call is used instead of switched virtual circuit.

Permanent Virtual Circuit

A permanent virtual circuit is similar to a point-to-point private line. It represents a permanent association between two DTEs and requires no call setup or call clearing by the DTE.

Logical Channels

A DTE is connected to a DCE by a physical circuit. With X.25, up to 4,095 logical channels may be assigned to this physical circuit. A *logical channel identifier* is used to identify the flow of data between the DTE and the PSDN. A packet interleaving technique, which involves assigning several logical channels to the same physical circuit, allows one DTE to communicate simultaneously with several other DTEs as shown in Figure 1-5.

A logical channel represents the path that data travels between its origin and the network or between the network and its destination.

When it sends a packet to the adjacent DCE, the DTE places a logical channel identifier in the header of the packet. The PSDN uses this logical channel identifier to route the packet, through the network, to its destination DTE. The logical channel identifier associates the packet with a switched virtual circuit or a permanent virtual circuit.

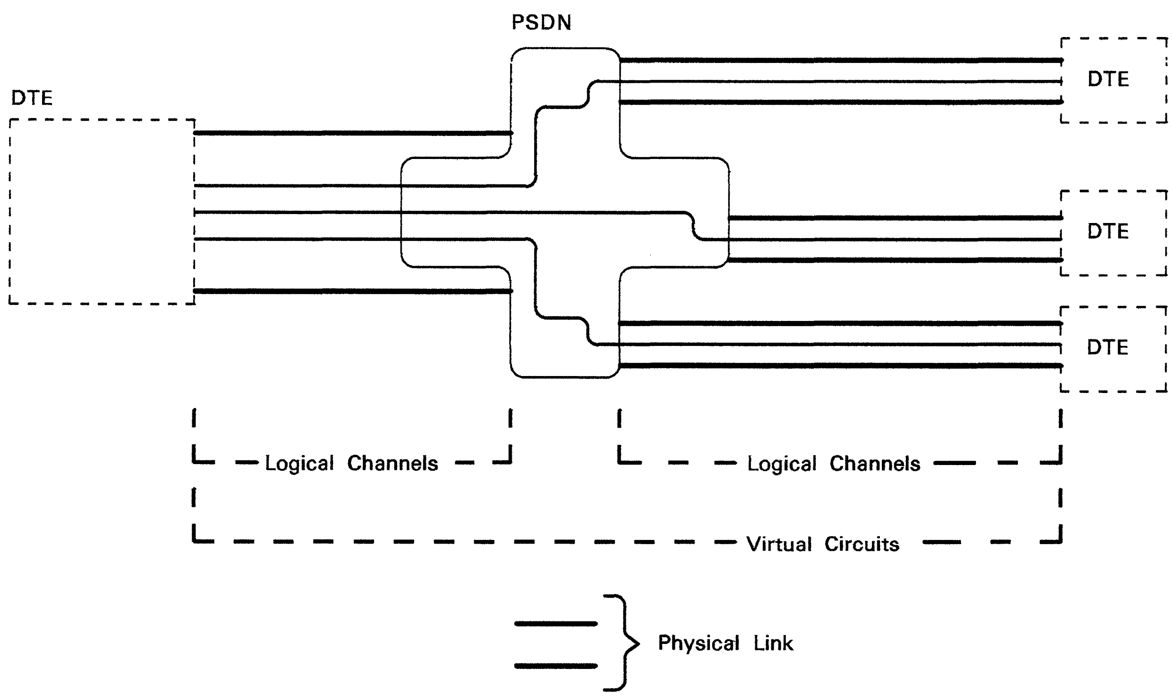

Figure 1-5. Logical Channels and Virtual Circuits through the PSDN

Optional User Facilities

CCITT Recommendation X.25 specifies several optional facilities that can be supplied to a user by the PSDN. The X.25 optional user facilities that are supported by the IBM X.25 NCP Packet Switching Interface are described in Chapter 2, "Functions of the X.25 NCP Packet Switching Interface."

The IBM X.25 NCP Packet Switching Interface

The X.25 NCP Packet Switching Interface offers SNA users the ability to use packet-switched data network services in conjunction with their SNA networks. It causes the PSDN to appear to the NCP and its associated host node as a series of one or more switched or non-switched SDLC links.

The program provides for (1) SNA-to-SNA communication and (2) SNA-to-non-SNA communication. It enables communication between the following types of DTEs:

- SNA Host Node-to-SNA Peripheral Node
- SNA Host Node-to-SNA Host Node[1]
- SNA Host Node-to-Non-SNA X.25 DTE
- SNA Host Node-to-X.28 Start-Stop DTE
- SNA Host Node-to-Other Non-SNA DTEs

These five types of communications are the major functions provided by the X.25 NCP Packet Switching Interface. Other functions include:

- X.25 Standard Services
- Support of Optional User Facilities
- Compatibility with other IBM Program Products

To better understand the functions of the X.25 NCP Packet Switching Interface it may be helpful to define the following terms. More detailed information for SNA terms can be found in the *SNA Concepts and Products* manual, GC30-3072.

A *host node* is a node in the network that contains a system services control point (SSCP); for example, a System/370 computer with OS/VS2 and ACF/VTAM.

A *peripheral node* is a node in the network that has less processing capability than a host node and uses logical addressing for routing. A peripheral node can be a cluster controller or a terminal.

An *X.28 start-stop DTE* refers to a start-stop device which conforms to CCITT Recommendation X.28. This recommendation and examples of X.28 start-stop DTEs are described under "SNA Host Node-to-X.28 Start-Stop DTE (Integrated PAD)" on page 2-9.

[1] This function is offered only for Releases 3 and 4 of the program product.

A *non-SNA X.25 DTE* is a non-SNA host, cluster controller, or terminal that can be attached to a PSDN, which can send and receive data using X.25 commands and procedures.

A *logical unit (LU)* is the SNA term for the *port* where users gain access to a network. In an SNA network, communication is accomplished through LU-to-LU sessions. This is the case for using either SDLC links or a PSDN. See Figure 1-6 on page 1-10.

A *physical unit* is the SNA component that manages and monitors the resources (such as attached links and adjacent link stations) of a node. Each node of an SNA network contains a physical unit.

A *path information unit (PIU)* is an SNA message unit.

Path control and *boundary function* are SNA mechanisms for routing data and for providing protocols support.

X.25 NCP Packet Switching Interface defines a *Logical Link Control (LLC),* which controls the end-to-end transmission of data over virtual circuits.

Recommendation X.25 defines *Link Access Procedure (LAP)* and *Link Access Procedure Balanced (LAPB)* as the procedures for link level data exchange between the DTE and DCE.

Many of these terms will become more clear as you read Chapter 2, "Functions of the X.25 NCP Packet Switching Interface." Figure 1-6 on page 1-10 shows a configuration of an SNA Host Processor communicating with an SNA cluster controller or terminal. This figure shows the LU-LU session between the host and the terminal, which takes place whether you are using an SDLC link or a PSDN.

Note: The Network Interface Adapter (NIA) is a stand-alone unit that allows you to attach a single SNA peripheral node to a packet-switched data network, using the X.25 interface. The NIA is described in more detail in Chapter 2, "Functions of the X.25 NCP Packet Switching Interface."

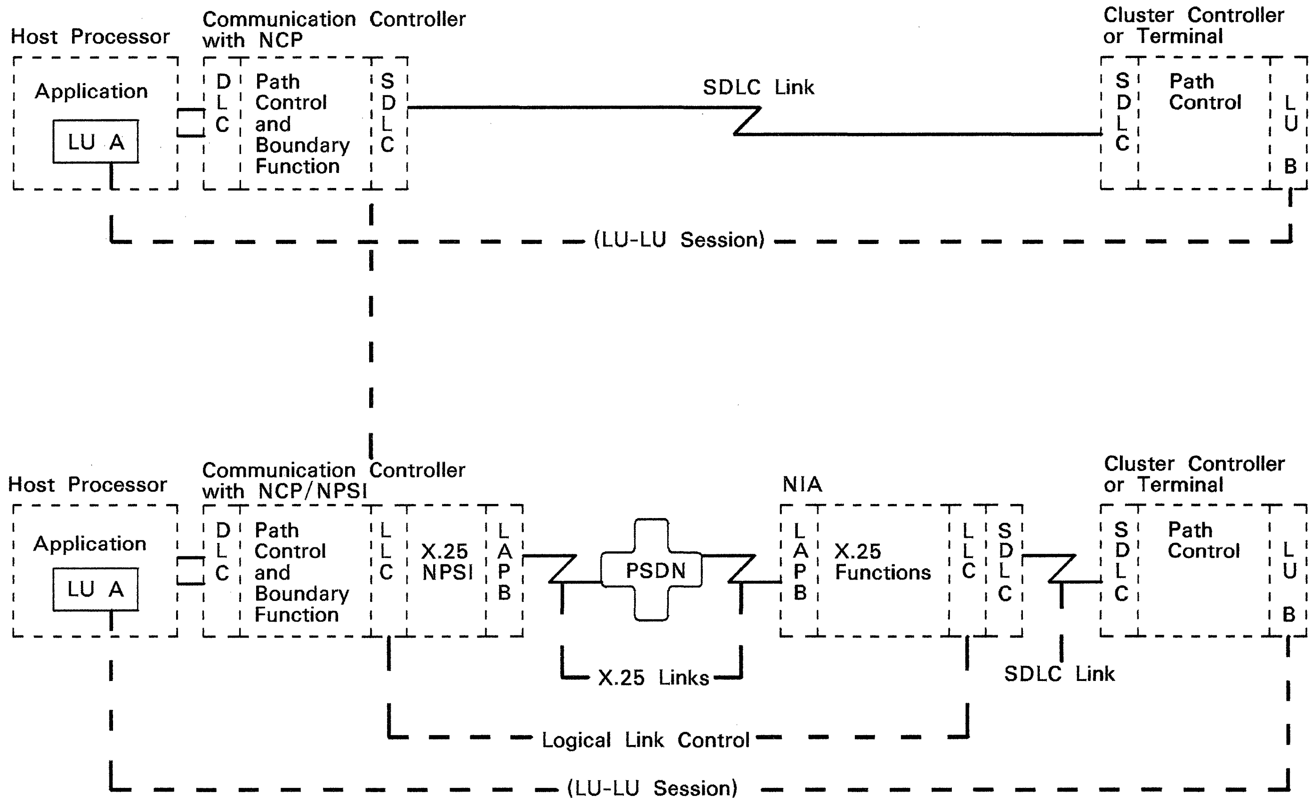

Figure 1-6. SNA-to-SNA Configuration Comparing SDLC Links to Packet Switching

In order to introduce you to the IBM X.25 NCP Packet Switching Interface, this chapter has provided an overview of (1) packet switching, (2) the X.25 interface to packet switching, and (3) IBM's support of this interface. Chapter 2, "Functions of the X.25 NCP Packet Switching Interface" describes the functions of the X.25 NCP Packet Switching Interface program product.

Chapter 2. Functions of the X.25 NCP Packet Switching Interface

This chapter describes the various functions performed by the program product. The functions are described according to the three levels of the DTE/DCE interface that were presented in "Levels of X.25" on page 1-4.

1. Physical Level
2. Link Level
3. Packet Level

Physical Level

The physical level of the X.25 interface defines the electrical and mechanical characteristics of the physical circuit between the DTE and the DCE. The physical level of the X.25 interface that is preferred by the CCITT is defined in Recommendation X.21, which was developed for public data networks. The CCITT has also approved use of Recommendation **X.21 bis** for an interim period. X.21 bis is a redefinition of several existing modem interfaces which are used with telephone networks (RS-232-C, CCITT V.24 or CCITT V.35). X.21 bis is supported for each release of the X.25 NCP Packet Switching Interface. Releases 3 and 4 also support the X.21 non-switched adapter. Detailed information and specifications can be found in the *CCITT Yellow Book Volume VIII-Fascicle VIII.2 Recommendations X.1—X.29.*

Link Level

Two link-level procedures are described in Recommendation X.25:

- Link Access Procedure (LAP)
- Link Access Procedure Balanced (LAPB)

Either of these procedures can be used to transfer frames containing control information or packets over the physical circuit between the DTE and the DCE. LAP procedures preserve the distinction between "primary" and "secondary" link stations. LAPB, on the other hand, combines the functions of primary and secondary link stations into a single link station at each end of the link.

LAP is supported for Release 2 of the X.25 NCP Packet Switching Interface only. LAPB is supported for each release of the program product.

Packet Level

The packet level defines the format and control procedures for the exchange of data between the DTE and the DCE. The following functions provided by the X.25 NCP Packet Switching Interface are performed at this level of the interface. They are presented for each release of the program product.

Basic Functions of X.25 NCP Packet Switching Interface

The X.25 NCP Packet Switching Interface provides standard X.25 services conforming to the CCITT recommendation. A key function in providing these services is the **Virtual Circuit Manager (VCM)**, which supervises all virtual circuits at the DTE/DCE interface. It establishes and terminates any connection with remote DTEs using switched virtual circuits. The Virtual Circuit Manager also handles error recovery procedures for virtual circuits. Virtual Circuit Manager functions are driven by commands received from the system services control point (SSCP) or by control packets received from the network. Using this function, the program product allows SNA host nodes to communicate with both:

- SNA peripheral nodes
- Non-SNA X.25 DTEs

Other functions include support of selected optional user facilities and coexistence of the X.25 NCP Packet Switching Interface with other IBM programing services and program products.

SNA Host Node-to-SNA Peripheral Node Communications

Communications between an SNA host node and an SNA peripheral node can be implemented by installing the program product in the NCP at the host site and by using the IBM 5973-LO2 Network Interface Adapter (RPQ Y96635) at the terminal or controller site.

The Network Interface Adapter (NIA) is a stand-alone unit that allows you to attach a single SNA peripheral node to a packet-switched data network, using the X.25 interface. The Network Interface Adapter converts Synchronous Data Link Control protocols to X.25 protocols (and vice-versa) in order to send and receive path information units (PIUs) to and from the PSDN.

Figure 2-1 on page 2-3 shows this configuration for using a packet-switched data network. The X.25 NCP Packet Switching Interface encloses PIUs sent from the host in X.25 packets and sends them over the PSDN using X.25 protocols. The Network Interface Adapter on the other side of the network, (1) receives the packets, (2) removes the PIUs from the X.25 packets, and (3) sends them over an SDLC link to the peripheral node.

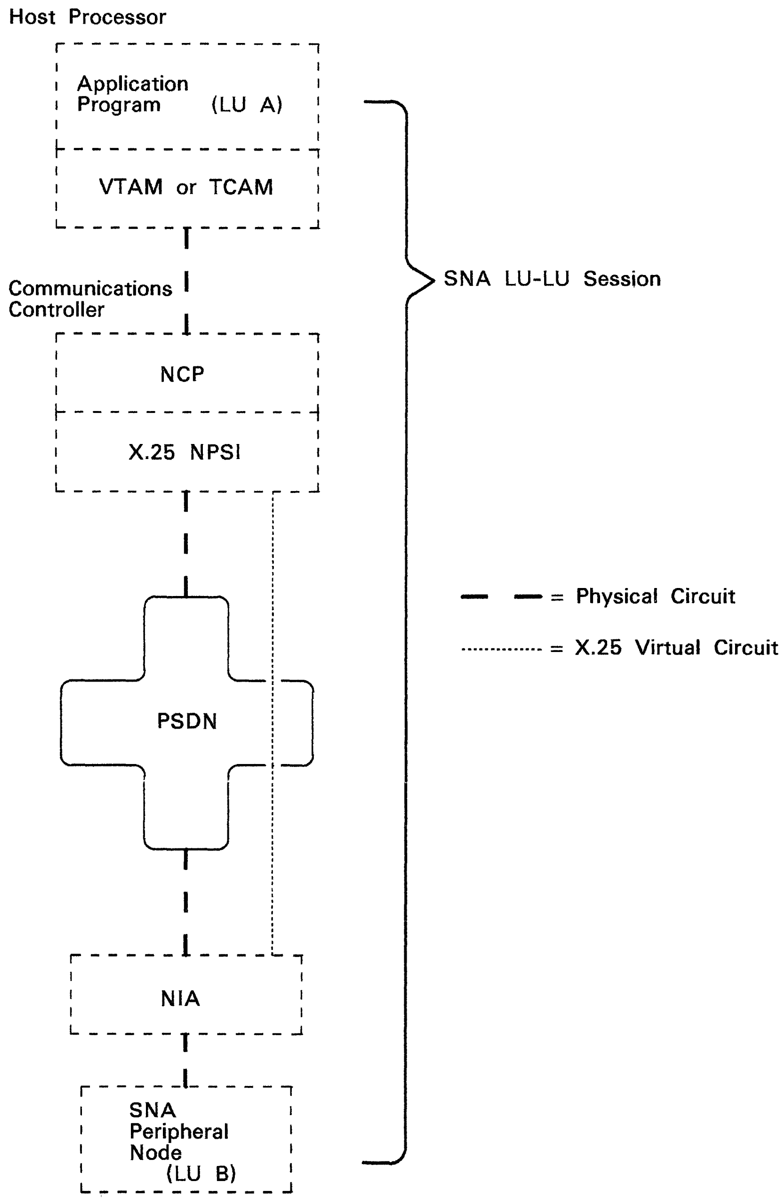

Figure 2-1. SNA Host Node Communicating with SNA Peripheral Node over a PSDN

SNA Host Node-to-Non-SNA DTE Communications

Communication between an SNA host node and a non-SNA X.25 DTE can be handled through a **Protocol Converter for Non-SNA Equipment** called the **PCNE**.

The PCNE is a function of the X.25 NCP Packet Switching Interface. It appears to be a logical unit (LU) to the host, so that the LU at the host believes that it is communicating with an LU type 1 (3767 terminal), rather than with a non-SNA X.25 DTE. Figure 2-2 on page 2-5 shows the LU-LU session between the host and the X.25 NCP Packet Switching Interface.

For data being sent from the host, the PCNE removes SNA headers, places the data into packets, and builds packet headers. The data is then sent over the network to the X.25 DTE, using X.25 protocols.

For data sent over the PSDN from the X.25 DTE, the PCNE removes the packet headers, takes the data out of packets, and builds SNA headers. The SNA data is then sent to the host.

Since SNA formats and protocols are not employed on an end-to-end basis, the user is responsible for ensuring that the necessary data stream compatibility and integrity mechanisms exist between (1) the application program in the SNA host and (2) the non-SNA X.25 DTE.

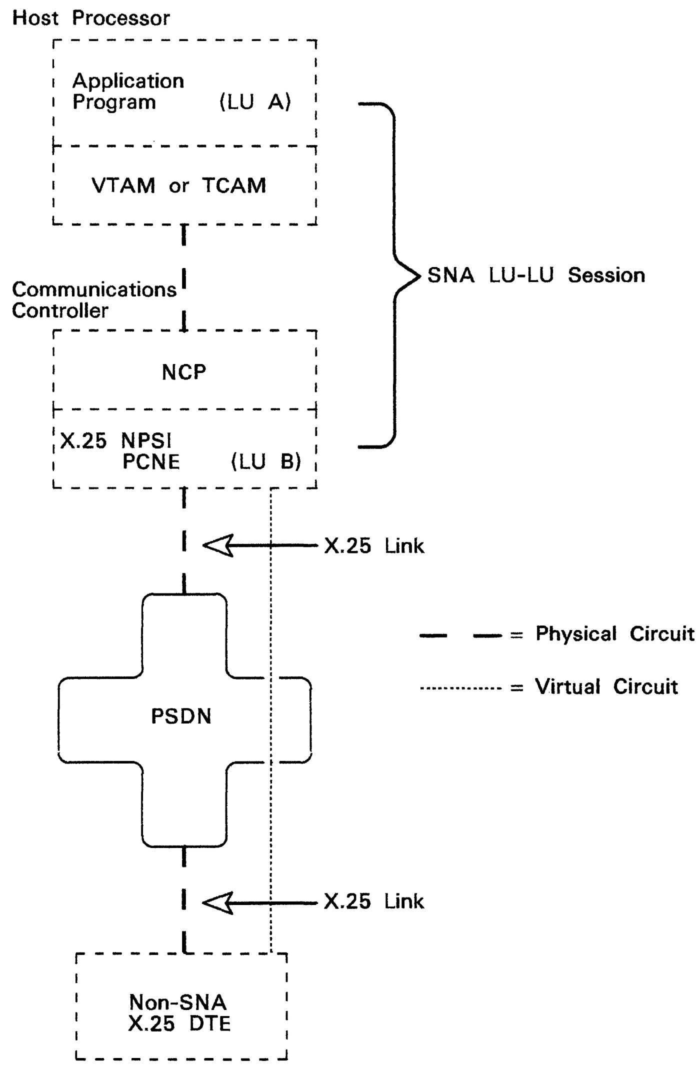

Figure 2-2. SNA Host Node Communicating with a Non-SNA X.25 DTE Using the PCNE

Other Basic Functions

Modulo 8 Packet Sequence Numbering

The CCITT Recommendation X.25 specifies Modulo 8 packet sequence numbering. Packets are sent in a sequence numbered 0 through 7. The window size can range from 1 to 7. In "The Packet" on page 1-6, window size is defined as the specifed number of packets that can be sent before receiving an acknowledgment.

Optional User Facilities

X.25 NCP Packet Switching Interface users can subscribe to the following optional user facilities that are provided by the network. Additional optional user facilities are supported for Release 2, which are described later in this chapter.

One-Way Logical Channel: This facility restricts the use of a range of logical channels to either incoming or outgoing calls only. One-way logical channels retain their duplex nature with respect to data transfer.

Closed User Group: The closed user group facility can be agreed upon for a certain period of time between the network supplier and a group of users. The users of the group can communicate with each other but not with users outside of the group. A DTE may belong to more than one closed user group.

Reverse Charging: Reverse charging is an optional facility which can be subscribed to by the user for a particular X.25 interface. The DTE that initiates the call is not charged by the network. The receiving DTE must agree to accept charges for all incoming calls that the network has allowed for reverse charging. The charges are established on a per call basis.

IBM Cryptographic Subsystem/Access Method Support

The following IBM cryptographic subsystem/access method products are compatible with the X.25 NCP Packet Switching Interface. These program products require OS/VS2 (MVS) Release 3.8 or OS/VS1 Release 7.

- Programmed Cryptographic Facility program product (5740-XY5)
- Cryptographic Unit Support program product (5740-XY6)
- ACF/VTAM Encrypt/Decrypt feature (6010, 5735-RC2)
- ACF/TCAM Version 2

Note: IBM line bracketing cryptographic products (3845 and 3846 data encryption devices) cannot be used.

Support of IBM Host-Resident Program Products

In addition to ACF/VTAM and ACF/TCAM, the following IBM program products can use the X.25 NCP Packet Switching Interface to communicate with remote SNA DTEs over a PSDN:

- Customer Information Control System/Virtual Storage (CICS/VS)
- Information Management System/Virtual Storage (IMS/VS)
- Time Sharing Option (TSO)
- Network Communications Control Facility (NCCF)
- Virtual Storage Personal Computing (VSPC)

These programs, used in conjunction with an SNA access method (ACF/TCAM or ACF/VTAM) and ACF/NCP can provide regular SNA support for specified controllers and devices using X.25 networks.

Note: An IBM 5932 LO2 Network Interface Adapter is required for communications with a peripheral node.

Coexistence with NTO Program Product (5735-XX7)

The IBM Network Terminal Option (NTO) program product, like the X.25 NCP Packet Switching Interface runs under ACF/NCP. It is designed so that a host processor can communicate with several start-stop DTEs (and a subset of BSC 3780 DTEs) that are attached directly to the communication controller. Network Terminal Option makes the supported DTEs appear like IBM 3767 terminals to the host processor.

Network Terminal Option converts the SNA headers from the host data to a non-SNA header that is processed by the NCP start-stop or Binary Synchronous Communication processor code for transmission to the DTE. Input from a DTE with the non-SNA header is sent to the Network Terminal Option program to be converted in an SNA header before it is sent to the host.

In contrast, the X.25 NCP Packet Switching Interface allows a host processor to communicate with remote start-stop DTEs over a PSDN. This is accomplished by using either (1) the integrated Packet Assembly/Disassembly (PAD) function (for terminals supported by a PAD conforming with CCITT Recommendations X.28 and X.29) or (2) the transparent PAD function (for terminals supported by a user-defined PAD). Both PAD functions are discussed under "Release 2 Functions" following in this chapter. A particular host processor, using ACF/NCP, can use both Network Terminal Option and X.25 NCP Packet Switching Interface program products for communication with start-stop DTEs. See Figure 2-3.

The X.25 NCP Packet Switching Interface can also coexist with any program product or user program that uses NCP user line control or the program resource interface.

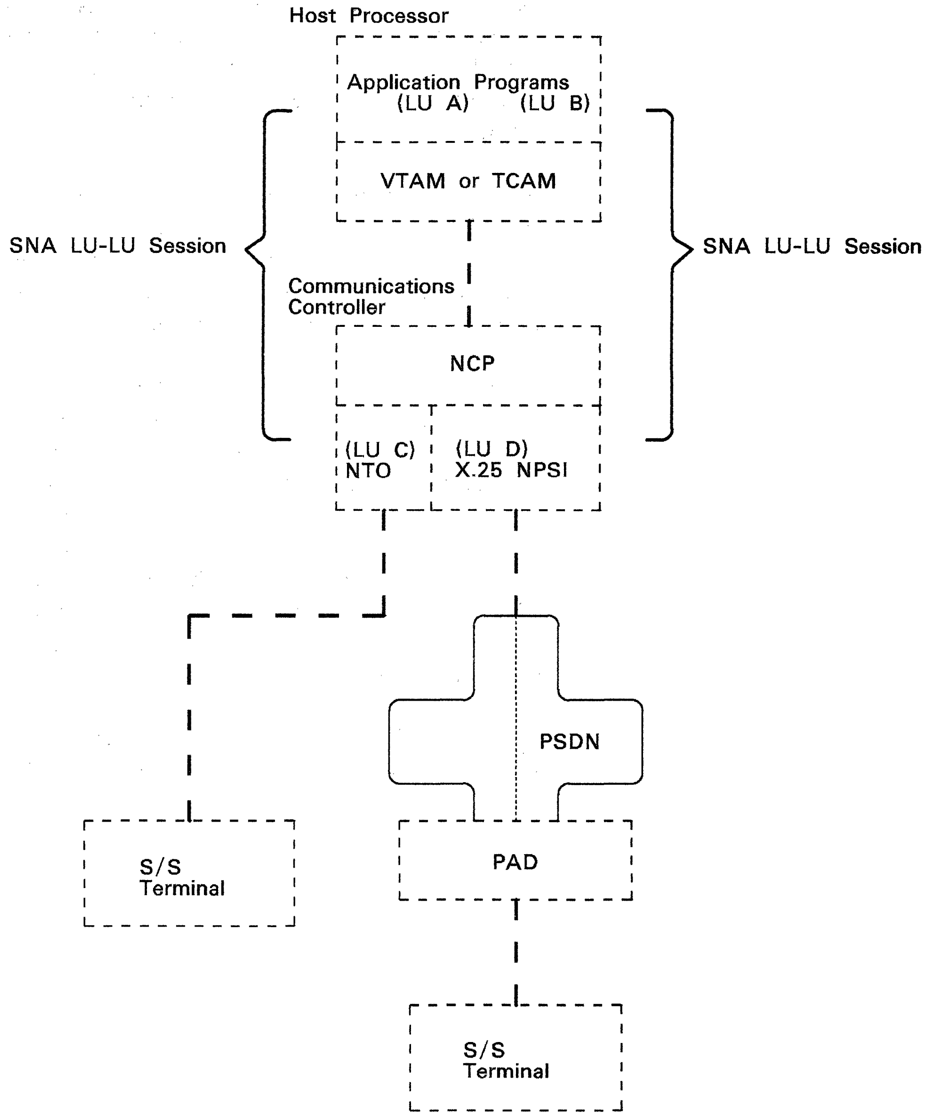

Figure 2-3. Configuration of NCP Containing Both the X.25 NCP Packet Switching Interface and NTO

Release 2 Functions

Release 2 of the X.25 NCP Packet Switching Interface includes all of the basic functions with the additional functions described in this section.

This release of the program product provides for communications between an SNA host node and the following:

- X.28 Start-Stop DTEs (using the integrated PAD function)
- Non-SNA DTEs (using the transparent PAD function)

Release 2 provides additional ways of communicating with SNA DTEs and Non-SNA X.25 DTEs. A user application in the host can control the communications between an SNA host node and the following:

- Non-SNA X.25 DTEs (using the General Access to X.25 Transport Extension function)
- Non-SNA X.25 DTEs and SNA Peripheral Nodes (using the Dedicated Access to X.25 Transport Extension function)

Other Release 2 functions include support of optional user facilities, delivery confirmation bit (D bit), and diagnostic processing support.

SNA Host Node-to-X.28 Start-Stop DTE (Integrated PAD)

Communication between an SNA host node and an X.28 start-stop DTE can be handled using the integrated **packet assembly/disassembly (PAD)** support. The PAD is a device provided by the network to allow start-stop DTEs to communicate over a PSDN.

The X.25 NCP Packet Switching Interface conforms to a subset of CCITT Recommendation X.29 for communications with TTY 33/35 and other start-stop DTEs that conform to Recommendation X.28. X.29 PAD support allows an SNA host node to communicate with start-stop DTEs connected to an X.25 PSDN through a network PAD.

X.28 defines terminal signaling; that is, (1) the commands typed at the start-stop DTE that are understood by the PAD, and (2) the service signals that are returned by the PAD to the start-stop DTE.

X.29 defines control procedures between an X.25 DTE and the network PAD. Within the network, the PAD operates in a manner similar to an X.25 DTE, performing packet assembly/disassembly at the packet level on behalf of the start-stop DTE.

Another CCITT Recommendation, X.3, defines the operation of the PAD itself.

Figure 2-4 on page 2-10 shows where these recommendations fit into a configuration.

This integrated PAD support is provided as an extension of the PCNE. There is also transparent PAD support which is discussed later in this chapter.

The PAD disassembles packets, which have been sent over the network, into characters for the start-stop DTE. It also assembles characters, which are sent from the start-stop DTE, into packets to be sent over the PSDN. The PAD provides appropriate line control for the physical circuit that attaches the start-stop DTE to the PSDN. Figure 2-4 on page 2-10 shows how a host processor can communicate with a start-stop DTE using the X.29 PAD support extension of the PCNE function for the network PAD.

Since SNA formats and protocols are not employed on an end-to-end basis, the user is responsible for ensuring that the necessary data stream compatibility and integrity mechanisms exist between (1) the application program in the SNA host and (2) the non-SNA DTE.

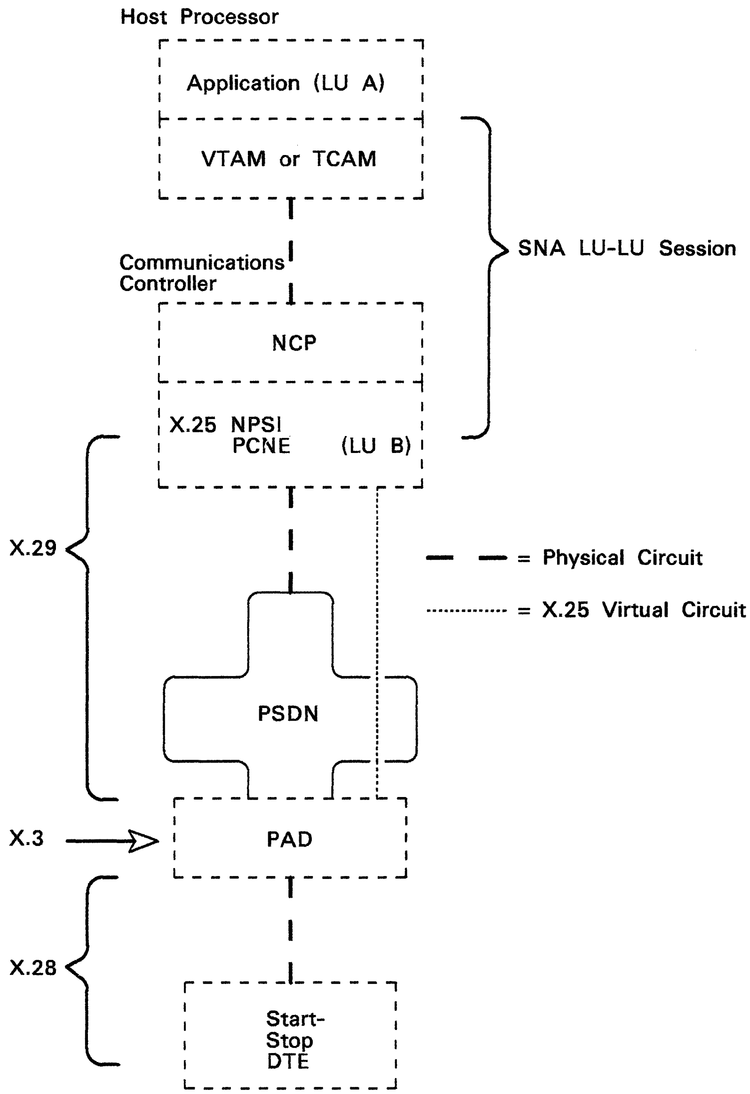

Figure 2-4. Host Processor Communicating with an X.28 Start-Stop DTE Using the Integrated PAD Function

SNA Host Node-to-Non-SNA DTEs (Transparent PAD)

Transparent PAD allows a user application program in the host to control a remote PAD that is associated with a non-SNA DTE. This support is provided for the use of PAD facilities that do not conform to CCITT Recommendations X.3, X.28, and X.29 (for example binary synchronous or BSC terminals). The user application communicates with the PAD by sending it qualified data packets over the PSDN.

A **qualified data packet** has a qualified bit in the header (called the Q bit) turned on. The qualified bit indicates that this data packet does not contain user data. It contains a command or information for some non-SNA control mechanism at the other end of the virtual circuit; in this case, the network PAD.

The user application also causes the X.25 NCP Packet Switching Interface to send interrupt packets over a virtual circut. An **interrupt packet** is used to transmit priority information "out of order" across the virtual circuit.

With transparent PAD, the contents of the following types of packets are sent from or routed to the application program by the X.25 NCP Packet Switching Interface:

- Data packets
- Qualified data packets
- Interrupt packets
- Reset packets

Commands and information for PAD control are contained in qualified data packets.

The transparent PAD support is an extension of the PCNE function. The PCNE presents the LU to the host, as it does with integrated PAD. However, with transparent PAD the PCNE also identifies which type of packet is being sent to or received from the host.

As described earlier, the PCNE receives SNA messages from the host, removes the SNA headers, places the data into packets, and builds a packet header. The PCNE also reads the first byte of the RU (of the SNA message), which identifies the type of packet (for example, qualified or interrupt) and places the proper indication in the packet header.

With transparent PAD, the user application in the host uses the first byte of the RU to specify to the PCNE the type of packet being sent.

When packets are sent to the PCNE from the network PAD, the PCNE removes the data from the packets and builds SNA headers. It places the packet type indication (specified in the packet header) into the first byte of the RU and then sends the SNA message to the host.

Figure 2-5 illustrates the transparent PAD support.

Since SNA formats and protocols are not employed on an end-to-end basis, the user is responsible for ensuring that the necessary data stream compatibility and integrity mechanisms exist between (1) the application program in the SNA host and (2) the non-SNA DTE.

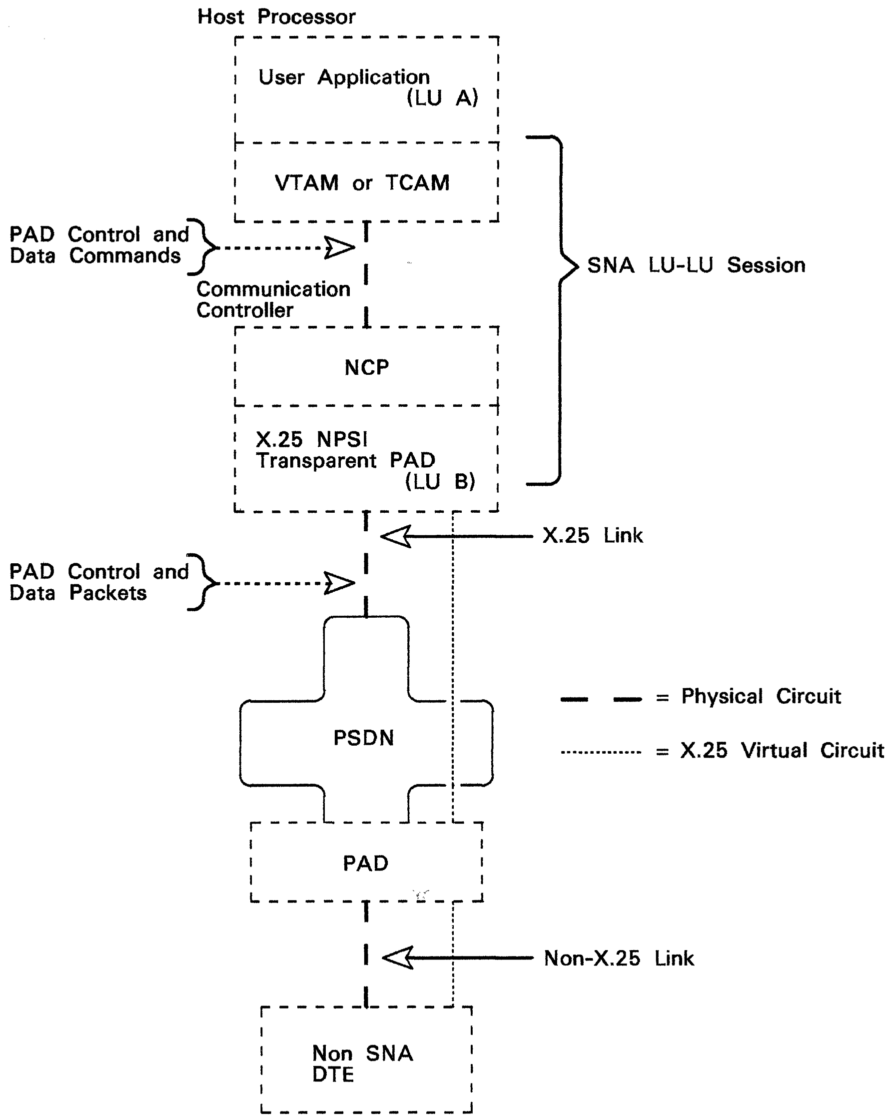

Figure 2-5. Host Processor Communicating with a Non-SNA DTE Using the Transparent PAD function.

SNA Host Node-to-Non-SNA X.25 DTE (GATE)

Release 2 of the program product provides **General Access to X.25 Transport Extension** (or GATE), which is a mechanism for a user application program in the host to assume the complete task of monitoring virtual circuits. The user application allows a user to define non-SNA protocols and line scheduling to communicate with non-SNA X.25 DTEs. The user application program in the host is called the **Communication and Transmission Control Program (CTCP).**

With GATE, the CTCP signals the X.25 NCP Packet Switching Interface to send certain types of control packets that activate and deactivate virtual circuits. Examples of such packets are "call setup" and "call clearing" packets. The CTCP signals the X.25 NCP Packet Switching Interface by sending it commands over an SNA session. When such control packets are received from the network, their contents are passed by the X.25 NCP Packet Switching Interface to the CTCP.

For virtual circuits associated with the GATE function, the CTCP causes the following types of packets to be sent, and it receives the contents of:

- Data packets
- Qualified data packets
- Interrupt packets
- Call setup and clearing packets
- Reset packets

Note that all data, including user data, is sent and received through the CTCP (see Figure 2-6).

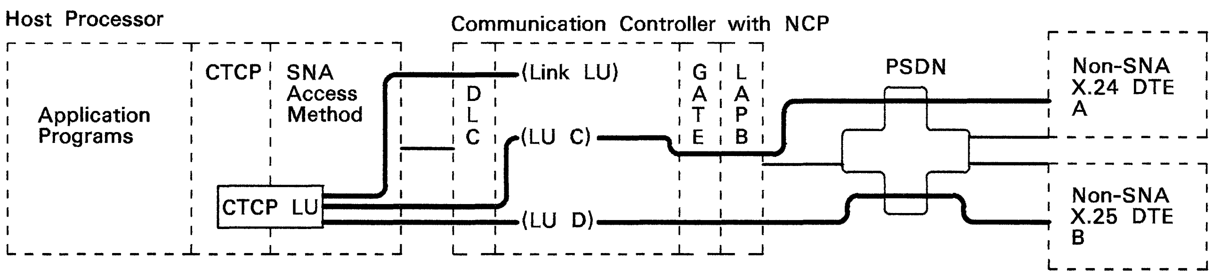

Figure 2-6. Communication Using the GATE Function

SNA Host Node-to-SNA Peripheral Node or to Non-SNA X.25 DTE (DATE)

Another mechanism provided by Release 2 for user application support is **Dedicated Access to X.25 Transport Extension** (or DATE). Like GATE, a user application program in the host is called the Communication and Transmission Control Program (CTCP).

The DATE mechanism allows the CTCP to assume control management of virtual circuits connected to SNA peripheral nodes and non-SNA X.25 DTEs.

With DATE, the CTCP causes the following types of packets to be sent and it receives the contents of:

- Qualified data packets
- Interrupt packets
- Call setup and clearing packets
- Reset packets

Here, the user application program sends and receives *user data* directly through its SNA LU in the host. (See Figure 2-7.)

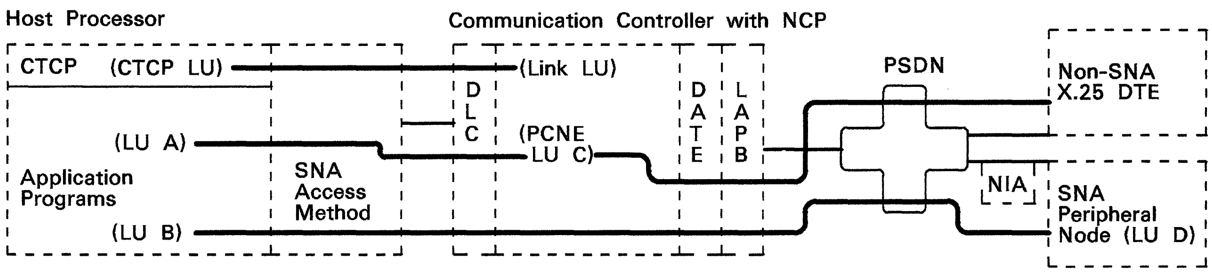

Figure 2-7. Communication Using the DATE Function

The following table shows the compatibility of GATE, DATE, integrated PAD, and transparent PAD, on the same multichannel link.

	GATE	DATE	INTEGRATED PAD	TRANSPARENT PAD	PCNE
GATE	/	NO	YES	YES	YES
DATE	NO	/	NO	YES	YES
INTEGRATED PAD	YES	NO	/	NO	YES
TRANSPARENT PAD	YES	YES	NO	/	YES
PCNE	YES	YES	YES	YES	/

Other Functions for Release 2

Optional User Facilities

Release 2 users can subscribe to the following optional user facilities, in addition to those described under "Other Basic Functions" earlier in this chapter.

Modulo 128 Packet Sequence Numbering: This function allows a DTE to send more than seven packets before receiving an acknowledgment. With modulo 128, packets are sent in a sequence numbered 0 through 127. The maximum window size in this case is 127, though some PSDNs may impose a lower limit.

Non-Standard Default Packet Size: This is a function that lets you select non-standard default packet sizes. Packet size refers to the amount of user data in the packet. The default packet size is 128 bytes. This facility lets you select default packet sizes from a list of packet sizes offered by the network.

Negotiated Packet Size and Window Size at Call Time: This optional user facility allows you to specify packet sizes and window sizes for each call. The calling DTE may separately request (in the Call Request packet) packet sizes and window sizes for each direction of data transmission. If a packet size or window size is not specified in the Call Request packet, then the DCE will assume that the default size was requested. The default packet size is 128 bytes of user data. The default window size is 2.

Note: Both DTEs must agree on packet size and window size. X.25 NCP Packet Switching Interface will not accept different packet or window sizes for different directions.

Delivery Confirmation Support

For SNA-to-Non-SNA X.25 communications, a user can implement and use a mechanism that confirms the delivery of a packet to a remote DTE. A bit in the packet header of a data packet can be set to 1 to request confirmation that the packet has been received at its destination. This bit is called the delivery confirmation bit (D bit). If the delivery confirmation bit is off (set to 0), then the acknowledgment for the packet that has been sent comes from the adjacent DCE (not the destination DTE).

For SNA-to-SNA communications, an end-to-end mechanism for delivery confirmation is provided by SNA.

Specific Encoding of Diagnostic and Cause Fields in Clear and Reset Packets

A function is provided so that you may specify specific diagnostics in Clear and Reset packets. This function is only available with use of the GATE or DATE function.

Support of X.25 Diagnostic Packets

A *diagnostic packet* is a packet that contains only diagnostic information. This packet can only be sent from the DCE to the DTE to describe an error at the local DTE/DCE interface without interrupting any flow on any virtual circuit.

Release 3 Functions

Release 3 of the X.25 NCP Packet Switching Interface includes all of Release 2 functions with the following additional functions.

SNA Host-to-Host Connection through X.25 Networks

Release 3 introduces a function that allows two communication controllers containing ACF/NCP to communicate with each other through an X.25 network. As a result, the host nodes associated with the controllers can participate in a multiple domain network, using the PSDN as a link between the SNA subarea nodes associated with the controllers. A **multiple domain network** is an SNA network having more than one system services control point (SSCP). For more information on multiple domain networks, see the *SNA Concepts and Products* manual, GC30-3072.

An SNA host-to-host connection can exist on one virtual circuit associated with a particular physical circuit. At the same time, other virtual circuits associated with the same physical circuit can handle communications with other types of remote DTEs. Only permanent virtual circuits may be used to link 3705 Communications Controllers.

Note: A remote communication controller cannot be loaded over an X.25 network.

Figure 2-8 illustrates the host-to-host connection using the X.25 NCP Packet Switching Interface.

Support of X.21 Non-Switched Adapter

The X.25 NCP Packet Switching Interface allows you to communicate on an X.25 network, using the X.21 non-switched adapter.

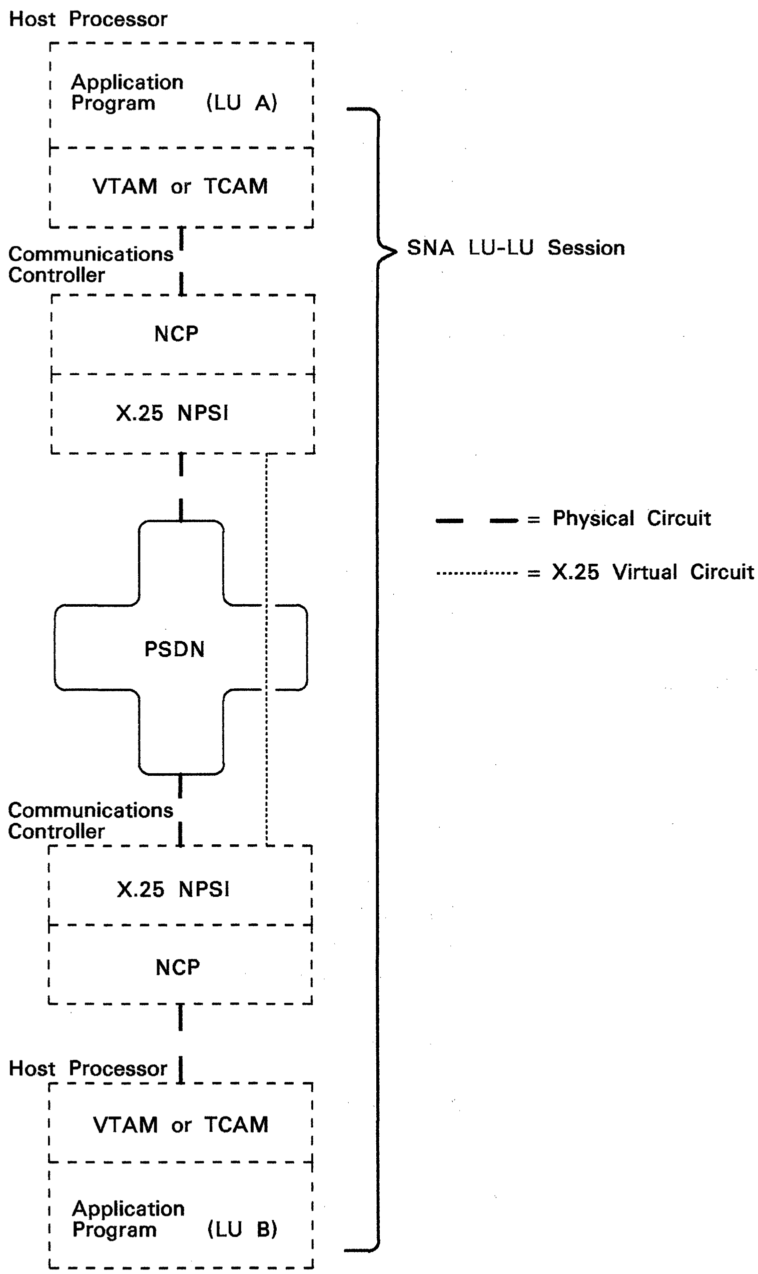

Figure 2-8. Host-to-Host Connection Using the X.25 NCP Packet Switching Interface

Release 3.1 Functions

Release 3.1 of the X.25 NCP packet Switching Interface includes all of the Release 3 functions with the following additions:

SNA Host Node-to-SNA Peripheral Node Communication

This function is described under "Other Basic Functions" on page 2-5, but Release 3.1 uses a different protocol from the earlier releases for SNA host node-to-SNA peripheral node communication. The Release 3.1 protocol is Qualified Logical Link Control (QLLC). SDLC commands, in both directions, are transmitted in qualified packets. Data is transmitted in packets, without modification.

This function allows the attachment of a SNA host node to:

- SNA periperal nodes attached to the network with a High-level Data Link Control-PAD provided by the PSDN
- SNA peripheral nodes that have implemented the QLLC protocol.

Release 3.2 Functions

Release 3.2 provides all of the functions of Release 3.1 to the IBM 3705 Communications Controller and ACF/NCP Version 3 for the 3705.

Release 4 Functions

Release 4 provides all of the functions of Release 3.1 to support the IBM 3725 Communication Controller and ACF/NCP Version 2. Refer to the following manuals for more information:

- *ACF/NCP Version 2 for the IBM 3725 General Information*, GC30-3071
- *Introduction to the 3725 Communication Controller*, GA33-0010.

Note: LAP is not supported for Release 4. This release uses LAPB only.

Release 4 also provides alert notification and problem determination by NCCF/NPDA, using the CNM RU's RECFMS '00' alert and RECFMS '03' traffic counters.

Note: The Network Problem Determination Application (NPDA) is a prerequisite for using Release 4 of X.25 NCP Packet Switching Interface.

Release 4.1 Functions

Release 4.1 provides all the functions of Release 4 to support the IBM 3725 Communications Controller and ACF/NCP Version 3 for the 3725.

Chapter 3. Planning for the X.25 NCP Packet Switching Interface

Before you install the X.25 NCP Packet Switching Interface, you need to know the hardware, software, and storage requirements for the program product. This chapter presents these requirements, as well as performance, migration considerations, and the other publications in the program product library.

Hardware Supported

Communication Controllers

Releases 2, 3, 3.1, and 3.2 of the X.25 NCP Packet Switching Interface can run on either the IBM 3705-II or the IBM 3705-80 Communications Controller. Releases 4 and 4.1 of the X.25 NCP Packet Switching Interface run on the 3725 Communication Controller.

To attach to an X.25 network using a 3705, you must have a duplex synchronous adapter (non-switched line) and at least one CS2 or CS3 communication scanner with the appropriate FDX line set (CS1 is not supported). CS3 communication scanner is required for speeds between 20.4 K bits and 56 K bits. V24 or RS-232-C (X.21 bis) or V35 adapters are supported for each release of the X.25 NCP Packet Switching Interface. Releases 2 and 3 also support the X.21 non-switched adapter.

Refer to the *Program Summary*, GC30-9544 for specifications of communication scanner types and line sets.

If you use a 3725; you must have a full duplex connection to one of the following:

- line interface coupler type 1 (V24 or RS-232-C (X.21 bis))
- line interface coupler type 2 (leased interface only)
- line interface coupler type 3 (V35)
- line interface coupler type 4A (X.21 leased only)
- line interface coupler type 4B (X.21 leased only).

Refer to the *Introduction to the IBM 3725 Communication Controller*, GA33-0010 for specifications of communication scanner types and line sets.

Data Terminal Equipment (DTE)

The program product supports both SNA and non-SNA DTEs that are connected to X.25 networks as follows:

- SNA host nodes connected to X.25 networks through a communication controller.

- SNA peripheral nodes connected to X.25 networks through the IBM 5973-L02 Network Interface Adapter (NIA) RPQ Y96635, specify code 7043 (remote).

- Non-SNA X.25 DTEs connected directly through the X.25 network.

- X.28 Start-Stop DTEs connected to X.25 networks through a PAD.

Release 2 of the program product introduces the transparent PAD that allows communications with other types of equipment (non-X.28 start-stop and BSC DTEs). These functions are described in Chapter 2 under *SNA Host Node-to-Non-SNA DTEs (Transparent PAD).*

Software Supported

Operating Systems

The X.25 NCP Packet Switching Interface is installed on ACF/NCP and, therefore, works with the same operating systems. Your operating system may be one of the following:

- VSE
- OS/VS1
- OS/VS2 (MVS)
- MVS SE

Network Control Program

The X.25 NCP Packet Switching Interface can be installed on the following releases of ACF/NCP.

- ACF/NCP Version 1, Release 2.1
- ACF/NCP Version 1, Release 3
- ACF/NCP Version 2 for the 3705
- ACF/NCP Version 2 for the 3725
- ACF/NCP Version 3 for the 3705
- ACF/NCP Version 3 for the 3725

System Support Programs

The program product is built on ACF/NCP and operates with the following access methods:

- ACF/VTAM Version 1 Releases 2 and 3
- ACF/VTAM Version 2 Releases 1 and 2
- ACF/TCAM Version 2 Releases 2 and 3

The following tables show which programs are current for each release of the program product. See Figure 3-1 on page 3-3 for X.25 NCP Packet Switching Interface releases that support the 3705. See Figure 3-2 on page 3-3 for releases that support the 3725.

X.25 NCP Packet Switching Interface Program Product	Release 2	Release 3	Release 3.1	Release 3.2
ACF/VTAM Version 1 Release 2	yes	no	no	no
ACF/VTAM Version 1 Release 3	yes	yes	yes	yes
ACF/VTAM Version 2 Release 1	yes	yes	yes	yes
ACF/VTAM Version 2 Release 2	yes	yes	yes	yes
ACF/TCAM Version 2 Release 2 [1]	yes	no	no	no
ACF/TCAM Version 2 Release 3 [1]	yes	yes	yes	yes
ACF/TCAM Version 2 Release 4 [1]	yes	yes	yes	yes
ACF/NCP Version 1 Release 2.1	yes	no	no	no
ACF/NCP Version 1 Release 3	no	yes	no	no
ACF/NCP Version 2 for the 3705	no	no	yes	no
ACF/NCP Version 2 for the 3725	no	no	no	no
ACF/NCP Version 3 for the 3705	no	no	no	yes
ACF/NCP Version 3 for the 3725	no	no	no	no

Figure 3-1. X.25 NCP Packet Switching Interface Releases Supporting the 3705

X.25 NCP Packet Switching Interface Program Product	Release 4	Release 4.1
ACF/VTAM Version 1 Release 3	yes	yes
ACF/VTAM Version 2 Release 1	yes	yes
ACF/VTAM Version 2 Release 2	yes	yes
ACF/TCAM Version 2 Release 4 [1]	yes	yes
ACF/NCP Version 2 for the 3705	no	no
ACF/NCP Version 2 for the 3725	yes	no
ACF/NCP Version 3 for the 3705	no	no
ACF/NCP Version 3 for the 3725	no	yes

Figure 3-2. X.25 NCP Packet Switching Interface Releases Supporting the 3725

[1] OS/VS operating system only

Application Program Products

The following IBM program products (which support SNA/SDLC communication) can, without modifications, use the X.25 NCP Packet Switching Interface:

- Customer Information Control System/Virtual Storage (CICS/VS)
- Information Management System/Virtual Storage (IMS/VS)
- Time Sharing Option (TSO)
- Network Communications Control Facility (NCCF)
- Virtual Storage Personal Computing (VSPC)

These programs, used in conjunction with the IBM 5973-LO2 Network Interface Adapter (RPQ Y96635), can provide regular SNA support for specified cluster controllers and terminals using X.25 networks.

The X.25 NCP Packet Switching Interface can also coexist on the communication controller with the IBM Network Terminal Option program product (5735-XX7).

Cryptographic Products Supported

The following IBM cryptographic products are compatible with the X.25 NCP Packet Switching Interface for OS/VS2 (MVS) Release 3.8 and OS/VS1 Release 7.

- Programmed Cryptographic Facility program product (5740-XY5)

- Cryptographic Unit Support (5740-XY6)

- ACF/VTAM Encrypt/Decrypt feature (6010, 5735-RC2)

- ACF/TCAM Version 2 for OS/VS2 (MVS) Release 3.8 and OS/VS1 Release 7

Note: The IBM line bracketing cryptographic products (3845 and 3846 data encryption devices) *are not supported* .

User Requirements for Installing the X.25 NCP Packet Switching Interface

You must code a set of X.25 macro instructions to define the X.25 NCP Packet Switching Interface module for your particular network configuration. You must determine which type of X.25 PSDN you are communicating with and define the communicating devices and their links. Instructions for coding these macros can be found in the *X.25 NCP Packet Switching Interface Installation and Operation* manual.

Networks Supported

The X.25 NCP Packet Switching Interface supports networks that conform to CCITT Recommendation X.25 (Geneva 1980). The program product makes a distinction between two categories or types of networks that support this recommendation: *Network Type 1* and *Network Type 2*. Your IBM representative or your network supplier can help you determine which type of network you will be using. The network type (1 or 2) must be specified when you generate the load module for your program.

There are several differences between Type 1 and Type 2 networks, but the only differences discussed here are those that affect the internal processing of the X.25 NCP Packet Switching Interface. These differences between a Type 1 and a Type 2 network apply to the cause and diagnostic bytes as described for the following types of packets:

1. Clear Request and Clear Indication packets

   For Network Type 1, a diagnostic byte is provided in these types of packets. The diagnostic byte contains information that can be propagated from DTE to DTE.

   For Network Type 2, these packets are only 4 bytes long and no diagnostic byte is provided or accepted. Therefore, no end-to-end diagnostic information is propagated between DTEs.

2. Reset Request packet

   For Network Type 1, the diagnostic byte in this type of packet can contain information that is forwarded by the network to the receiving DTE.

   For Network Type 2, there is no end-to-end diagnostic information forwarded by the network for this type of packet. The diagnostic byte in a Reset Request packet must equal X'00' to be accepted by a Type 2 network.

3. Reset Indication packet

   The meaning of the cause byte in this type of packet differs between Type 1 and Type 2 networks.

   For Network Type 1, a cause byte equal to X'09' specifies that the *remote DTE is operational.* A cause byte equal to X'0F' specifies that the *network is operational.*

   For Network Type 2, a single cause byte equal to X'00' specifies that both the *remote DTE and the network is operational.*

Note: One other distinction between the two types of networks is an optional user facility that is only supported for Type 2 networks. This facility is called *High Priority Class of Traffic*, which is a non-X.25 facility offered only by Type 2 networks. For Releases 2, 3, and 4, the X.25 NCP Packet Switching Interface recognizes that this facility corresponds with a Type 2 network.

Functions Not Supported by the X.25 NCP Packet Switching Interface

The following points should be considered before you install the X.25 NCP Packet Switching Interface.

- The ACF/NCP dynamic reconfiguration capability is not supported for the X.25 access links or for virtual circuits controlled by the X.25 NCP Packet Switching Interface.

- The X.25 access to fast select and datagram services is not supported.

- X.25 LAP link access procedure is not supported for Releases 4 and 4.1 (only LAPB is supported).

- Only the X.21 bis physical interface is supported for Release 2. X.21 bis (RS 232-C or V.24 or V.35) and the X.21 non-switched adapter are supported for Releases 3 and 4.

- Remote loading and dumping of an ACF/NCP is not supported through the X.25 network. If this is required, an alternative (non-X.25) communication facility may be used.

- In Release 3 there is no migration path facility over the X.25 Intermediate Network Node link.

Storage and Performance

The functions provided by this program product will increase the ACF/NCP storage requirements and path lengths. The actual performance level varies depending upon your particular hardware and software configuration. IBM aids, such as the 3705 Configurator (CF3705) or the 3725 Configurator (CF3725) should be used to assess your performance capability and storage requirements.

Storage Estimates

The following figures have to be added to the NCP requirements.

Release 2 of the X.25 NCP Packet Switching Interface program product requires 37K to 55K bytes for the base program plus 400 bytes for each NCP-defined physical unit (PU) operating through the X.25 network.

Release 3 of the program product requires 37K to 59K bytes for the base program plus 400 bytes for each NCP-defined physical unit (PU) operating through the X.25 network.

A maximum of 300 virtual circuits can be defined in a 3705.

Release 4 of the program product requires 40K to 65K bytes for the base program, in addition to 420 bytes for a virtual circut.

Performance Considerations

Examples are provided here, to demonstrate performance considerations. The performance for each release of the program product is reviewed separately.

For Basic Support

The following points may be considered for basic X.25 NCP Packet Switching Interface support, based on the given assumptions:

- On outgoing PIUs, the only performance consideration is the additional cycles between (1) the XIO link from Boundary Network Node Path Control—Out and (2) the scheduling of the frames for transmission.

- The actual sending and receiving of data has similar 3705 cycle use as the SDLC procedure, without non-productive polling.

- On incoming PIUs, the only performance consideration is the additional cycles between (1) the end-of-frame received and (2) the scheduling of the Boundary Network Node Path Control-In delayed. Consider the following:

1. First Case, using SNA to SNA communications:

   Assume that the PIU (segment) to be transmitted or received can be contained in only one packet. The PIU must be 2 bytes less than the packet size because the Logical Link Control header is 2 bytes long.

   Additional cycles include 2000 cycles for each PIU OUT plus 900 cycles for each Receive Ready received, and 3100 cycles for each PIU IN plus 1300 cycles for each Receive Ready sent to the network.

2. Second Case, using SNA to SNA communications:

   Assume that the PIU (segment) contains 256 bytes of data, with a maximum packet length of 128 and a buffer size of 100 bytes. This PIU (segment) must be sent or received in three packets.

   Additional cycles include 6800 cycles to transform the outgoing PIU (segment) into three packets, plus 900 cycles for each Receive Ready packet received from the network.

   7300 cycles are used, on the receiving side, to receive the three packets and combine them into one PIU (segment) plus 3900 cycles to build and send three Receive Ready packets.

3. Third case, using SNA to non-SNA communications with the PCNE (SNA/X.25 Protocol Converter):

   Assume that the data unit is contained in one packet. On the SNA side, the RU length would equal the packet length.

   Additional cycles include 2800 cycles for each data unit OUT plus 900 cycles for each Receive Ready packet received, and 3600 cycles for each data unit IN plus 1300 cycles for each Receive Ready sent.

4. Fourth case, using SNA to non-SNA communications with the PCNE (SNA/X.25 Protocol Converter):

   Assume that the data unit contains 384 bytes, with a maximum packet lenght of 128. The data unit must be contained in three packets.

   Additional cycles include 7600 cycles to transform the outgoing PIU into three packets, plus 900 cycles for each Receive Ready packet received from the network.

   7800 cycles are used, on the receiving side, to combine the three packets into one PIU plus 3900 cycles to send three Receive Ready packets.

Release 2

The path length is unchanged from the basic support functions. However, data unit handling through the transparent PAD or through the GATE and DATE functions use 500 additional cycles for each data unit IN or OUT.

Release 3

The path length is the same as that for Release 2 functions. For Intermediate Network Node PIUs, the following may be considered, based on the given assumptions.

- On outgoing PIUs, consideration is given only to the additional cycles between (1) the XIOTG from the Transmission Group Control—Out and (2) the scheduling of the frame for transmission.

- The actual transmission or reception of the frames has similar 3705 cycle use as the SDLC procedure, without non-productive polling.

- On incoming PIUs, performance consideration is given only to the additional cycles between (1) the end-of-frame reception and (2) the XPC-OUT to the Transmission Group Control-In.

- If the PIU, which is to be transmitted or received, can be contained in a single packet, then the maximum length of data is:

  - 99 bytes for a packet length of 128
  - 227 bytes for a packet length of 256
  - 483 bytes for a packet length of 512

  Note: Twenty-nine bytes are used because for FID4, the TH=26, and the RH=3 (for Intermediate Network Node, there is no Link Level Control header).

  Additional cycles include 1900 cycles for each PIU OUT plus 900 cycles for each Receive Ready packet received from the network and 4100 cycles for each PIU IN plus 1300 cycles for each Receive Ready packet sent to the network.

- If the PIU is contained in more than one packet, the additional cycles to be taken into account are as follows:

  - OUTBOUND - 3300 for each packet, including one Receive Ready from the network
  - INBOUND - 3400 for each packet, including one Receive Ready to the network

Release 4

To obtain the number of 3725 cycles executed in the paths mentioned above, multipy the number of 3705 cycles by 2.3.

Note: A 3725 cycle lasts 0.2 microseconds.

Migration

Release 2 and 3 users can migrate to Release 4, as specified by the hardware and software requirements, listed earlier in this chapter. Release 4 of the program product 5668-981 supports only LAPB. A change in the PROTOCOL keyword on the X25MCH macro to specify LAPB during system generation may be required for some 5799-BAK users. Release 3 of the program product does not support the migration path over the X.25 Intermediate Network Node links.

Additional Publications

Four other publications for this program product provide the information you need to install, operate, and maintain the NCP Packet Switching Interface:

X.25 NCP Packet Switching Interface Installation and Operation

The *Installation and Operation* manual contains directions for installing and using the program product. It is written for the system programmer and the network operator. This manual describes the user generation process, access method dependencies, starting and stopping the program, and controlling the program for accurate and efficient communication. See Figure 3-3 for appropriate order number.

X.25 NCP Packet Switching Interface Diagnosis Guide

The *Diagnosis Guide* is designed to help you track and diagnose problems. It is to be used as a supplement to the NCP Diagnosis Guide and contains directions for isolating and describing problems associated with the program product. This manual describes the diagnostic aids provided by IBM and tells you how to interact with an IBM Field Support Center to correct programming errors. See Figure 3-3 for appropriate order number.

X.25 NCP Packet Switching Interface Diagnosis Reference

The *Diagnosis Reference* manual provides information to help you or the IBM service representative to resolve problems in your program. It provides information on the internal structure and functions of the program product. This manual contains a logic overview and a description of each major program component. See Figure 3-3 for appropriate order number.

You may use this book in conjunction with the *Reference Summary*, described next.

X.25 NCP Packet Switching Interface Reference Summary

The *Reference Summary* presents the data areas and control blocks used by the program product. It also contains information on exception responses, ABEND codes, messages, modules and macros. See Figure 3-3 for the appropriate order number.

MANUAL	For releases supporting the 3705	For releases supporting the 3725
X.25 NCP Packet Switching Interface Installation and Operation	SC30-3163	SC30-3201
X.25 NCP Packet Switching Interface Diagnosis Guide	SC30-3164	SC30-3200
X.25 NCP Packet Switching Interface Diagnosis Reference	LY30-3054	LY30-3073
X.25 NCP Packet Switching Interface Reference Summary	SC30-3079	SC30-3202

Figure 3-3. Reference Publications

Appendix A. Acronym List

The following is a list of acronyms used or referred to in this publication.

ACF	Advanced Communication Function
BSC	Binary Synchronous Communication
CCITT	International Telegraph and Telephone Consultative Committee
CNM	Communications Network Management
CTCP	Communication and Transmission Control Program
DATE	Dedicated Access to X.25 Transport Extension
DCE	Data Circut-Terminating Equipment
DTE	Data Terminal Equipment
GATE	General Access to X.25 Transport Extension
INN	Intermediate Network Node
LAP	Link Access Procedure
LAPB	Link Access Procedure Balanced
LLC	Logical Link Control
LU	Logical Unit
NCCF	Network Communications Control Facility
NCP	Network Control Program
NIA	Network Interface Adapter
NTO	Network Terminal Option
PAD	Packet Assembly/Disassembly
PCNE	Protocol Converter for Non-SNA Equipment
PIU	Path Information Unit
PSDN	Packet-Switched Data Network
RECFMS	Record Formatted Maintenance Statistics
RU	Request/Response Unit
SDLC	Synchronous Data Link Control

SNA	Systems Network Architecture
SSCP	System Services Control Point
TG	Transmission Group
VCM	Virtual Circuit Manager

Glossary

This glossary contains definitions reprinted from:

- The *American National Dictionary for Information Processing*, copyright 1977 by the Computer and Business Equipment Manufacturers Association, copies of which may be purchased from the American National Standards Institute at 1430 Broadway, New York, New York 10018. These definitions are identified by an asterisk.
- The *ISO Vocabulary of Data Processing*, developed by the International Standards Organization, Technical Committee 97, Subcommittee 1. Definitions from published sections of this vocabulary are identified by the symbol "(ISO)" preceding the definition. Definitions from draft proposals and working papers under development by the ISO/TC97 vocabulary subcommittee are identified by the symbol "(TC97)," indicating that final agreement has not yet been reached among its participating members.
- The *CCITT Sixth Plenary Assembly Orange Book, Terms and Definitions*, and working documents published by the International Telecommunication Union, Geneva, 1978. These are identified by the symbol "(CCITT/ITU)" preceding the definition.

access barred. (CCITT/ITU) The state in which the calling data terminal equipment (DTE) is not permitted to make a call to the DTE identified by the selection signals.

balanced data link. A data link between two participating combined stations; each station can transmit both command frames and response frames and assumes responsibility for the organization of its data flow and for the data link level error recovery operations for the transmissions that it originates. Contrast with unbalanced data link. (Based on ISO/TC97/SC6 N2100.)

call. (1) (CCITT/ITU) A transmission for the purpose of identifying the transmitting station for which the transmission is intended. (2) (CCITT/ITU) An attempt to reach a user, whether or not successful.

call accepted packet. (CCITT/ITU) A call supervision packet transmitted by a called data terminal equipment (DTE) to inform the data circuit-terminating equipment (DCE) of the acceptance of the call.

call-accepted signal. (TC97) A call control signal that is sent by the called data terminal equipment (DTE) to indicate that it accepts the incoming call.

call connected packet. (CCITT/ITU) A call supervision packet transmitted by a data circuit-terminating equipment (DCE) to inform a calling data terminal equipment (DTE) of the complete establishment of a call.

called party. On a switched line, the location to which a connection is established.

call establishment. (CCITT/ITU) The sequence of events for the establishment of a data connection.

calling. (TC97) The process of transmitting selection signals in order to establish a connection between data stations.

calling party. On a switched line the location that originates a connection.

call not accepted signal. (TC97) A call control signal sent by the called data terminal equipment (DTE) to indicate that it does not accept the incoming call.

call request packet. (CCITT/ITU) A call supervision packet transmitted by a data terminal equipment (DTE) to ask for a call establishment through the network.

call request signal. (CCITT/ITU) A signal in the call establishment phase which alerts the data circuit-terminating equipment (DCE) that the data terminal equipment (DTE) wishes to make a call.

call supervision packet. (CCITT/ITU) A packet used for the establishment or the clearing of a call at the DTE/DCE interface.

channel. See data communication channel.

circuit. See data circuit.

circuit switched data transmission service. (TC97) A service using circuit switching to establish and maintain a connection before data can be transferred between data terminal equipments (DTEs). See also packet switched data transmission service.

circuit switching. (TC97) A process that, on demand, connects two or more data terminal equipments (DTEs) and permits the exclusive use of a data circuit between them until the connection is released. Synonymous with line switching. See also message switching and packet switching.

clear indication packet. (CCITT/ITU) A call supervision packet transmitted by a data circuit-terminating equipment (DCE) to inform a data terminal equipment (DTE) of the clearing of a call.

clear request packet. (CCITT/ITU) A call supervision packet transmitted by a data terminal equipment (DTE) to ask for clearing a call.

closed user group. (TC97) In a group of users, a subgroup that is assigned a facility that enables a member of one subgroup to communicate only with other members of the subgroup.

Note: A data terminal equipment (DTE) may belong to more than one closed user group.

closed user group with outgoing access. (CCITT/ITU) A closed user group that has a user assigned a facility which enables that user to communicate with other users of a public data network transmission service, where appropriate, or with users having a data terminal equipment (DTE) connected to any other public switched network to which interworking facilities are available.

command frame. A frame transmitted by a primary station or a frame transmitted by a combined station that contains the address of the other combined stations. (ISO/TC97/SC6 N2100.)

communication line. Deprecated term for telecommunication line.

communication common carrier. In the USA and Canada, a public data transmission service that provides the general public with transmission service facilities; for example, a telephone or telegraph company. See also Post Telephone and Telegraph Administration and public network.

data channel. A device that connects a processor and main storage with I/O control units. Synonymous with input/output channel, I/O channel. Contrast with data communication channel.

data circuit. (1) (TC97) Associated transmit and receive channels that provide a means of two-way data communication. (2) See also physical circuit and virtual circuit.

- Between data switching exchanges (DSEs), the data circuit may or may not include data circuit-terminating equipment (DCE), depending on the type of interface used at the data switching exchange.
- Between a data station and a data switching exchange or data concentrator, the data circuit includes the data circuit-terminating equipment at the data station end, and may also include equipment similar to a DCE at the data switching exchange or data concentrator location.

data circuit-terminating equipment (DCE). (TC97) The equipment installed at the user's premises that provides all the functions required to establish, maintain, and terminate a connection, and the signal conversion and coding between the data terminal equipment (DTE) and the line.

Note: The DCE may be separate equipment or an integral part of other equipment.

data communication channel. (1) (TC97) A means of one-way transmission. (2) Contrast with data channel.

- A channel may be provided, for example, by frequency or time division multiplexing.
- In CCITT terminology, a channel (that is, a data communication channel), provides one-way (simplex) transmission; data circuits and "logical channels" provide two-way (duplex) transmission. In data processing terminology, a channel (that is, an I/O channel or data channel), provides two-way transfers, or moves, of data. This distinction must be kept in mind when documenting the interface.

datagram. (CCITT/ITU) A self-contained, independent entity of data carrying sufficient information to be routed from the source data terminal equipment (DTE) to the destination DTE without relying on earlier exchanges between the source or destination DTE and the transporting network.

data link level. The conceptual level of control or processing logic existing in the hierarchical structure of a data station (primary, secondary, or combined station) that is responsible for maintaining control of the data link. The data link level functions provide an interface between the data station high level logic and the data link. These functions include transmit bit insertion and receive bit deletion; address/control field interpretation; command/response generation, transmission, and interpretation; and frame check sequence computation and interpretation. See also packet level and physical level. (ISO/TC97/SC6 N2100.)

data packet. (CCITT/ITU) A packet used for the transmission of user data on a virtual circuit at the DTE/DCE interface.

data terminal equipment (DTE). (TC97) That part of a data station that serves as a data source, data sink, or both, and provides for the data communication control function according to protocols.

DCE. Data circuit-terminating equipment.

DCE clear confirmation packet. (CCITT/ITU) A call supervision packet transmitted by a data circuit-terminating equipment (DCE) to confirm the clearing of a call.

DCE/DTE interface. See DTE/DCE interface.

dedicated channel. A channel that is not switched.

dedicated circuit. A circuit that is not switched.

dedicated connection. Deprecated term for nonswitched connection.

direct call. (CCITT/ITU) A facility which enables the establishment of a call without the need to convey address signals to the network.

discarded packet. (CCITT/ITU) A packet which is destroyed intentionally or by default while being transmitted through the network.

disconnected mode. Synonym for disconnected phase.

DTE. Data terminal equipment.

DTE clear confirmation packet. (CCITT/ITU) A call supervision packet transmitted by data terminal equipment (DTE) to confirm the clearing of a call.

DTE/DCE interface. (CCITT/ITU) The physical interface elements and the link access procedures between data terminal equipment (DTE) and data circuit-terminating equipment (DCE).

end-to-end control. (CCITT/ITU) A means whereby during the data phase of a call, interconnected data terminal equipment (DTE) may exchange control signals without loss of data bit sequence independence.

FCS. Frame checking sequence.

flag (F) sequence. The unique sequence of eight bits (01111110) employed to delimit the opening and closing of a frame. (ISO/TC97/SC6 N2100.)

flow control. (1) (TC97) The procedure for controlling the data transfer rate. (2) In SNA, the process of managing the rate at which data traffic passes between components of the network. The purpose of flow control is to optimize the rate of flow of message units with minimum congestion in the network; that is, to neither overflow the buffers at the receiver or at intermediate routing nodes, nor leave the receiver waiting for more message units.

frame. (1) In high level data link control (HDLC), the sequence of contiguous bits bracketed by and including opening and closing flag (01111110) sequences. (2) (CCITT/ITU) A set of consecutive digit time slots in which the position of each digit time slot can be identified by reference to a frame alignment signal.

frame checking sequence (FCS). See frame check sequence.

frame check sequence (FCS). The field immediately preceding the closing flag sequence of a frame, containing the bit sequence that provides for the detection of transmission errors by the receiver. (ISO/TC97/SC6 N2100.)

frame level interface. (CCITT/ITU) The level of the DTE/DCE interface in packet mode operation relating to the exchange of packets with local error control, where packets are contained in frames. See also packet level interface.

high-level data link control (HDLC). (CCITT/ITU) Control of data links by use of a specified series of bits rather than by the control characters of the ISO Standard 7-bit character set for information processing interchange.

I format. Information format.

I frame. Information frame.

incoming call packet. (CCITT/ITU) A call supervision packet transmitted by a data circuit-terminating equipment (DCE) to inform a called data terminal equipment (DTE) of a call requested by another DTE.

information (I) format. A format used for information transfer.

information (I) frame. A frame in I format, used for numbered information transfer.

LAP. Link access procedure.

LAPB. Link access procedure balanced. See link access procedures.

leased line. Synonym for nonswitched line.

line switching. Synonym for circuit switching.

link access procedures (LAP, LAPB). The link level elements used for data interchange between a data circuit-terminating equipment (DCE) and a data terminal equipment (DTE) operating in user classes of service 8 to 11, as specified in CCITT Recommendation X.1.

link level. See data link level.

logical channel. (CCITT/ITU) In packet mode operation, a means of two-way simultaneous transmission across a data link, comprising associated send and receive channels. A logical channel can represent the path that data travels from its origin to the network or from the network to its destination.

- A number of logical circuits may be derived from a data link by packet interleaving.
- Several logical circuits may exist on the same data link.

lower window edge. (CCITT/ITU) The lowest sequence number in a window.

message switching. (1) (TC97) In a data network, the process of routing messages by receiving, storing, and forwarding complete messages. (2) The technique of receiving a complete message, storing, and then forwarding it to its destination unaltered.

multichannel link. (CCITT/ITU) A means of enabling a data terminal equipment (DTE) to have several access channels to the data network over a single circuit. Three likely methods have been identified: packet interleaving, byte interleaving, and bit interleaving.

network failure. (CCITT/ITU) A circumstance occurring in a network which prevents a service to be offered because the network is not functioning correctly.

nonswitched connection. A connection that does not have to be established by dialing. Contrast with switched connection.

nonswitched line. A telecommunication line on which connections do not have to be established by dialing. Contrast with switched line. Synonymous with leased line.

packet. (TC97) A sequence of binary digits including data and call control signals that is switched as a composite whole. The data, call control signals, and possibly error control information, are arranged in a specific format. See call accepted packet, call connected packet, call request packet, call supervision packet, clear indication packet, clear request packet, data packet, DCE clear confirmation packet, discarded packet, incoming call packet, permit packet, and reset packet.

packet assembly/disassembly (PAD). (CCITT/ITU) A user facility which permits non-packet mode terminals to exchange data in the packet mode.

packet level. The packet format and control procedures for the exchange of packets containing control information and user data between the data terminal equipment (DTE) and the data circuit-terminating equipment (DCE). See also data link level and physical level.

packet level interface. (CCITT/ITU) The level of the DTE/DCE interface in packet mode operation relating to the exchange of data and signaling, where this information is contained in packets. See also frame level interface.

packet mode operation. (TC97) Synonym for packet switching.

packet mode terminal. (TC97) Data terminal equipment that can control, format, transmit, and receive packets.

packet sequencing. (TC97) A process of ensuring that packets are delivered to the receiving data terminal equipment (DTE) in the same sequence as they were transmitted by the sending DTE.

packet switched data transmission service. (CCITT/ITU) A user service involving the transmission and, if necessary, the assembly and disassembly of data in the form of packets.

packet switching. (TC97) The process of routing and transferring data by means of addressed packets so that a channel is occupied only during the transmission of a packet;

upon completion of the transmission, the channel is made available for the transfer of other packets. Synonymous with packet mode operation. See also circuit switching.

PAD. Packet assembly/disassembly.

permit packet. (CCITT/ITU) A packet used for the transmission of permits for a virtual circuit at the DTE/DCE interface.

physical circuit. (CCITT/ITU) A circuit created with hardware rather than by multiplexing. See also data circuit. Contrast with virtual circuit.

physical level. The mechanical, electrical, functional and procedural media used to activate, maintain and deactivate the physical link between the data terminal equipment (DTE) and the data circuit-terminating equipment (DCE). See also data link level and packet level.

Post Telephone and Telegraph Administration (PTT). A generic term for the government-operated common carriers in countries other than the USA and Canada. Examples of the PTT are the Post Office in the United Kingdom, the Bundespost in Germany, and the Nippon Telephone and Telegraph Public Corporation in Japan.

primary station. The data station that supports the primary control functions of the data link, generates commands for transmission, and interprets received responses. Specific responsibilities assigned to the primary include initialization of control signal interchange, organization of data flow, and actions regarding error control and error recovery functions at the data link level. Contrast with secondary station. See also combined station. (ISO/TC97SC6 N2100.)

public data network (PDN). See public network.

public network. (CCITT/ITU) A network established and operated by an administration for the specific purpose of providing data transmission services to the public. Circuit switched, packet switched, and leased-circuit services are feasible. Contrast with user-application network.

receive not ready packet. See RNR packet.

receive ready packet. See RR packet.

reset (of a virtual circuit). (CCITT/ITU) Reinitialization of flow control on a virtual circuit, which eliminates all data that may be in transit for the virtual circuit at the time of resetting.

reset packet. (CCITT/ITU) A packet used for the resetting of a virtual circuit at the DTE/DCE interface.

response. In data communications, a reply represented in the control field of a response frame. It advises the primary/combined station with respect to the action taken by the secondary/combined station to one or more commands. (ISO/TC97/SC6 N2100.)

response frame. A frame transmitted by a secondary station or a frame transmitted by a combined station that contains the address of the transmitting combined station. (ISO/TC97/SC6 N2100.)

reverse charging acceptance. A facility that enables a data terminal equipment (DTE) to receive incoming packets that request reverse charging.

RNR packet. A packet used by a data terminal equipment (DTE) or by a data circuit-terminating equipment (DCE) to indicate a temporary inability to accept additional packets for a given virtual call or permanent virtual circuit.

RR packet. A packet used by a data terminal equipment (DTE) or by a data circuit-terminating equipment (DCE) to indicate that it is ready to receive data packets within the window.

secondary station. A data station that executes data link control functions as instructed by the primary station. A secondary station interprets received commands and generates responses for transmission. Contrast with primary station. (ISO/TC97/SC6 N2100.)

sequence number. A number assigned to a particular frame or packet to control the transmission flow and receipt of data.

switched connection. (1) (TC97) A mode of operating a data link in which a circuit or channel is established to switching facilities, for example, in a public switched network. (2) A connection that is established by dialing. (3) Contrast with nonswitched connection.

switched line. A telecommunication line in which the connection is established by dialing. Contrast with nonswitched line.

switched network. Any network in which connections are established by closing switches, for example, by dialing.

telecommunication line. (1) (TC97) The portion of a data circuit external to a data-circuit terminating equipment (DCE) that connects the DCE to a data switching exchange (DSE), that connects a DCE to one or more other DCEs, or that connects a DSE to another DSE. (2) Any physical medium, such as a wire or microwave beam, that is used to transmit data. (3) Synonymous with data transmission line, transmission line. (4) Contrast with data link.

Note: A telecommunication line is the physical medium; for example, a telephone wire or a microwave beam. A data link includes the physical medium of transmission, the protocol, and associated devices and programs—it is both logical and physical.

time-out. (CCITT/ITU) A parameter related to an enforced event designed to occur at the conclusion of a predetermined elapsed time.

unbalanced data link. A data link between a primary station and one or more participating secondary stations. The primary station assumes responsibility for the organization of data flow and for data link level error recovery operations and transmits command frames to the secondary stations. The secondary stations transmit response frames. Contrast with balanced data link. (Based on ISO/TC97/SC6 N2100.)

user-application network. (TC97) A configuration of data processing products, such as processors, controllers, and terminals, established and operated by users for the purpose of data processing or information exchange, which may use services offered by communication common carriers or telecommunication administrations. Contrast with public network.

user class of service. (TC97) A category of data transmission provided in a network in which the data signaling address selection and call progress signals signalling rates and terminal operating mode are standardized.

virtual call. See virtual call facility.

virtual call facility. (CCITT/ITU) A user facility in which a call setup procedure and a call clearing procedure will determine a period of communication between two data terminal equipments (DTEs) in which user's data will be transferred in the network in the packet mode of operation. All the user's data is delivered from the network in the same order in which it is received by the network.

- This facility requires end-to-end transfer control of packets within the network.
- Data may be delivered to the network before the call setup has been completed, but it is not delivered to the destination address if the call setup attempt is unsuccessful.
- Multi-access DTEs may have several virtual calls in operation at the same time.

virtual circuit. (TC97) In packet switching, those facilities provided by a network that give the appearance to the user of an actual connection. See also data circuit. Contrast with physical circuit.

window. An ordered set of consecutive packet send sequence numbers of the data packets authorized to cross a DTE/DCE interface on a logical channel used for a virtual call or as a permanent virtual circuit.

window edge. The lowest sequence number in a window.

window size. The specified number of frames of information that can be sent before receiving an acknowledgement response.

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IBM X.25 NCP
Packet Switching Interface
General Information

Order No. GC30-3189-1

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