IBM

X.25 Network Control Program Packet Switching Interface

GC30-3469-2

General Information

Version 3

IBM®

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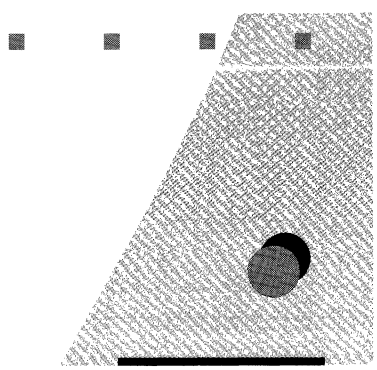

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This edition applies to the IBM licensed program X.25 NCP Packet Switching Interface Version 3 (program number 5688-035) Releases 1, 2, and 3.

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About This Book

X.25 NCP Packet Switching Interface General Information introduces you to the basic concepts of packet switching, X.25 protocol, and IBM's X.25 NCP Packet Switching Interface (X.25 NPSI) licensed program. X.25 NPSI offers Systems Network Architecture (SNA) users the ability to use communication facilities that support the X.25 protocol as defined by the International Telegraph and Telephone Consultative Committee (CCITT) at Geneva in 1980 and Malaga-Torremolinos in 1984.

This book provides no general-use programming interfaces.

Who Should Use This Book

X.25 NPSI General Information is intended for managers, system designers, programmers, and other data processing personnel involved in making data communication decisions for their respective organizations.

How to Use This Book

Read the beginning section of each chapter to familiarize yourself with information that you will need in evaluating this product.

How This Book Is Organized

Chapter 1 introduces X.25 concepts and the benefits of the X.25 NPSI licensed program.

Chapter 2 describes the X.25 NPSI functions.

Chapter 3 discusses the hardware, software, and other considerations that affect planning for X.25 NPSI.

The book also includes a glossary, a bibliography, and an index.

Abbreviations and Terms Used in This Book

Throughout the book, the following abbreviations and terms apply.

CCITT International Telegraph and Telephone Consultative Committee

DATE Dedicated Access to X.25 Transport Extension

GATE General Access to X.25 Transport Extension

ISDN Integrated Services Digital Network

ISO International Organization for Standardization

MVS Multiple Virtual Storage/System Product (MVS/SP) operating system, Multiple Virtual Storage/Extended Architecture (MVS/XA) operating system, or Multiple Virtual Storage/Enterprise System Architecture (MVS/ESA)

NCP Network Control Program

PAD Packet Assembler/Disassembler

PSDN	Packet Switched Data Network
SNA	Systems Network Architecture
SSP	System Support Programs
SSCP	System Services Control Point
SVCSC	Switched Virtual Circuit Subarea Communication
VM	Virtual Machine/System Product (VM/SP) operating system or Virtual Machine/Extended Architecture (VM/XA) operating system
VSE	Disk Operating System/Virtual Storage Extended (DOS/VSE) operating system
VTAM	Virtual Telecommunications Access Method
X.25 NPSI	X.25 NCP Packet Switching Interface.

Other abbreviations used in this book are listed in the "Glossary."

How the Term Network Is Used

The term network has at least two meanings. A public network is established and operated by communication common carriers or telecommunication administrators for the specific purpose of providing circuit-switched, packet-switched, and leased-circuit services to the public.

A user application network is a configuration of data processing products, such as processors, controllers, and terminals, established and operated by users for data processing or information exchange, which can use transport services offered by communication common carriers or telecommunication administrators.

Network, as used in this book, refers to a user application network.

How Version and Release Are Abbreviated

The terms version and release are abbreviated as "V" and "R." For example, X.25 NPSI Version 3 Release 3 is abbreviated as X.25 NPSI V3R3.

How Numbers Are Written

In this book, numbers over four digits are represented in metric style. A space is used rather than a comma to separate groups of three digits. For example, the number ten thousand, five hundred fifty-two is written 10 552.

Symbols Used in This Book

Figure 1 on page ix illustrates the symbols used throughout this book.

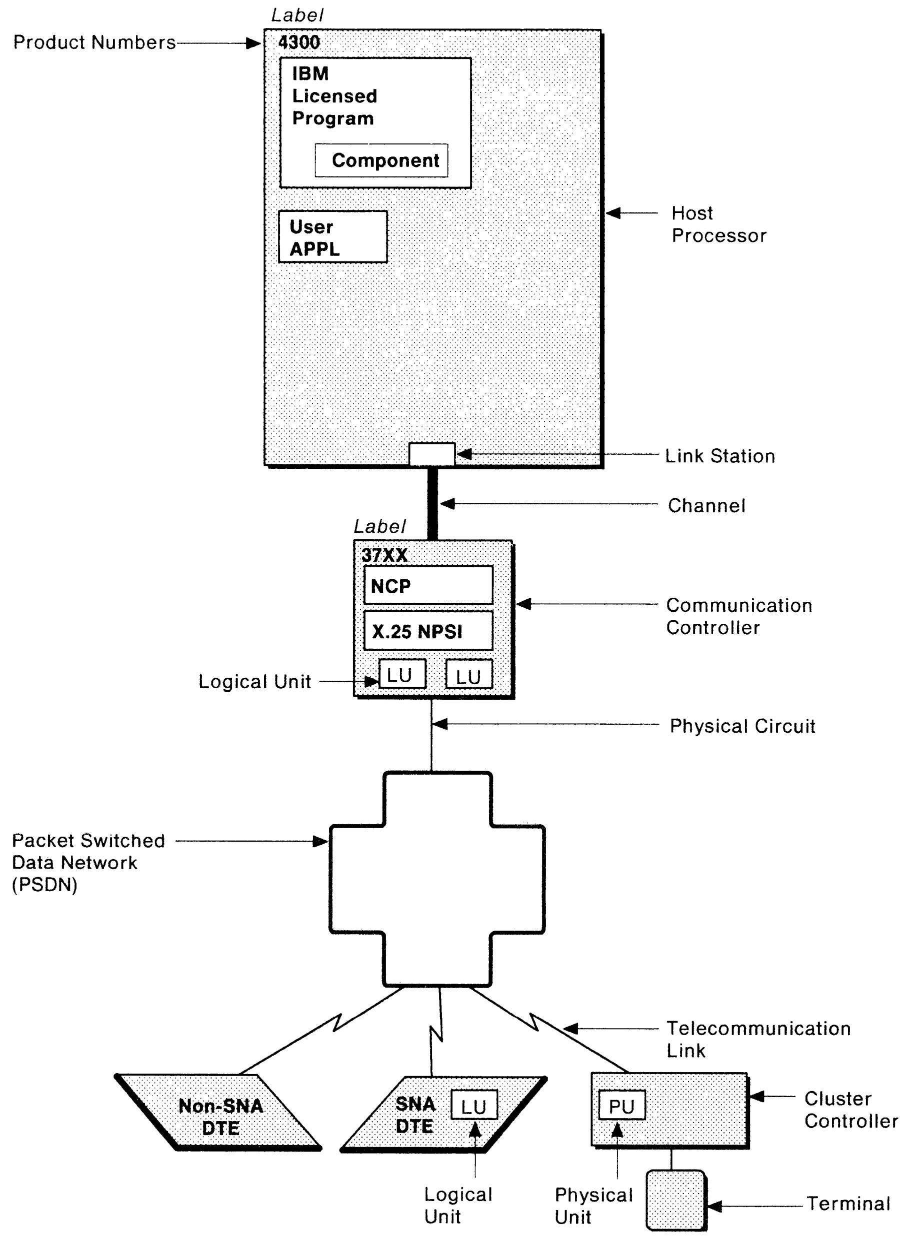

Figure 1. Symbols Used in This Book

What Is New in This Book

This book describes the following enhancements in X.25 NPSI Version 3 Release 3:

- Enhanced multichannel link compatibility
- Ability to establish link session priority
- Enhanced SNA type 2.1 boundary function support (casual connection)
- RU chaining for long non-SNA messages
- Improved connection capability
- Enhanced PAD support
- Improved conformance to the International Organization for Standardization (ISO) 7776 and 8208
- X.21 switched connections support for DTE-to-DTE communication across ISDN
- Enhanced capability to activate/load/dump remote NCPs
- Miscellaneous enhancements.

The Bibliography has been updated, and the Glossary has been expanded.

Where to Find More Information

You do not need to be familiar with CCITT Recommendation X.25 or packet switching before reading this book, but you should be familiar with SNA concepts and products, as described in *Systems Network Architecture Concepts and Products*.

For more information on the ISO standards described in this general information book, see:

- *ISO 7776 Information Processing Systems—Data Communication— High-Level Data Link Control Procedures—Description of the X.25 LAPB-Compatible DTE Data Link Procedures*
- *ISO 8208 Information Processing Systems—Data Communication—X.25 Packet Level Protocol for Data Terminal Equipment.*

For information on other related publications, see "Bibliography" at the back of this book.

Chapter 1. Introduction

Chapter 1. Introduction

This chapter provides you with an introduction to circuit switched and packet switched data networks and the protocols that govern them.

This chapter:

- Compares types of data networks
- Explains X.25 protocol
- Introduces X.25 protocol concepts
- Identifies the functional levels of X.25 protocol
- Identifies the CCITT Recommendations related to packet assemblers/disassemblers (PADs)
- Describes the purpose of X.25 NPSI.

Data Network Comparison

The two main types of data networks are circuit switched and packet switched.

Circuit Switched Data Network

A circuit switched data network (CSDN) provides a dedicated point-to-point circuit between two network devices. The communicating devices have exclusive use of the dedicated physical circuit while they are connected to each other over the network. Other users cannot communicate over that circuit until the devices are disconnected. Figure 2 on page 5 illustrates a CSDN.

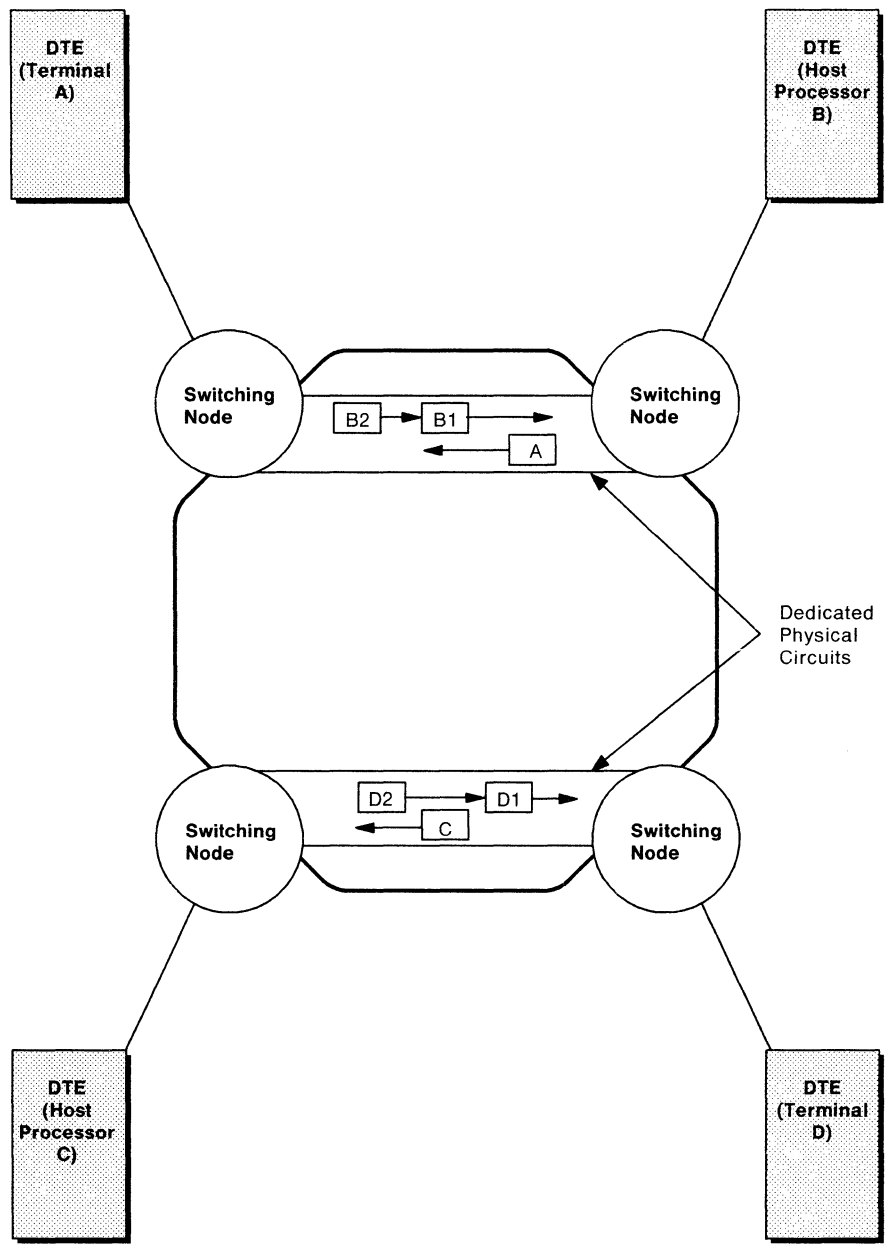

Figure 2. Circuit Switched Data Network (CSDN)

Packet Switched Data Network

In a packet switched data network (PSDN), you do not have exclusive right to a specific physical circuit. Instead, many network users share the same circuits to transmit their messages, which are divided into segments called packets. Packets from many users can be transmitted simultaneously; however, if a particular circuit is too crowded or is not working, data is rerouted to a different circuit.

PSDNs offer an alternative to circuit-switched or leased common carrier services. Transmitting each data packet separately across a PSDN and on different circuits reduces the cost of transmitting messages.

A PSDN consists of switching nodes and high-speed transmission lines between these nodes. Data terminal equipment (DTE) is the standard term used for a communication device that sends or receives network data. DTEs can be host processors, cluster controllers, or terminals. DTEs are connected to data circuit-terminating equipment (DCE), which in turn connects your equipment to the PSDN. The network supplier usually provides the DCE. The DCE and DTE can be located on the same premises.

Figure 3 on page 7 illustrates how physical circuits are shared by many DTEs in a PSDN.

Function of Packet Switching

Packet switching is the data transport method used in a PSDN. All user data is segmented into packets that include both the data and a header. The header specifies the control functions and an implied destination address.

Data packets from many users are dynamically routed over shared network facilities and then sent to their destinations. When the packets reach their destinations, they are placed in the proper sequence and sent to the DTE. The DTE combines the packets into messages.

Data is sent across the network in fixed-length packets; however, packets need not be filled to the maximum length.

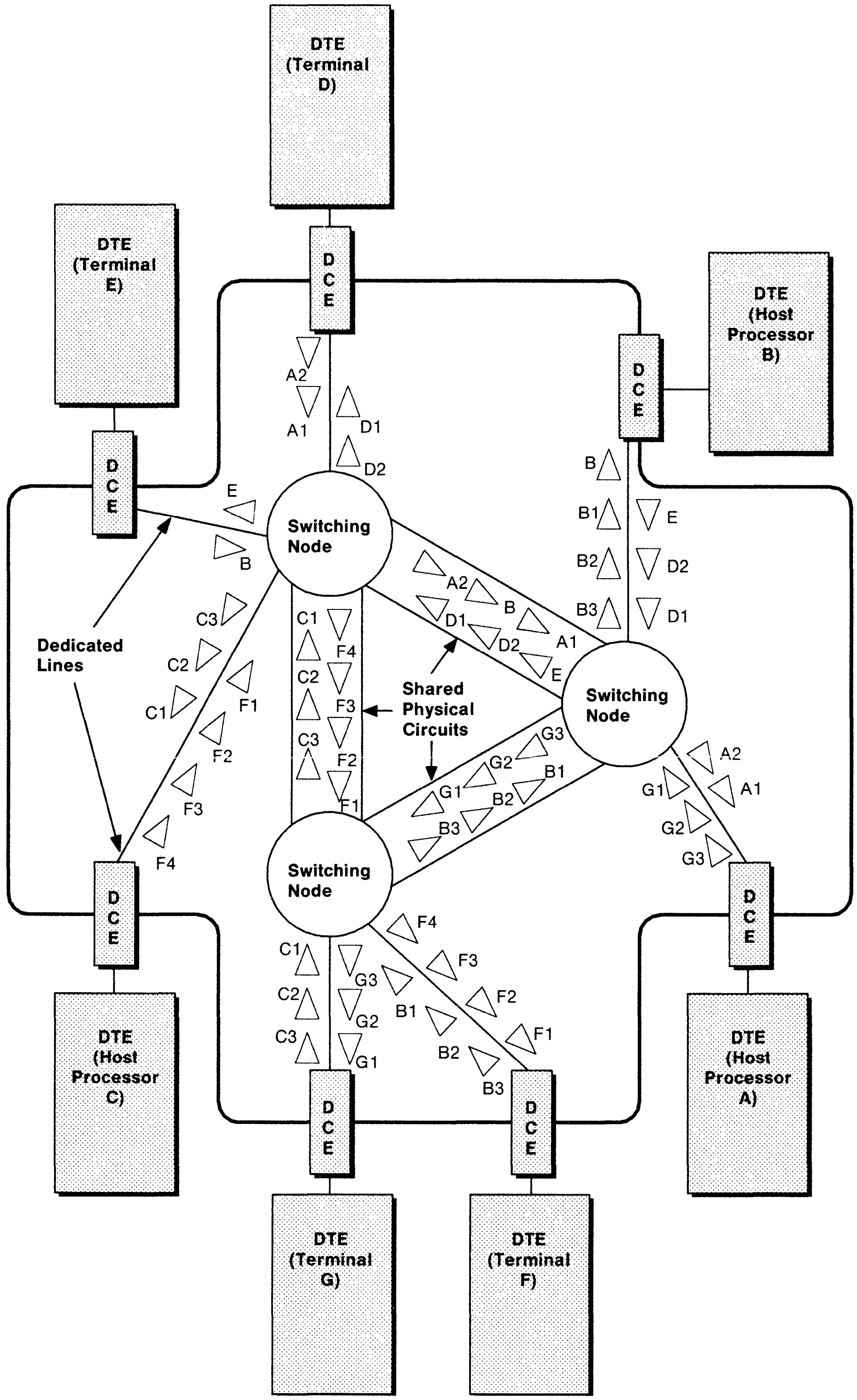

Figure 3. Packet Switched Data Network (PSDN)

Comparison of SNA/SDLC Connections with PSDN

Even though SNA/SDLC connections and PSDNs share many similarities, the following comparison notes several differences.

SNA/SDLC	PSDN
Multipoint and point-to-point	Point-to-point only
Switched physical	Switched logical
Synchronous data link control (SDLC)	High-level data link control (HDLC)

Figure 4 on page 9 illustrates the comparison of SDLC and X.25 linkages in an SNA-to-SNA configuration. Note that the LU-LU session in both occurs between an SNA host processor and an SNA cluster controller.

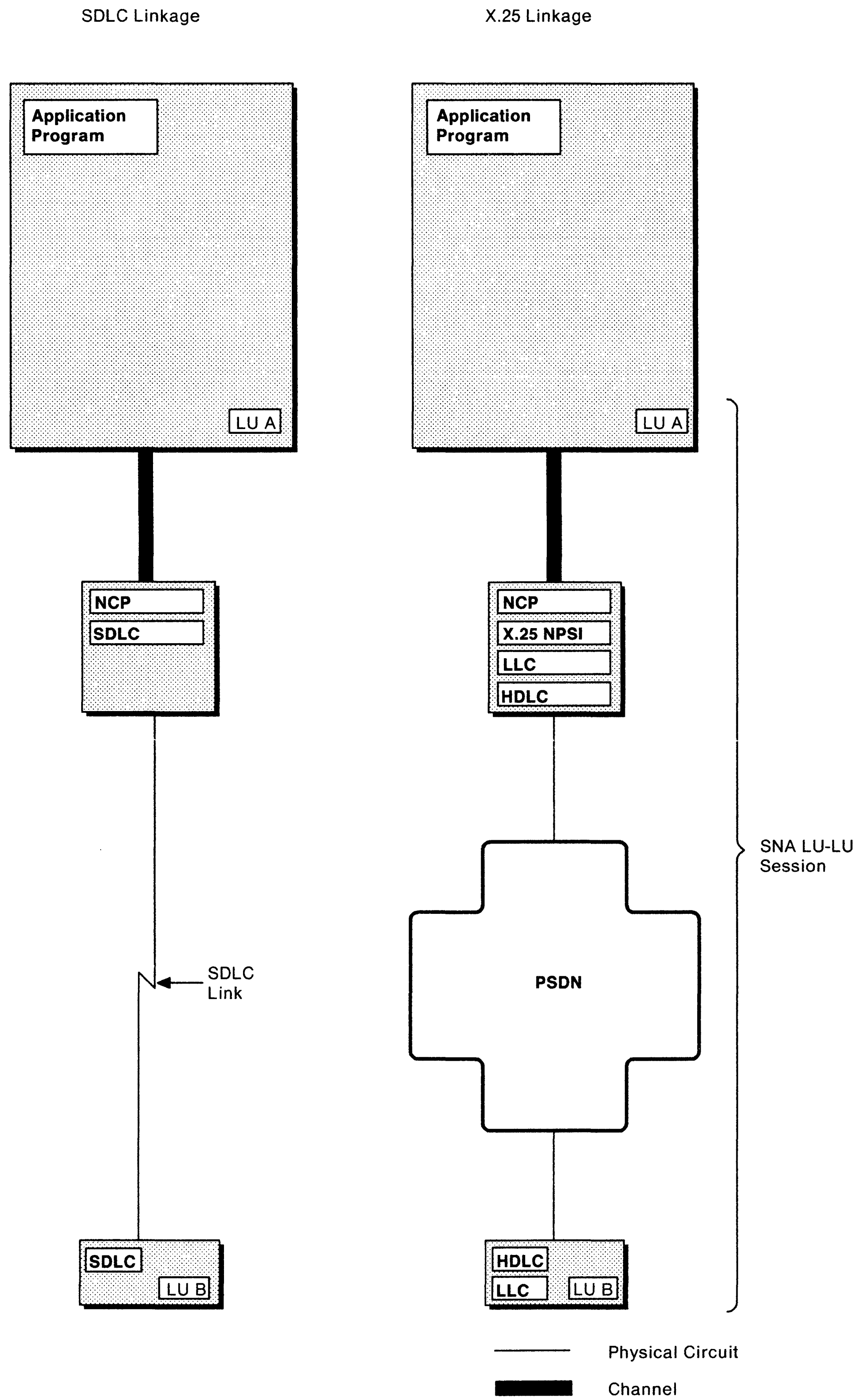

Figure 4. Comparison of SDLC and X.25 Linkages in an SNA-to-SNA Configuration

X.25 Protocol Overview

Recommendation X.25 of the International Telegraph and Telephone Consultative Committee[1] (CCITT) describes the interface between the customer-provided DTE and the network DCE. This book provides you with general information on Recommendation X.25. For detailed information on this topic, see:

- *CCITT Yellow Book Volume VIII — Fascicle VIII.2 Recommendations X.1 — X.29 (Geneva 1980)*
- *CCITT Red Book Volume VIII — Fascicle VIII.3 Recommendations X.20 — X.32 (Malaga-Torremolinos 1984).*

For more information on the ISO standards related to the CCITT Recommendations, see:

- *ISO 7776 Information Processing Systems—Data Communication—High-Level Data Link Control Procedures—Description of the X.25 LAPB-Compatible DTE Data Link Procedures*
- *ISO 8208 Information Processing Systems—Data Communication—X.25 Packet Level Protocol for Data Terminal Equipment.*

Many telecommunication organizations that offer services to the general public have implemented or plan to implement PSDNs with a DTE/DCE interface that is based on CCITT Recommendation X.25. Also, several private PSDN suppliers have implemented networks using the CCITT Recommendation X.25 interface.

X.25 is a protocol used on a point-to-point line for multiple concurrent conversations between users. The original concept was to promote communication between equipment vendors; however, telecommunication services extended the X.25 protocol to include connecting two different point-to-point lines using existing telephone networks. Packet assemblers/disassemblers (PADs) allow for more connections to other protocols, such as asynchronous ASCII. A PSDN is not required to use X.25 protocols.

X.25 Protocol Concepts

To understand the PSDN network environment, you must be familiar with information units, logical channels, virtual circuits, and windows.

[1] Geneva 1980 and Malaga-Torremolinos 1984.

Information Units

In the X.25 environment, the information units are called frames and packets.

Frames

A frame is the link-level vehicle for transmitting commands, responses, or packets over the physical circuit between a DTE and a DCE. A frame contains either control information, user data, or both, and is delimited by flags on each end.

The three types of frames are supervisory, unnumbered, and information. Supervisory and unnumbered frames carry only link-control information. Information frames (I frames) carry one packet of data or one packet of control information over the DTE/DCE circuit.

Packets

A packet is the basic information unit that is transmitted through the network. Each data packet contains a header and user data. A header includes a logical channel identifier, which is described in "Logical Channels."

In addition to data packets, various control packets can be sent either from a DTE to the adjacent network DCE or from the adjacent network DCE to a DTE. For example, when a DCE is ready to receive data from a DTE, the DCE can send a Receive Ready packet to the DTE, indicating that it is ready to receive data. Then, the DTE can send a data packet to the DCE. The DCE sends the packet through the network. The DCE sends a Receive Not Ready packet to the DTE if it is not ready to receive data. 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. Figure 5 illustrates frames and packets.

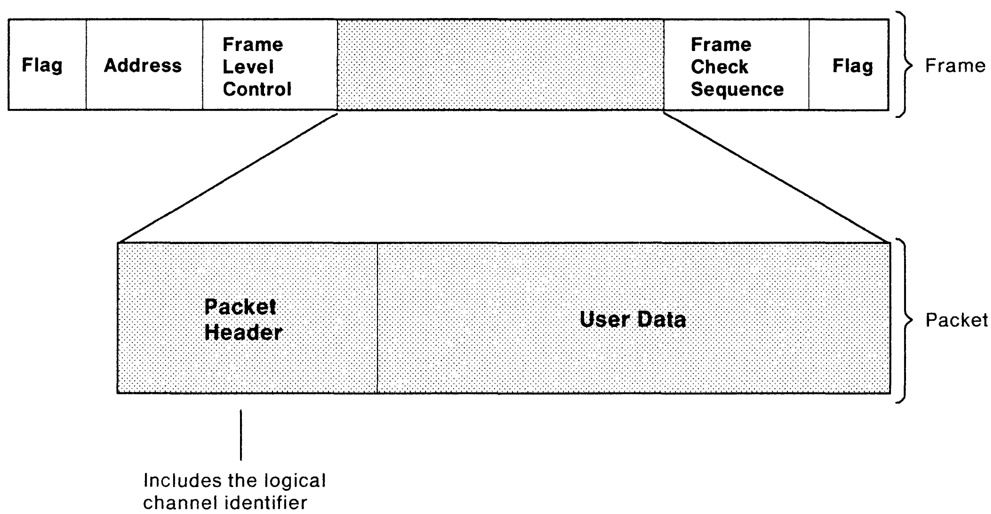

Figure 5. Frame and Packet

Logical Channels

A physical circuit connects DTEs to DCEs. This physical circuit is called a multichannel link (MCH). Each physical circuit can accommodate multiple logical channels.

The logical association between two logical channels is a virtual circuit. DTEs are linked across a PSDN through virtual circuits. The packet switching nodes within the

PSDN are responsible for keeping track of the end points and logical channel numbers of a virtual circuit connection, and for routing the packets to the correct destination.

Each X.25 packet header contains a logical channel identifier that is used to identify the logical channel to which the packet belongs, and to associate the packet with a switched virtual circuit (SVC) or permanent virtual circuit (PVC). Recommendation X.25 allows up to 4096 logical channels to be assigned to a single physical circuit. When the DTE sends a packet to the adjacent DTE, the DTE places a logical channel identifier in the packet header. When the PSDN sends the packet to the DTE, the PSDN places the logical channel identifier in the packet header.

For example, a packet-interleaving technique, which involves assigning several logical channels to the same physical circuit, allows one DTE to communicate simultaneously with several DTEs. Figure 6 illustrates the relationship between logical channels and virtual circuits through a PSDN.

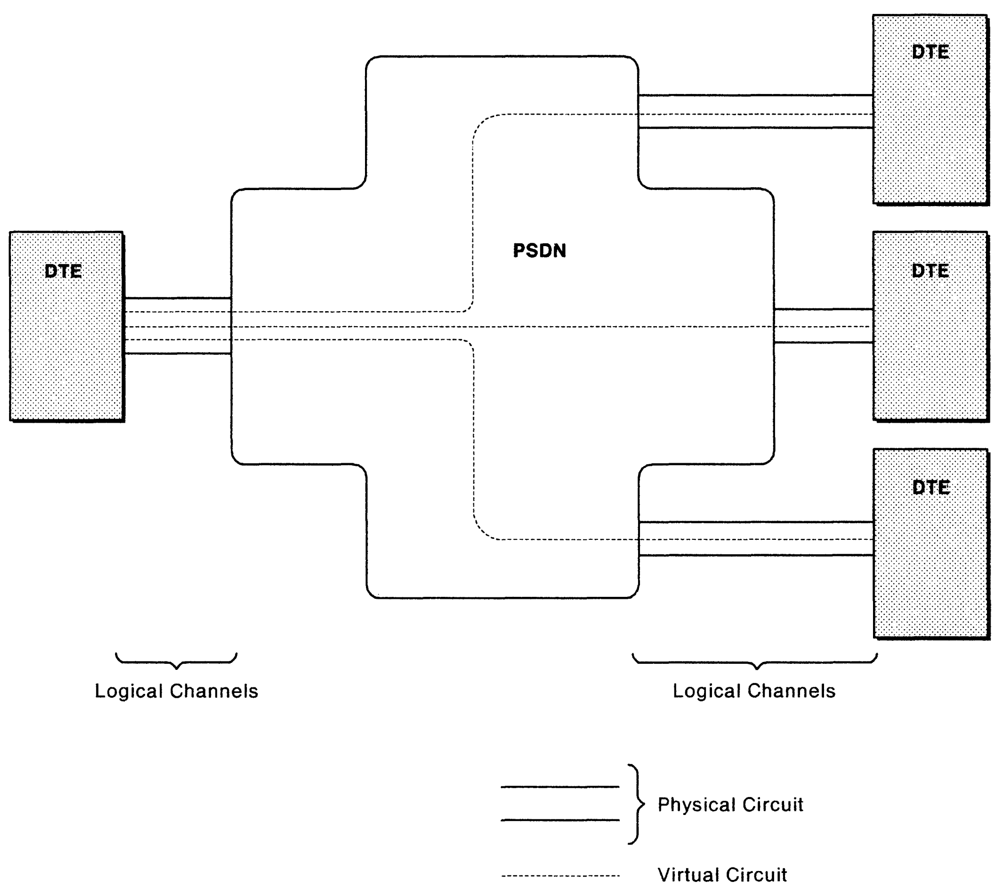

Figure 6. Logical Channels and Virtual Circuits through a PSDN

Virtual Circuits

A virtual circuit refers to the network facilities that give the appearance of an actual point-to-point connection. The network appears as if a dedicated point-to-point circuit exists between two communicating DTEs in a PSDN, even though one does not.

The PSDN sets up the virtual circuit between the two DTEs, which ensures an association between the source and destination addresses. Each DTE is given a logical channel identifier that it uses to access a particular virtual circuit. Logical channel identifiers at either end of the same virtual circuit are independent and, in general, are not the same.

Both the network and the DTE share the job of controlling data flow. This control restricts the DTE from flooding either the network or the DCE with too much data.

Depending on your needs and the services offered by the network, the virtual circuit can be set up to act as either a switched or permanent virtual circuit.

Switched Virtual Circuits

A switched virtual circuit (SVC) is a temporary circuit between two DTEs. An SVC is initiated when one DTE makes a call request to the network. Virtual calls, the term used by the CCITT, are sometimes referred to as SVCs.

A virtual call facility requires end-to-end transfer control of packets within the network. Data can be delivered to the network before the call setup has been completed; however, if the call setup attempt is unsuccessful, the data is not delivered to the destination address. Multiple-access DTEs can have several virtual calls in operation at the same time.

Permanent Virtual Circuits

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

Windows

Windows are the main mechanism for pacing or controlling the packet flow.

Frame window size is the maximum number of consecutive information frames that can be sent across the DTE/DCE interface on a physical circuit before receiving an acknowledgment.

Packet window size is the maximum number of consecutive data packets that can be sent across the DTE/DCE interface on a logical channel before receiving an acknowledgment.

In most PSDNs, the default frame window size is 7 and the default packet window size is 2. Assuming the line is error free, a larger window size directly correlates with a faster data transmission speed.

Larger packet window sizes consume more buffer storage space; therefore, the choice of packet window size depends on the application, data volume, and physical access line speed. You should check your network parameters before selecting the window size. For further information, see "Modulo 8 and Modulo 128 Packet Sequence Numbering" on page 36.

X.25 Protocol Levels

CCITT Recommendation X.25 defines three levels of the DTE/DCE interface that PSDN suppliers use as a functional design guide. These three levels are physical, link, and packet.

Physical Level

The physical level defines the electrical and mechanical characteristics of the physical circuit between the DTE and the DCE. Control functions at this level include activating, maintaining, and deactivating the physical circuit between the communicating device (DTE) and the network entry point (DCE).

Recommendations X.21 and X.21bis define the physical level. Recommendation X.21bis specifies several common modem interfaces used with telephone networks (RS-232-C, CCITT V.24, or CCITT V.35). Detailed information and specifications can be found in the CCITT publications cited in "X.25 Protocol Overview" on page 10.

Link Level

The link level defines the procedure for the accurate exchange of information between the DTE and the DCE. X.25 NPSI supports Recommendation X.25's link access procedure balanced (LAPB). This procedure can be used to transfer frames containing link level control information or packets across the physical circuit between the DTE and the DCE. The LAPB data formatting functions and first-level recovery procedures ensure that data and control information are accurately exchanged over the DTE/DCE physical circuit. LAPB also combines the functions of primary and secondary link stations into a single link station at each link end.

Packet Level

The packet level defines how user data and control information are structured into packets that are exchanged between a DTE and a PSDN. The packet level also specifies the procedure through which virtual calls between DTEs are established, maintained, and cleared. The packet level specifies the flow control mechanisms and optional user facilities to be used. Packet level protocol applies to both PVCs and SVCs.

PAD Requirements

Many vendors of DTEs have provided X.25 interface support as a standard interface or as an additional feature. For those devices that do not offer an X.25 interface, a packet assembler/disassembler (PAD) can be used to communicate through an X.25 PSDN.

Users of start-stop communication who wish to connect with an X.25 PSDN must use a PAD. The CCITT has defined a PAD for international usage in their Recommendations X.3, X.28, and X.29 for start-stop terminals:

- Recommendation X.3 defines a set of parameters, which can be used to select operational characteristics of the PAD service.
- Recommendation X.28 defines the procedures that are used by the start-stop ASCII device that accesses the PAD. These procedures provide you with an initial set of X.3 PAD parameters, a profile, and an explanation of how these PAD parameters can be changed for each virtual call.
- Recommendation X.29 defines the procedures that access the PAD service, which can be used by the DTE. Recommendation X.29 also includes procedures to change the X.3 PAD parameters during the virtual call, if required.

In addition to the CCITT PAD, public PSDNs can offer other types of PADs, such as those for supporting BSC 3270 or point-of-sale terminals. However, these PADs are generally local implementations and are not included in the CCITT Recommendations.

X.25 NPSI Overview

The X.25 Network Control Program Packet Switching Interface (X.25 NPSI) licensed program provides users of IBM's Network Control Program (NCP) with the capability to attach IBM 3720 and 3745 communication controllers to data transmission services supporting interfaces complying with CCITT Recommendation X.25 and the mandatory functions of the International Organization for Standardization (ISO) 7776 and 8208. X.25 NPSI allows SNA host processors to communicate with SNA and non-SNA equipment over PSDNs that use the X.25 protocols.

X.25 NPSI allows SNA users and non-SNA users to access an SNA host through a PSDN. Through X.25 NPSI, SVCs and PVCs appear to the NCP, and its associated host node, as switched and nonswitched SDLC links, respectively.

In addition, X.25 NPSI provides:

- X.25 basic functions
- Support of optional user facilities
- Compatibility with other IBM licensed programs.

The X.25 NPSI licensed program provides for SNA-to-SNA communication and SNA to non-SNA communication. It enables communication between the following types of DTEs:

- SNA host node and SNA peripheral node
- SNA host node and SNA host node
- SNA host node and X.28 start-stop DTEs
- SNA host node and non-SNA X.25 DTEs
- SNA peripheral node and SNA peripheral node.

Figure 7 illustrates how the X.25 interface enables data to enter and leave the network.

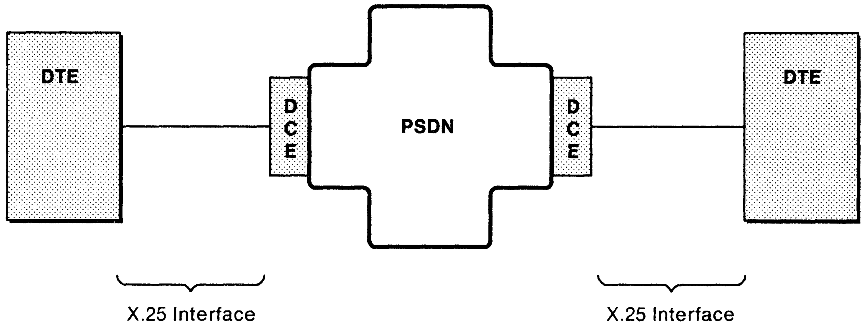

Figure 7. X.25 DTE/DCE Interface

Chapter 2. Functions of X.25 NPSI

Chapter 2. Functions of X.25 NPSI

This chapter describes the functions supported by X.25 NPSI and is divided into four functional areas. These areas include:

- Functions that were present in X.25 NPSI V1R4.3 and are currently supported
- Enhancements to X.25 NPSI V3R1 functions
- Enhancements to X.25 NPSI V3R2 functions
- Enhancements to X.25 NPSI V3R3 functions.

X.25 NPSI provides X.25 services that supervise all virtual circuits at the DTE/DCE interface. This interface is referred to as a multichannel link (MCH). X.25 NPSI establishes and terminates any remote DTE connections that use switched virtual circuits. In addition, it handles virtual circuit error recovery procedures. System services control point (SSCP) commands or network control packets drive X.25 NPSI functions.

X.25 NPSI Version 1 Release 4.3 Functions

The following sections describe the functions that were present in X.25 NPSI V1R4.3 and remain supported. These functions include:

- SNA configurations
- Multichannel link compatibility
- Coexistence with other network products
- Miscellaneous functions.

SNA Configurations Supported by X.25 NPSI

The following section describes the types of SNA communication configurations supported by X.25 NPSI.

Communication between Subarea Nodes

X.25 NPSI allows you to implement communication between two subarea nodes through a PSDN in one of four configurations:

1. Connection to an SNA host node equipped with its own communication controller and X.25 NPSI
2. Connection to a remote communication controller
3. Connection to an SNA host node or another communication controller using an SDLC PAD
4. Connection to an SNA host node with an integrated X.25 feature.

Figure 8 on page 21 illustrates the first two configurations; Figure 9 on page 22 illustrates the second two configurations.

Notes:

1. A remote communication controller can be loaded only under certain conditions. See "Enhanced Capability to Activate/Load/Dump Remote NCPs" on page 46 for further information about these conditions.
2. Only single-link transmission groups (TG) can be defined for X.25 NPSI-to-X.25 NPSI communication through X.25 networks.
3. All SDLC PAD implementations do not support subarea node to subarea node connections.

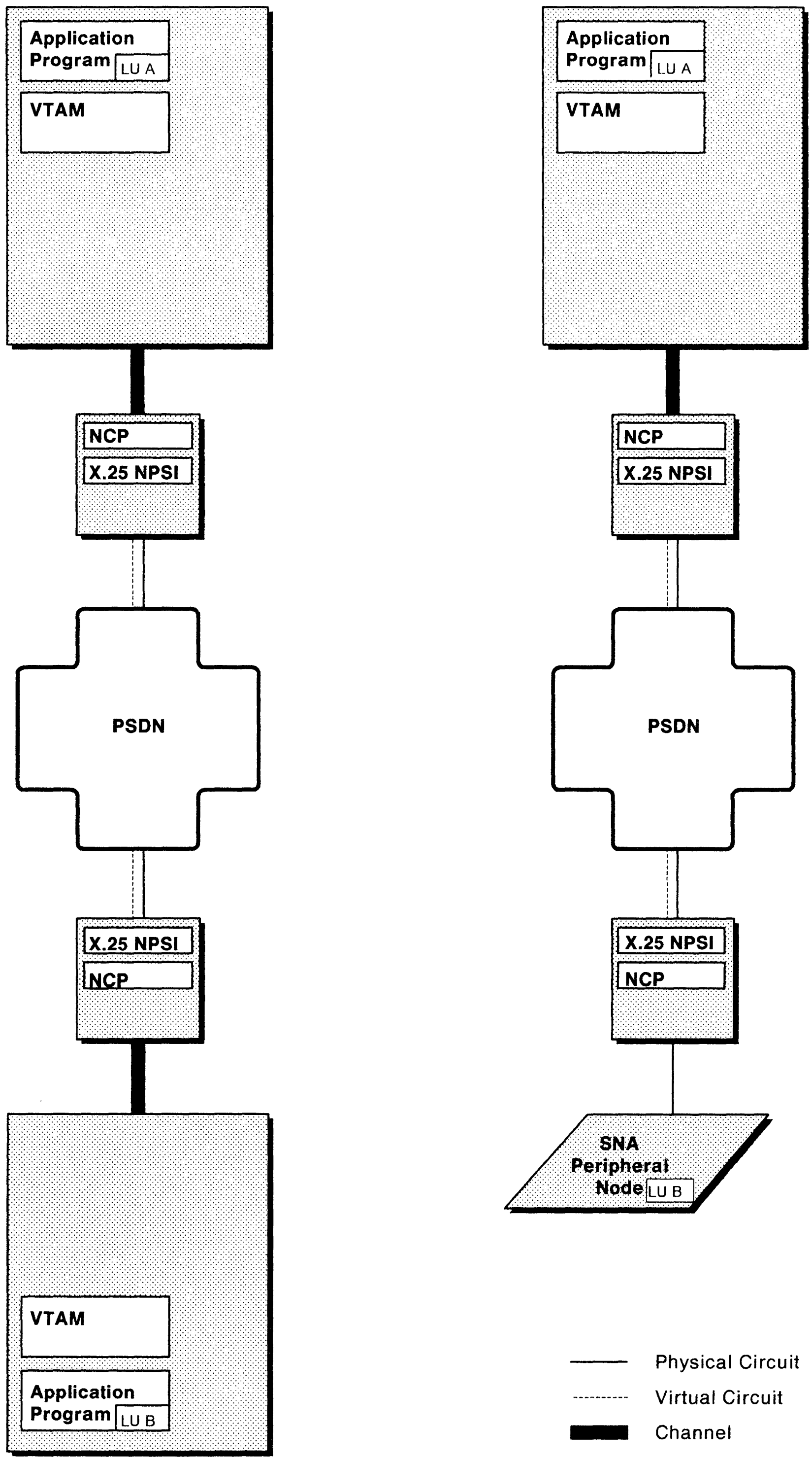

Figure 8. Communication between Subarea Nodes

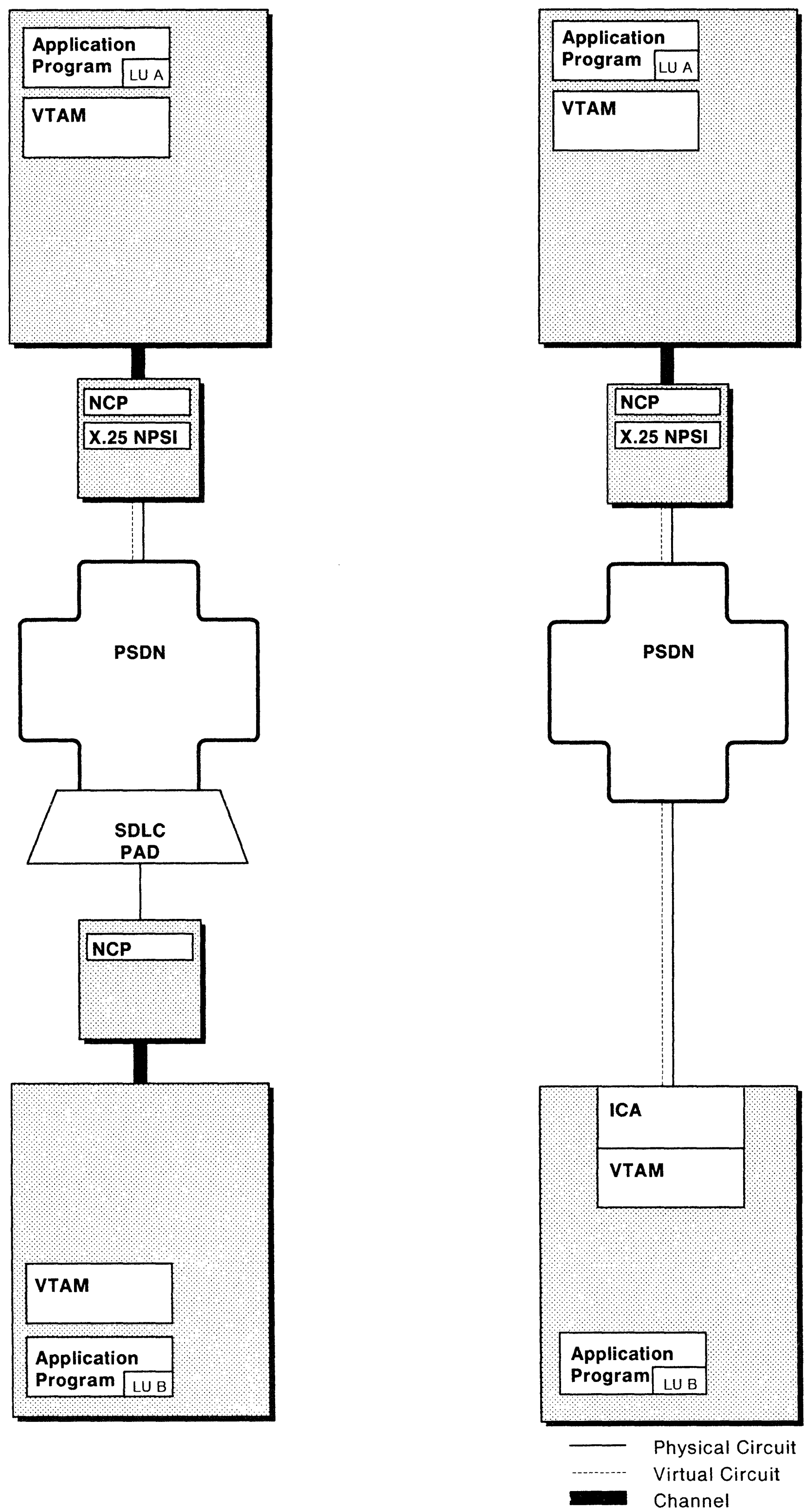

Figure 9. More Communication between Subarea Nodes

Communication between an SNA Host Node and an SNA Peripheral Node

You can implement communication between an SNA host node and an SNA peripheral node by installing X.25 NPSI in the NCP at the host site. At the terminal site, the SNA peripheral node can attach to the PSDN using the following interfaces:

- Integrated X.25 support
- SDLC PAD
- Network Interface Adapter (NIA).

Integrated X.25 support, which is contained in the SNA peripheral node, allows packets simulating SDLC commands and data to transparently pass through the PSDN. Many IBM devices have integrated X.25 support or can be customized to support X.25 protocol.

The SDLC PAD supports high-level data link control (HDLC) to the PSDN and SDLC to the peripheral node. An SNA peripheral node can be attached to an SDLC PAD.

An NIA converts SDLC protocols to X.25 protocols or X.25 protocols to SDLC protocols. An NIA is an IBM-supplied unit.

Figure 10 on page 24 illustrates the communication between an SNA host node and an SNA peripheral node.

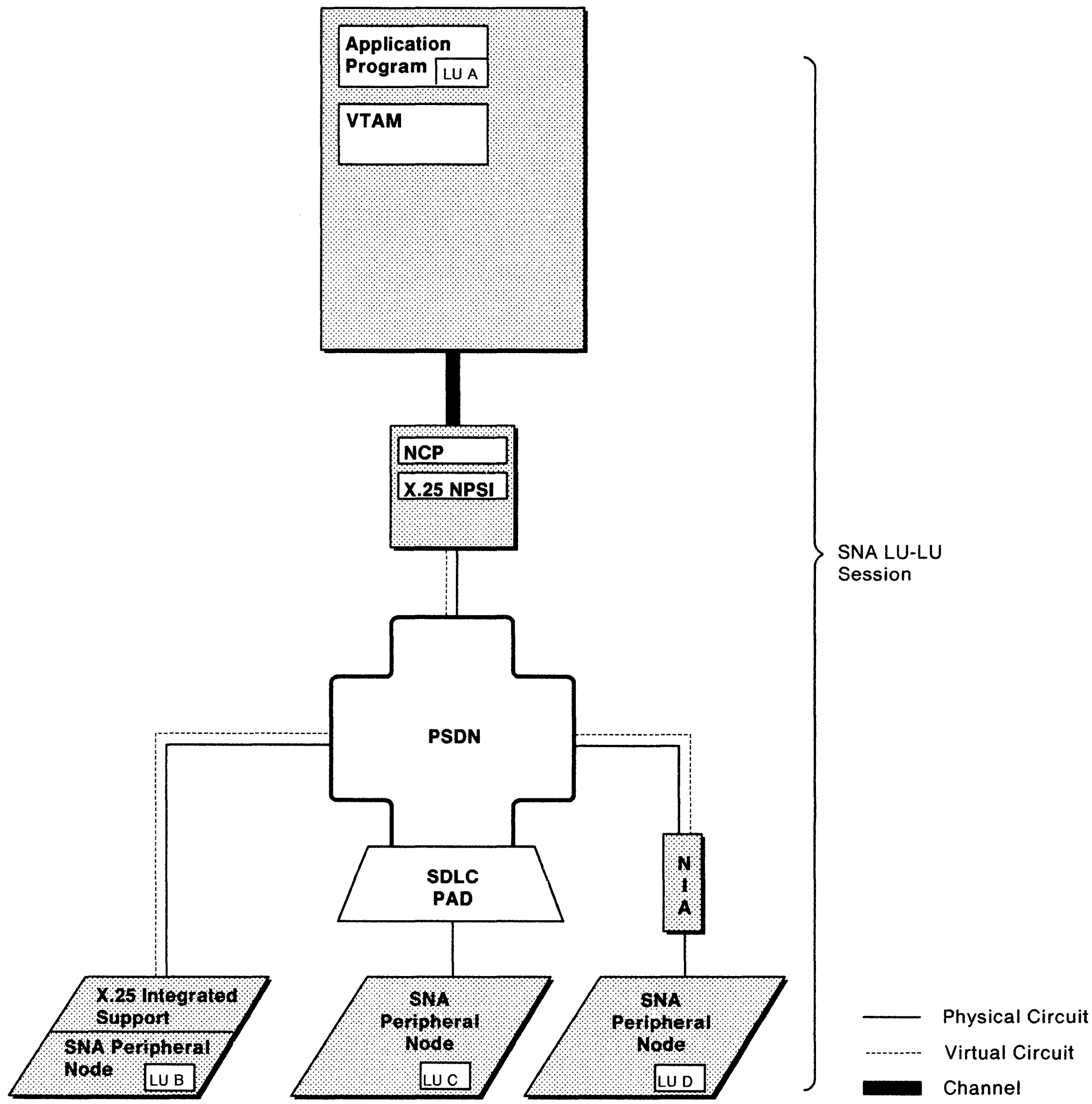

Figure 10. SNA Host Node to SNA Peripheral Node

Communication between an SNA Host Node and a Non-SNA X.25 DTE (PCNE)

You can establish communication between an SNA host node and a non-SNA X.25 DTE by using the protocol converter for the non-SNA equipment (PCNE) function of X.25 NPSI.

The PCNE simulates a logical unit (LU) for the non-SNA device to the host, so the host LU believes that it is communicating with an SNA LU type 1, rather than with a non-SNA X.25 DTE.

For data sent from the host to the X.25 DTE, the PCNE replaces the SNA headers with packet headers. The data is then sent over the network to the X.25 DTE using X.25 protocols.

For data sent from the X.25 DTE to the host, the PCNE replaces the packet headers with SNA headers. The SNA data is then sent to the host. Figure 11 on page 26 illustrates communication using a PCNE.

You can also establish a PCNE-to-PCNE connection for communication between SNA application programs in two subarea nodes as an alternative to using cross-domain SNA networking facilities.

Note: Because SNA formats and protocols are not employed on an end-to-end basis, you must ensure that the necessary compatible data streams and integrity mechanisms exist between the application program in the SNA host and the non-SNA X.25 DTE.

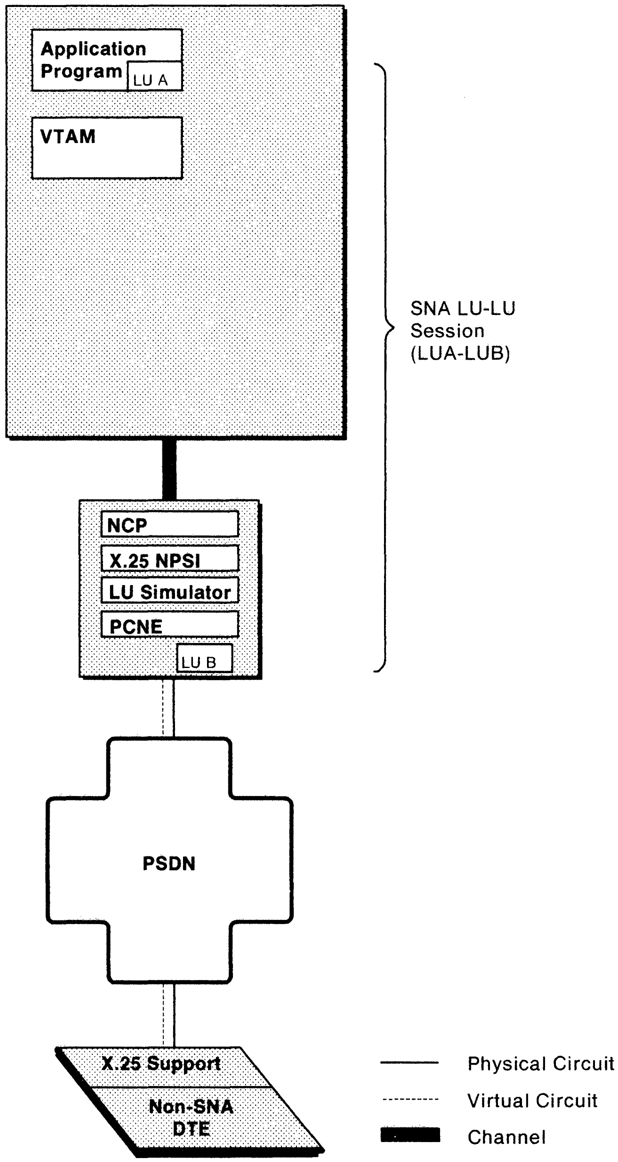

Figure 11. SNA Host Node to Non-SNA X.25 DTE (PCNE)

Communication between an SNA Host Node and a CCITT PAD (Integrated PAD Support)

You can establish communication between an SNA host node and a start-stop DTE that conforms to Recommendation X.28 using the integrated PAD support function of X.25 NPSI.

Integrated PAD support is an extension to the PCNE. Integrated PAD support implements a subset of CCITT Recommendation X.29 for communication with TTY 33/35 and other start-stop DTEs that conform to CCITT Recommendation X.28 that access the PSDN over a CCITT PAD.

Within the network, the PAD operates in a manner similar to an X.25 DTE, by performing packet assembly/disassembly on behalf of the start-stop DTE. Figure 12 on page 28 illustrates integrated PAD support.

Note: Because SNA formats and protocols are not employed on an end-to-end basis, you must ensure that the necessary compatible data streams and integrity mechanisms exist between the application program in the SNA host and the non-SNA X.25 DTE.

See "PAD Requirements" on page 14 for further information on CCITT Recommendations that relate to PADs.

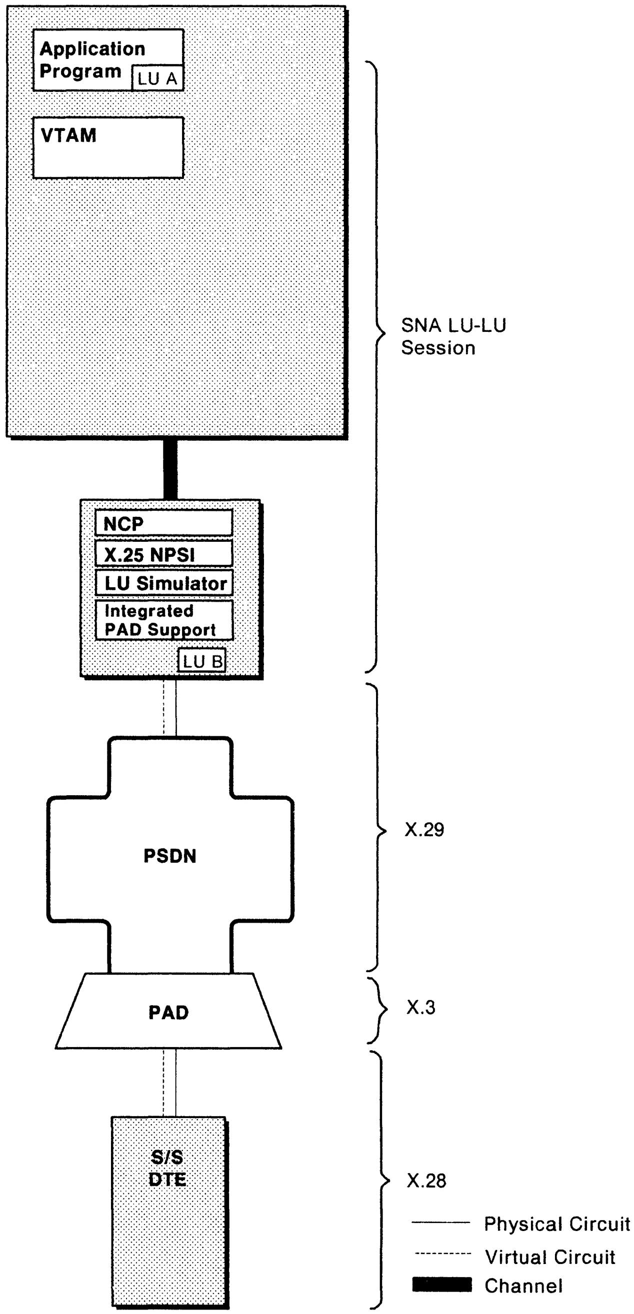

Figure 12. SNA Host Node to Non-SNA X.25 DTE (Integrated PAD Support)

Communication between an SNA Host Node and a Nonstandard PAD (Transparent PAD Support)

The transparent PAD support allows an application program in the host to control a remote PAD associated with a DTE. This support is provided to allow control of PADs that do not conform to CCITT Recommendations or to allow greater control over PAD operation than is provided with the integrated PAD support.

Like integrated PAD support, transparent PAD support is an extension of the PCNE function. Transparent PAD support identifies the packet type that is being sent to or received from the host through the use of a packet type identifier that occupies the first byte of the message.

When the host sends data, the transparent PAD support replaces the SNA header with the appropriate packet header, which was identified by the host application in the first byte of the request unit.

When the network PAD sends packets, the transparent PAD support replaces the X.25 packet header with an SNA header and identifies, in the first byte of the request unit, the packet type received by the transparent PAD support.

X.25 NPSI and the application program identify four packet types:

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

A data packet transmits user data from end to end on a virtual circuit.

A qualified data packet has a qualified bit (Q bit) turned on in the packet header. This type of packet is generally used to carry PAD commands and control information.

An interrupt packet transmits priority information *out of sequence* across the virtual circuit.

A reset packet resets virtual circuits at the DTE/DCE interface.

Note: Because SNA formats and protocols are not employed on an end-to-end basis, you must ensure that the necessary compatible data streams and integrity mechanisms exist between the application program in the SNA host and the non-SNA X.25 DTE.

Figure 13 on page 30 illustrates transparent PAD support.

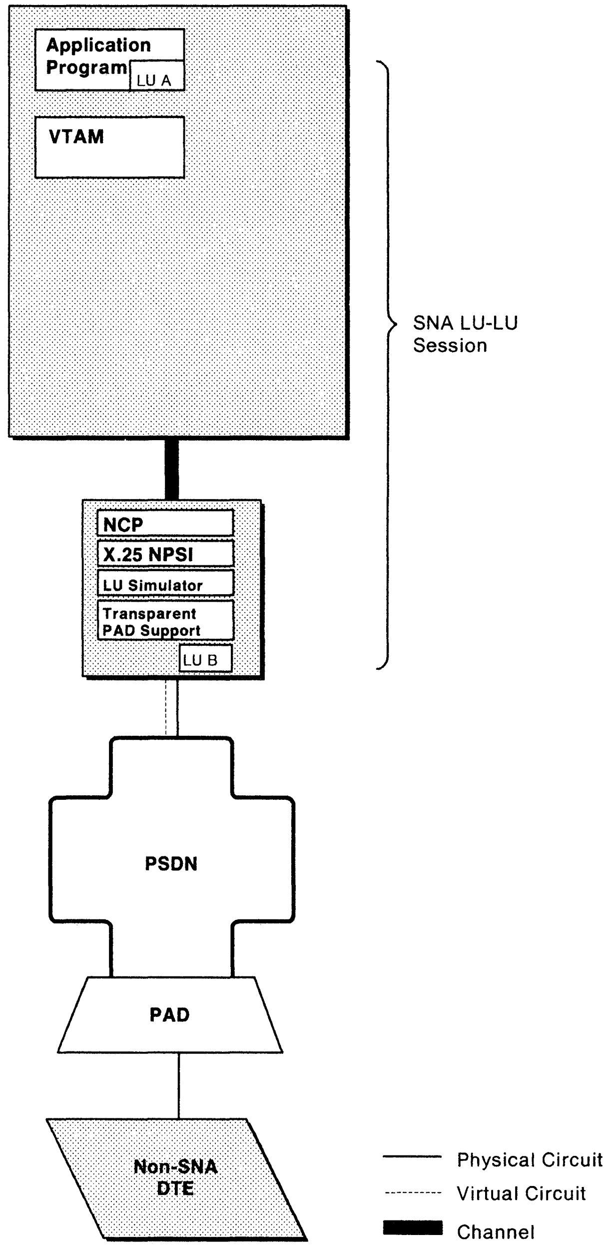

Figure 13. Host Node to Non-SNA X.25 DTE (Transparent PAD Support)

Communication between an SNA Host Node and a Non-SNA X.25 DTE (GATE)

The general access to the X.25 transport extension (GATE) function of X.25 NPSI allows a host user application program, called the communication and transmission control program (CTCP), to monitor virtual circuits to non-SNA X.25 DTEs by processing the contents of the following packets:

- Data packets
- Qualified data packets
- Interrupt packets
- Call and Clear packets
- Reset packets.

Call and Clear packets activate and deactivate switched virtual circuits respectively. Both control data and user data is sent and received through the CTCP. Figure 14 on page 32 illustrates the GATE function. Control and qualified data packets flow on the CTCP LU to VC LU session if that session is active. If the session is not active, they flow on the CTCP LU to MCH LU session. Non-qualified data packets are sent on the LU-LU session between the CTCP and the simulated LU (LU A to LU B and LU A to LU C).

In addition to managing the virtual circuits, GATE CTCPs can be used as a relay program to subsystems, such as CICS, IMS, and TSO. X.25 NPSI V3 allows you to connect up to 28 CTCPs to the same MCH.

In certain countries, IBM can provide CTCPs that can be used with GATE. An example is General Teleprocessing Monitor for Open Systems Interconnection (GTMOSI).

Note: Because SNA formats and protocols are not employed on an end-to-end basis, you must ensure that the necessary compatible data streams and integrity mechanisms exist between the application program in the SNA host and the non-SNA X.25 DTE.

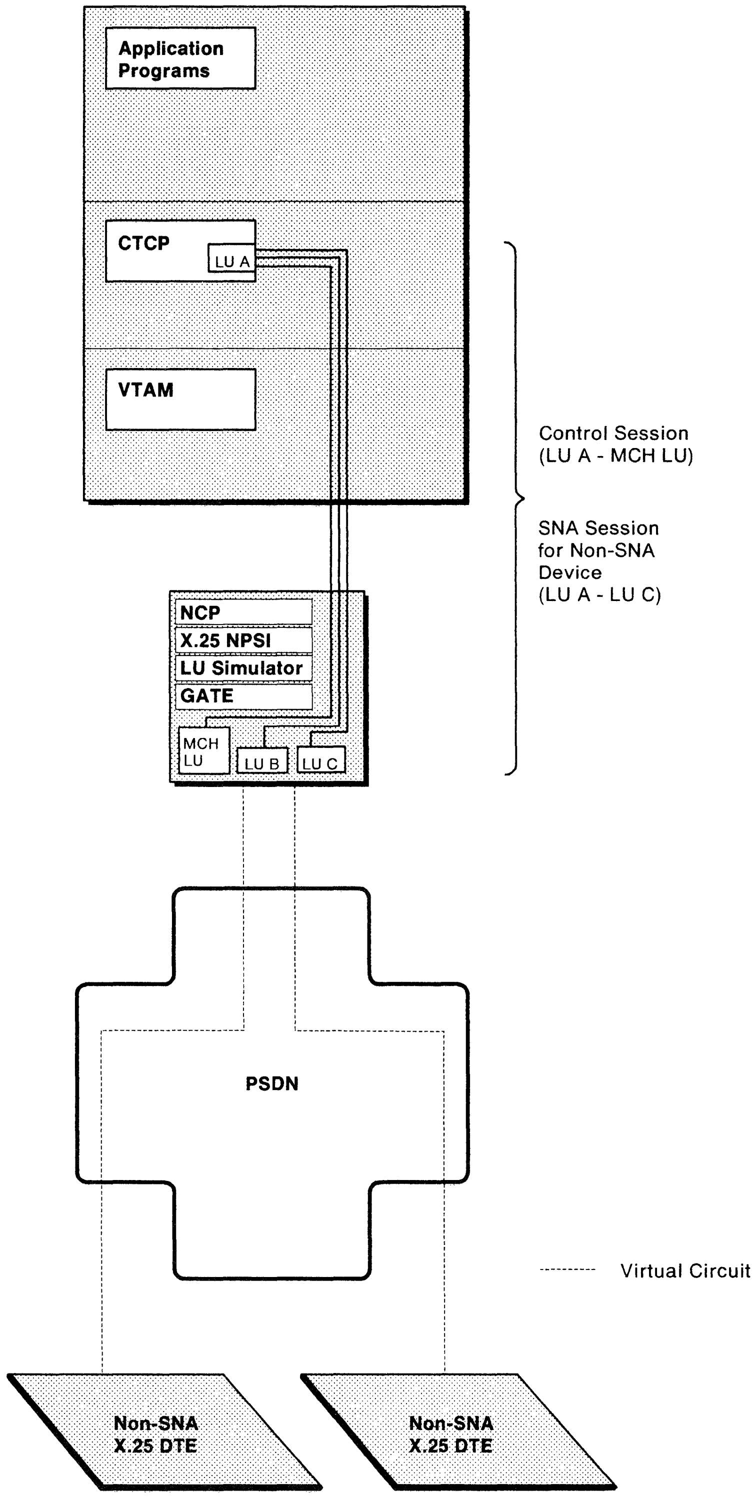

Figure 14. Host Node to Non-SNA X.25 DTE (GATE)

Communication between an SNA Host Node and a Remote DTE (DATE)

The dedicated access to the X.25 transport extension (DATE) function of X.25 NPSI allows the CTCP to manage the virtual circuits to SNA and non-SNA X.25 DTEs by processing the contents of the following packets:

- Qualified data packets
- Interrupt packets
- Call and Clear packets
- Reset packets.

With DATE, the contents of the data packets are transferred between the virtual circuit LU and the application program LU. The control packets are transferred between the MCH LU and the CTCP LU that performs virtual circuit management.

DATE and GATE have the following differences:

- DATE supports both SNA and non-SNA X.25 DTEs. X.25 NPSI and the DATE CTCP exchange only control information; however, X.25 NPSI exchanges user data directly with the application program.
- GATE supports only non-SNA X.25 DTEs. X.25 NPSI and the GATE CTCP exchange both control information and user data.

Figure 15 on page 34 illustrates the DATE function.

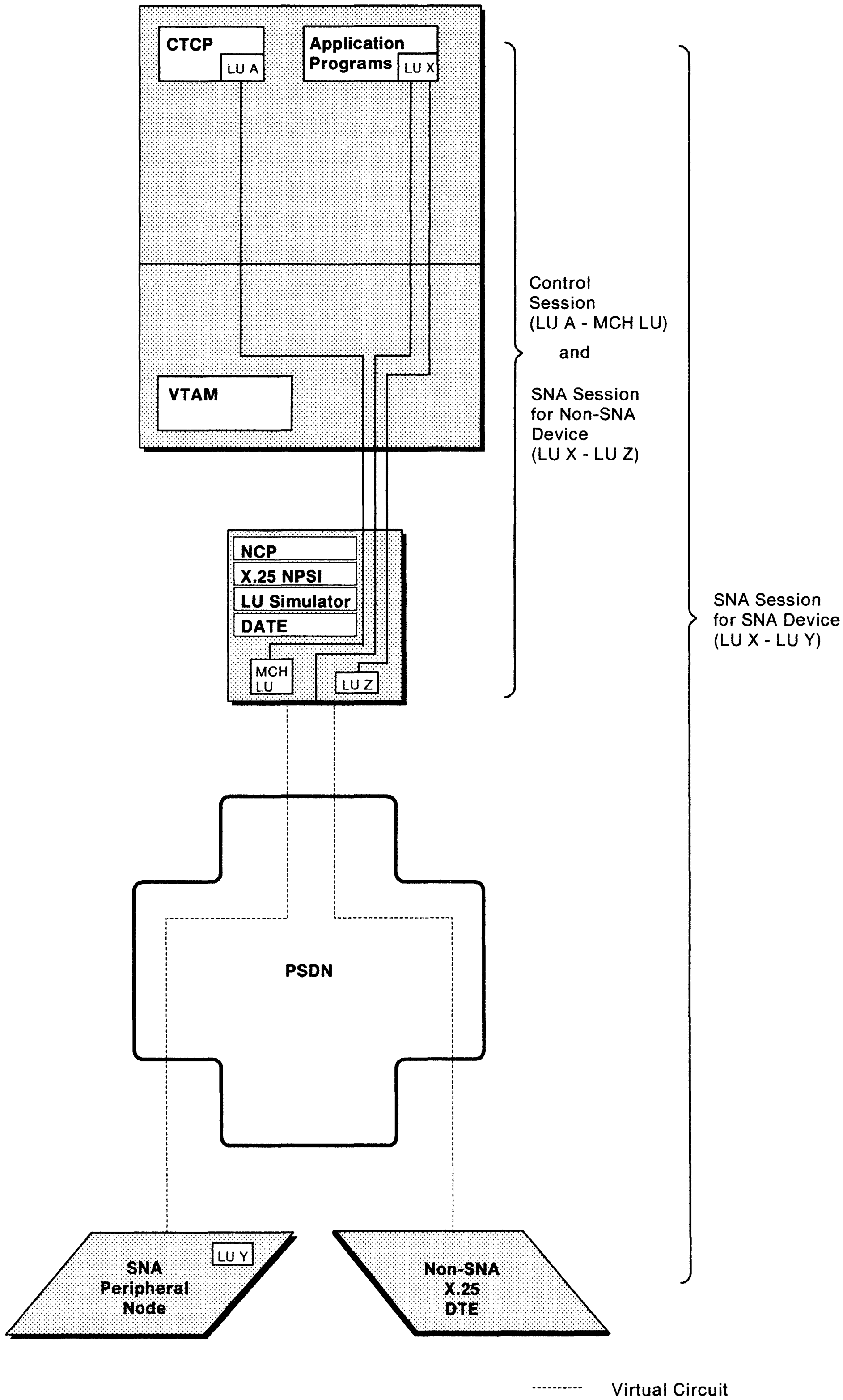

Figure 15. SNA Host Node to SNA Peripheral Node or to Non-SNA X.25 DTE (DATE)

Multichannel Link Compatibility

Table 1 shows the compatibility of GATE, DATE, integrated PAD, transparent PAD, and PCNE on the same multichannel link.

Table 1. Multichannel Link Compatibility

	GATE	DATE	Integrated PAD Support	Transparent PAD Support	PCNE
GATE	N/A	No	Yes	Yes	Yes
DATE	No	N/A	No	Yes	Yes
Integrated PAD Support	Yes	No	N/A	No	Yes
Transparent PAD Support	Yes	Yes	No	N/A	Yes
PCNE	Yes	Yes	Yes	Yes	N/A

Coexistence with Related Network Programs

X.25 NPSI can coexist with the Network Routing Facility (NRF) licensed program, the Non-SNA Interconnection (NSI) licensed program, the Network Terminal Option (NTO) licensed program, the X.25 SNA Interconnection (XI) licensed program, and SNA network interconnect (SNI).

NRF

The Network Routing Facility (NRF) licensed program resides with the NCP in the communication controller. NRF provides a path for messages between terminals and routes messages over this path without going through the host processor.

NSI

The Non-SNA Interconnection (NSI) licensed program extends NCP capabilities to provide SNA transport support for binary synchronous communication remote job entry (BSC RJE) data from selected non-SNA facilities.

NTO

The Network Terminal Option (NTO) licensed program extends NCP capabilities to allow access to certain non-SNA terminals through the record mode application program interface in VTAM and TCAM. NTO also provides an SNA interface for a select group of start-stop and binary synchronous communication (BSC) devices that emulate the SDLC 3767 communication terminal to VTAM and TCAM.

NTO preserves the non-SNA data stream, which minimizes changes to existing application programs.

SNI

SNA network interconnect (SNI) allows separate SNA networks to interconnect through a gateway NCP. The gateway NCP, with assistance from a gateway SSCP, performs name and address conversions to permit interconnection. X.25 NPSI fully supports SNI connections across subarea link virtual circuits.

XI and X.25 NPSI Bridge

X.25 SNA Interconnection (XI) licensed program allows the SNA network to transport X.25 packets from one DTE to another DTE. The X.25 NPSI bridge function of XI allows X.25 NPSI and XI to exchange packets directly at the packet layer, bypassing the lower layers of X.25 protocol.

Additional X.25 NPSI Functions

This section describes additional X.25 NPSI V1R4.3 functions.

Communication without a Network

X.25 NPSI can communicate directly with an X.25 DTE using a link connection. In this case, X.25 NPSI functions as a DCE at the link level. X.25 NPSI can also function as a DTE when it is connected directly to a DCE.

Delivery Confirmation Support

For communication with non-SNA DTEs, use the PCNE function, as defined under "Communication between an SNA Host Node and a Non-SNA X.25 DTE (PCNE)" on page 25. You can specify that X.25 NPSI use the delivery confirmation bit (D bit) to map the definite response mode. If the D bit is off (set to 0), then the packet acknowledgment comes from the adjacent DCE rather than from the destination DTE.

For SNA-to-SNA communication, SNA provides an end-to-end mechanism for delivery confirmation; the D bit is not used.

Support of X.21 Nonswitched Adapter

X.25 NPSI allows you to communicate over an X.25 network using the X.21 non-switched adapter.

Optional Facilities

CCITT defines optional user facilities. If GATE or DATE is used, X.25 NPSI allows all facilities to be supported by the CTCP. If GATE or DATE is not used, X.25 NPSI supports the following facilities.

Flow Control Parameter Negotiation

This facility permits negotiation on a per-call basis of the flow control parameters. The flow control parameters are the packet and window sizes for each direction of data transmission. If the packet or window sizes are not specified in the Call Request packet, the DCE assumes the default sizes. If the packet and window sizes requested by the DCE are the same in both directions, X.25 NPSI always accepts and uses these sizes.

Modulo 8 and Modulo 128 Packet Sequence Numbering

Modulo 128 support provides modulo 128 packet sequence numbering on all the virtual circuits of a given DTE/DCE interface. In the absence of this facility, modulo 8 sequence numbering is performed.

Nonstandard Default Packet Sizes

This facility provides for the selection of default packet sizes from the list of packet sizes supported by the X.25 PSDN. In the absence of this facility, the default packet size is 128 bytes.

Nonstandard Default Packet Window Sizes

This facility provides for the selection of default window sizes from the list of window sizes supported by the X.25 PSDN. In the absence of this facility, the default window size is 2.

One-way Logical Channel

This facility restricts logical channel use to either incoming or outgoing calls. However, one-way logical channels retain their duplex nature during data transfer.

Other Facilities

X.25 NPSI supports other X.25 optional user facilities, such as reverse charging and closed user group, in the following ways:

- Facilities can be specified in the outgoing Call Request packet.
- Facilities are always accepted in the Incoming Call and the Call Connected packets.

A complete list of the X.25 optional user facilities and a description of the corresponding X.25 NPSI support are presented in *X.25 NPSI Planning and Installation.*

X.25 NPSI Version 3 Release 1 Enhancements

X.25 NPSI V3R1 includes all the X.25 NPSI V1R4.3 functions, but also contains further enhancements described in the following sections.

3745 Support

X.25 NPSI V3R1 can run on the IBM 3745 communication controller, as well as on the IBM 3720 communication controller. The 3745 communication controller allows X.25 NPSI to use additional line addresses.

Port Swapping

X.25 NPSI allows the physical circuit to be swapped to a controller port reserved for that support.

Common NCP/X.25 NPSI Generation

X.25 NPSI and NCP generation are now integrated. You can define the X.25 NPSI/NCP network in the same input stream and generate it simultaneously in a single job step under the NCP/EP definition facility (NDF).

Performance Improvement

The path length for packet transmission has been significantly reduced. At the same CCU utilization, this enhancement to X.25 NPSI V3 increases throughput in packets per second by approximately 40 percent over V1R4.3. However, your actual improvement will vary depending on your particular hardware and software configuration.

This improvement applies to communication with SNA peripheral nodes, non-SNA X.25 DTEs, and subarea-to-subarea communication.

Fast Connect

Fast connect[2] provides a quick way of establishing connections for non-SNA X.25 terminals communicating over SVCs using the GATE function. Because fast connect is based on the GATE function, it requires the use of a CTCP.

Fast connect preestablishes SNA sessions between the CTCP LU and the simulated X.25 NPSI LUs. These sessions are permanently established to allow processing to continue, despite virtual circuit CLEAR commands. Therefore, you do not have to reestablish the SNA session for each call request.

You can choose fast connect for individual X.25 physical circuits. When chosen, the entire physical circuit is dedicated to fast connect. Up to 28 CTCPs can communicate with the virtual circuits of a given physical circuit. A CTCP is selected according to the first byte of the CALL USER DATA (CUD) field or the last subaddressing digit.

The SNA lines used to map the virtual circuits appear as nonswitched lines to the NCP and the host access method. For a given X.25 physical circuit, the total number of nonswitched lines declared to the NCP and to the access method can exceed the defined number of switched virtual circuits. This allows a given CTCP to absorb peak traffic if the usage of other CTCPs on the shared physical circuit is low. Conversely, virtual circuits of different physical circuits can connect to the same CTCP to achieve the same end.

Improved Availability

In X.25 NPSI V3R1, a switched virtual circuit is no longer tied to a specific SNA resource; instead, the association is done during call setup.

The dynamic relationship between the switched virtual circuits and the SNA resources allows X.25 NPSI to bypass unusable SNA resources.

This dynamic relationship allows X.25 NPSI to bypass an unusable SNA resource. However, this relationship makes it more difficult to relate a virtual circuit number to a specific SNA resource name.

To assist in problem diagnosis, X.25 NPSI sends the virtual circuit number and the SNA resource address to the NetView™ program.[3] The NetView program displays this information when a problem occurs.

Virtual Circuit Trace

The NCP can perform a line trace on a specific physical circuit that includes one or more virtual circuits. The SSP V3R3 Trace Analysis Program (TAP) formats, interprets, and prints the trace for X.25 NPSI V3R1 virtual circuits. (This formatting is not performed for X.25 NPSI V1 virtual circuits.) For enhanced problem determination, the traffic for each virtual circuit can be printed separately, even if you select several virtual circuits. If you request a trace for all the virtual circuits of a physical circuit, the data will be interleaved but still formatted and interpreted.

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2 The Fast Connect PRPQ (ZD9700), formerly available only in certain countries, is integrated as a part of X.25 NPSI. The interface between the fast connect function of X.25 NPSI and the CTCP is changed slightly from the interface of the Fast Connect PRPQ. See *X.25 NPSI Host Programming* for more information.

3 NetView is a trademark of IBM Corporation.

Miscellaneous Enhancements

The following miscellaneous enhancements are available in X.25 NPSI V3R1.

CTCP/LLC Selection

This enhancement allows you to create a correspondence table enabling X.25 NPSI to select a logical link control (LLC) or GATE CTCP as a function of any value of the first byte of the CUD field. The correspondence table is used for both incoming and outgoing calls. If the correspondence table is not used, X.25 NPSI V3R1 selects the logical link control and the CTCP, as it did in previous releases.

DATE Message to Unbound LU

This function allows you to send a message on the CTCP LU to MCH LU session. It is similar to the SNA unformatted system services (USS) message 10 facility, because it allows a message to be sent to the remote terminal while the SSCP activates the application LU to virtual circuit LU session. For example, the DATE message can notify the remote terminal that the connection is proceeding. This is advantageous during peak hours when session setup can take an extended period of time.

Multiple GATE CTCPs

This X.25 NPSI enhancement allows up to 28 GATE CTCPs to be in session with one physical circuit. This significant increase allows 26 more CTCPs for each physical circuit than in X.25 NPSI V1R4.3.

Optional Inbound Queuing

This function allows X.25 NPSI to queue inbound data coming from non-SNA X.25 DTEs until the LU-LU session is established between the application program and the virtual circuit. X.25 NPSI's ability to queue inbound data prevents the inbound data from being erroneously interpreted as a logon request.

PAD Selection

Versions of X.25 NPSI before V3R1 allowed a type 5 virtual circuit for PAD to be selected for an incoming call that contained X'01', X'41', and X'81' in the first byte of the CUD field. However, X.25 NPSI V3R1 allows a type 5 virtual circuit for PAD to be selected for an incoming call that contains X'51' in the first byte of the CUD field. Conversely, X.25 NPSI V3R1 puts X'51' in the first byte of the outgoing CUD field if requested in the DIALNO parameter of the switched major node.

Password Protection

Use of X.25 NPSI's X.3 integrated PAD support allows you to specify that commands to control the ECHO function of the PAD should be sent to the PAD whenever the outgoing data stream contains SNA inhibit presentation (INP), or enable presentation (ENP), characters. Password protection can be used to prevent the display of some data, such as passwords. For example, if you use a typewriter-like communication terminal, an area of the terminal's print line is darkened by overstrikes when X.25 NPSI detects the INP character in the data stream. Data typed thereafter (for example, a password) cannot be read.

TSO users require VTAM V3R2 to use this X.25 NPSI function. The VTAM V3R2 DCODE parameter allows the INP and ENP characters to be present, where appropriate, in the data stream.

Remote PU Type 4 Activation

The 3720 and 3745 communication controllers allow the NCP/X.25 NPSI load module to be loaded from the controller's disk. In X.25 NPSI V3R1, the X25.MNLNK function allows the MCH to be activated remotely. Remote activation allows the remote NCP to be activated over a subarea link PVC. This activation does not require an SDLC connection.

SHUTD Processing

You can optionally specify that when the X.25 NPSI LU simulator receives a shutdown data flow control (SHUTD) request unit from the host LU, the LU simulator should not send an invitation to clear on the virtual circuit to the PAD. Some host application programs send a shutdown request in conjunction with a VTAM CLSDST OPTCD=PASS command. If this option is specified, X.25 NPSI does not cause the virtual circuit to be cleared upon receipt of a shutdown request.

X.25 NPSI Version 3 Release 2 Enhancements

X.25 NPSI V3R2 includes all the functions listed under "X.25 NPSI Version 3 Release 1 Enhancements" on page 37, but also contains further enhancements described in the following sections.

SNA Type 2.1 Node Support

X.25 NPSI V3R2, in conjunction with VTAM V3R2, allows SNA type 2.1 peripheral nodes to communicate through a PSDN. Two peer systems can communicate using the SNA backbone network, without requiring the participation of a host application program for relay purposes. X.25 NPSI V3R2 also provides SNA LU 6.2 multiple-session support for the LUs residing on the SNA type 2.1 node.

Enhanced Availability during Loss of SSCP Ownership

This function ensures the continuation of active cross-domain LU-LU sessions for SNA and non-SNA devices after the owning SSCP is lost. X.25 NPSI allows a permanent or switched virtual circuit to remain active as long as the session partners can still be reached. In other words, enhanced availability during loss of SSCP ownership allows another SSCP to establish ownership during the disruption period. Upon reactivation, the original SSCP can reestablish ownership.

Switched Virtual Circuit Subarea Communication

Switched virtual circuit subarea communication (SVCSC) allows two subarea nodes to be connected by an SVC. This connection is used primarily for the following circumstances:

- Connecting two subarea nodes in different PSDNs

  When the PSDNs support only SVC interconnection, you can connect two subarea nodes in different PSDNs.

- Adding transfer capacity

  You can add additional capacity to subarea node connections. Though the X.25 NPSI link cannot be part of a multilink transmission group, you can use it to increase the number of available links needed for transferring information between subarea nodes. This is possible when new applications are started.

- Connecting to a subarea node

  You can connect to another subarea node dynamically by way of an SVC through a PSDN.

SVCSC allows X.25 NPSI V3R2 to communicate with either another communication controller running X.25 NPSI V3R2 (or V2R1) or a host computer with the X.25 ICA[4] running VTAM V3R2 (with V3R2 Enhancements). In addition, this function is fully compatible with SNI, allowing these remote subarea nodes to be in different SNA networks.

Both the access method and the NCP are aware that an SVC is being used. All connection parameters, such as dial number, VCCPT index, and OUFT index are defined to the access method. A VTAM operator or an automated operator facility, such as a NetView program CLIST, must initiate the dial connection.

SVCSC does not require a dedicated multichannel link (MCH). Switched peripheral links and switched subarea links can coexist on the same MCH. You cannot activate the remote NCP over a switched subarea link virtual circuit using X.25 NPSI V3R2.

Switched Virtual Circuit Short Hold Mode

X.25 NPSI's SVCSC provides an optional function known as short hold mode (SHM). This function applies only when X.25 NPSI communicates with another X.25 NPSI.

SHM allows for a virtual connection to be cleared if traffic does not occur for a user-defined amount of time. X.25 NPSI does not report this clearing to the NCP or the access method, enabling the cross-domain sessions and the cross-domain manager to remain active. When traffic resumes from either side, X.25 NPSI automatically reestablishes the connection. This function can provide a significant saving in network fees, especially if you use international connections.

Miscellaneous Enhancements

The following miscellaneous enhancements are available in X.25 NPSI V3R2.

Line Speeds up to 128 000 BPS

X.25 NPSI V3R2 allows IBM communication controllers to be attached to data transmission services, supporting interfaces complying with CCITT Recommendation X.25[5], at line speeds up to 128 000 bits per second.

Retry of Clear, Reset, and Restart Requests

The releases of X.25 NPSI before V3R2, do not retry the Clear, Reset, or Restart requests when the corresponding timer expires. X.25 NPSI V3R2 retries these requests one or more times, as specified by you during X.25 NPSI generation. X.25 NPSI V3R2 also allows you to define a timer value other than the interval specified by the CCITT Recommendation.

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4 For example, an IBM 4361 with a Communication Adapter or an IBM ES/9370™ with a Telecommunication Subsystem Controller (TSC).

5 Geneva 1980 and Malaga-Torremolinos 1984.

Choice of Diagnostic Codes

X.25 NPSI V3R2 allows you to specify that either CCITT (1984)-specified or IBM-specified diagnostic codes be inserted in Clear, Reset, and Restart packets. See *X.25 NPSI Diagnosis, Customization, and Tuning* for further information.

Ability to Reject Incoming Calls that Specify Certain Optional Facilities

X.25 NPSI V3R2 allows you to reject incoming call packets that specify certain optional facilities. This function can be used, for example, to prevent X.25 NPSI from accepting calls that specify reverse charging, fast select, or call redirection. You can specify up to nine optional facilities to be rejected. However, you cannot reject negotiation of packet and window sizes and the use of high-priority class of service.

Choice of Clearing or Not Clearing SVC after Reset

The releases of X.25 NPSI before V3R2 always clear an SVC upon receipt of a Reset Indication packet. X.25 NPSI V3R2 allows you to specify whether the SVC is to be maintained or cleared after receipt of a Reset Indication packet.

Improved Resource Naming

Additional optional keywords have been added to the X25.VC and X25.FCG definition statements to allow greater flexibility and ease in naming resources.

Virtual Circuit Trace

When a line trace was requested before X.25 NPSI V3R2, all physical circuits were traced. X.25 NPSI V3R2 provides you with the option to perform a line trace on specified physical circuits. Because a trace can be performed for individual physical circuits, processing time is shortened and performance can be increased.

X.25 NPSI Version 3 Release 3 Enhancements

X.25 NPSI V3R3 includes all the functions listed under "X.25 NPSI Version 3 Release 2 Enhancements" on page 40, but also contains further enhancements described in the following sections.

Enhanced Multichannel Link Compatibility

Table 2 shows the enhanced compatibility of GATE, DATE, integrated PAD, transparent PAD, and PCNE on the same multichannel link for X.25 NPSI V3R3. X.25 NPSI V3R3 allows both integrated PAD and DATE to coexist on the same multichannel link.

Table 2. Enhanced Multichannel Link Compatibility

	GATE	DATE	Integrated PAD Support	Transparent PAD Support	PCNE
GATE	N/A	No	Yes	Yes	Yes
DATE	No	N/A	Yes	Yes	Yes
Integrated PAD Support	Yes	Yes	N/A	No	Yes
Transparent PAD Support	Yes	Yes	No	N/A	Yes
PCNE	Yes	Yes	Yes	Yes	N/A

Ability to Establish Link Session Priority

X.25 NPSI V3R3 provides the ability to use the NEO USER LINK SESSION PRIORITY of NCP. This ability provides you with a method to obtain more consistent turn-around time for interactive sessions on peripheral links. Priority is given to the transmission order of the LUs on the link.

Enhanced SNA Type 2.1 Boundary Function Support (Casual Connection)

The enhanced SNA type 2.1 boundary function support provided by the NCP, in conjunction with VTAM V3R2, extends the boundary node support by allowing primary SNA type 2.1 peripheral nodes to be attached to an NCP that is acting as a secondary partner. This support, which allows subarea nodes to connect to SNA type 2.1 nodes, is referred to as casual connection. Casual connection allows VTAM and one or two NCPs to be connected to an SNA type 2.1 node.

The enhanced SNA type 2.1 support provided in X.25 NPSI V3R3 similarly extends the NCP's X.25 boundary node support, by allowing a primary SNA type 2.1 peripheral node to be attached to an NCP through an X.25 NPSI that is acting as a secondary partner.

Note: This support is available on MVS and VM only.

RU Chaining Support for Long Non-SNA Messages

X.25 NPSI V3R3 provides optional support for request/response unit (RU) chaining on inbound and outbound flows for non-SNA devices.

On inbound flows, X.25 NPSI can divide long messages from non-SNA DTEs into RU chains. On outbound flows, X.25 NPSI can send RU chains to non-SNA X.25 DTEs using chained packets.

Improved Connection Capabilities

X.25 NPSI uses the IDNUM and IDBLK keywords for call-in and call-out definition.

The structure of the IDNUM and IDBLK keywords is improved for X.25 NPSI V3R3, and provides you with the ability to:

- Have a maximum of 32 768 SVCs connected to one X.25 NPSI
- Have more than 16 NCPs/X.25 NPSIs defined under one host
- Have both PAD and GATE SVCs existing concurrently on the same MCH
- Add additional MCHs and SVCs by allowing you to define the IDNUM and IDBLK keywords at system generation
- Support the NCP anonymous caller function.

Enhanced PAD Support

The enhancements to X.25 NPSI V3R3 PAD support provide you with the ability to:

- Choose from an increased number of translate table options during X.25 NPSI generation.
- Define PAD parameter settings for each individual MCH during X.25 NPSI generation.

Improved Conformance to International Organization for Standardization 7776 and 8208

X.25 NPSI V3R3 has implemented changes to improve conformance to International Organization for Standardization (ISO) 7776 and ISO 8208 for DTE-to-DTE communication. DTE-to-DTE communication is defined as one X.25 DTE communicating with another X.25 DTE without the use of an X.25 network. In this environment, one of the DTEs must perform the functions of both a DTE and DCE.

ISO 7776 and 8208 are standards that are related to the operation with X.25 protocol at the frame and packet level, respectively. X.25 NPSI must meet the mandatory requirements of the two standards to operate in the DTE-to-DTE environment. These standards define how the DTE operates when it acts as a DTE or DCE. X.25 NPSI satisfies some of the requirements of the two standards by having its role as a DTE or DCE predefined through system generation options.

One of the more important benefits of this added support is the reduced potential for call collisions during DTE-to-DTE virtual circuit establishment.

X.21 Switched Connections Support for DTE-to-DTE Communication across ISDN

X.25 NPSI V3R3 provides support for X.21 switched connections for DTE-to-DTE communication across an integrated services digital network (ISDN). Cross-domain networking facilities are not supported. The X.21 switched support has the following characteristics:

- Existence with GATE only.
- Must have a dedicated MCH.
- One CTCP for each MCH.
- A maximum of 15 digits is reserved for X.21 dialing.
- LAPB and PLP parameters are predefined; no DTE/DCE negotiation occurs.
- MCH is predefined as a DCE or DTE.
- X.21 Incoming Call packets are only accepted when the CTCP is in session with X.25 NPSI.
- X.21 calling/called line identification is not supported.
- X.21 Short_Hold_Mode/Multiple_Port_Sharing is not supported.

Figure 16 on page 45 illustrates an X.21 switched connection using an IBM 7820 terminal adapter.

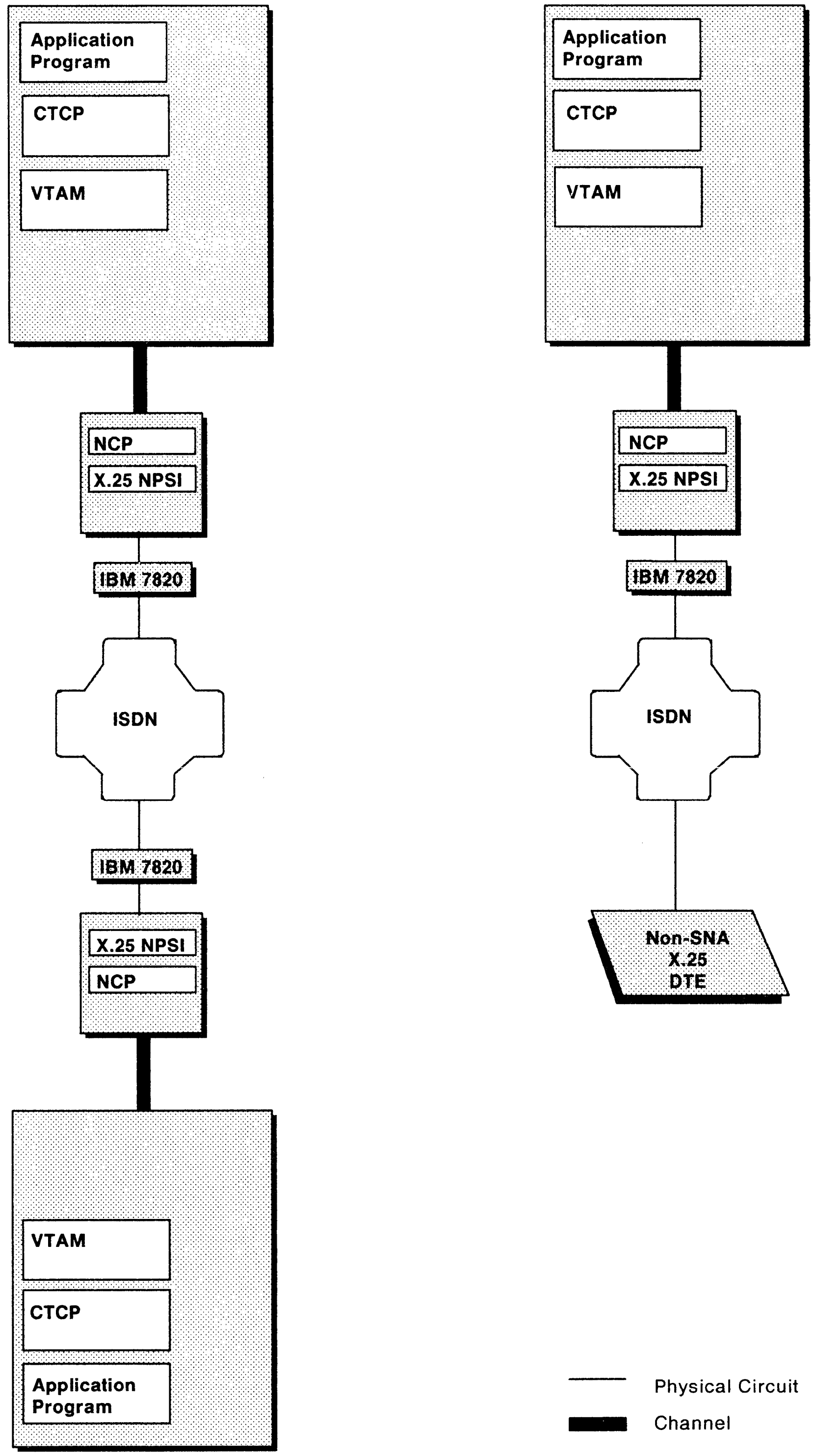

Figure 16. SNA Host to ISDN (X.21 Switched Connection)

Enhanced Capability to Activate/Load/Dump Remote NCPs

In conjunction with VTAM V3R3 and NCP V5R3, X.25 NPSI V3R3 provides enhanced support for remote IBM 3720 or 3745 communication controllers attached to X.25 virtual circuits.

X.25 NPSI V3R3 supports activation of a remote communication controller across an SVC. Previous releases of X.25 NPSI supported activation across PVCs only. You must initially load the remote communication controller using an existing method.

Once the remote communication controller has been activated, you can use an SVC or PVC to transmit a load module from the host to the CCU of the communication controller or the disk of an IBM 3720 or 3745 communication controller.

An additional enhancement for remote IBM 3720 or 3745 communication controllers is the capability for the host to initiate a dump to disk using a host-initiated forced abend in conjunction with VTAM V3R3. The abend will cause a dump to disk and will re-IPL the load module. Once the remote IBM 3720 or 3745 communication controller has been activated, a PVC or SVC can transmit the dump from disk to host.

Note: This support is available on MVS and VM only.

Miscellaneous Enhancements

X.25 NPSI V3R3 contains the following miscellaneous enhancements.

Ability to Clear an SVC Based on Inactivity Time-Out

If an SVC has had no data activity for a user-specified period of time, X.25 NPSI V3R3 is able to clear that SVC. This prevents you from being charged for an unused SVC.

Ability to Use Billing Units as Statistics

X.25 NPSI V3R3 gives you the option of having statistic record formatted maintenance statistics (RECFMS) report the number of billing units, rather than the number of packets, sent across a PSDN.

This enhancement allows you to compare X.25 NPSI statistics to the subscription costs of the PSDN.

Improved Inbound Flow Control

When host applications, such as IMS and CICS, do not accept large numbers of RUs from non-SNA DTEs at the same rate as the NCP sends them, the NCP can enter a slowdown state.

A flow control mechanism has been developed that allows X.25 NPSI V3R3 to stop accepting packets when a specified number has been received. This mechanism helps prevent the NCP from entering the slowdown state.

Improved Flow Control Negotiation in GATE and DATE

For GATE and DATE, X.25 NPSI has been enhanced to recognize the flow control parameters contained within the Call Connected packets.

Improved Integrated PAD Support with DATE

A new generation option has been added to X.25 NPSI V3R3 that allows the support of integrated PAD with DATE. Table 2 on page 42 illustrates this option. This support allows you to specify that interrupt packets, reset packets, and qualified (indication of break) packets that are received from the PSDN are no longer sent to the DATE CTCP. These packets are converted into SIGNAL commands, which are sent to the host application.

Improved Reset Processing

This enhancement allows X.25 NPSI to selectively cause the physical unit to become inoperative (INOP) when a reset packet is sent or received for the virtual circuit that is associated with the physical unit. The INOP processing is based on the cause and diagnostic codes contained in the Reset Indication packet.

You can unconditionally or selectively suppress the INOP processing.

Chapter 3. Planning for X.25 NPSI

Chapter 3. Planning for X.25 NPSI

Before you install the X.25 NPSI licensed program, you need to know the hardware, software, and storage requirements. This chapter describes these requirements, as well as performance and migration considerations.

Hardware Supported

X.25 NPSI supports the following data terminal equipment and communication controllers.

Data Terminal Equipment

X.25 NPSI supports the following SNA and non-SNA DTEs:

- SNA host nodes connected to X.25 networks through a communication controller or through an integrated communication adapter supporting X.25 subarea-to-subarea connections
- SNA peripheral nodes with integrated X.25 support connected to X.25 networks
- SNA peripheral nodes connected to X.25 networks through an SDLC PAD
- SNA peripheral nodes connected to X.25 networks through the IBM 5973-L02 Network Interface Adapter (NIA)
- Non-SNA X.25 DTEs connected directly to the X.25 network
- X.28 start-stop DTEs connected to X.25 networks through a PAD
- Non-X.28 network PADs connected by transparent PAD, GATE, or DATE.

Communication Controllers

X.25 NPSI V3R1, R2, and R3 run on the IBM 3720 or IBM 3745 communication controller.

Each release of X.25 NPSI supports V.24 or RS-232-C (X.21bis) or V.35 adapters. X.25 NPSI V3R1 and R2 support the X.21 nonswitched adapter. X.25 NPSI V3R3 also supports the X.21 switched adapter.

You must use one of the following connections:

- Line interface coupler type 1 (V.24 or RS-232-C [X.21 bis])
- Line interface coupler type 2
- Line interface coupler type 3 (V.35)
- Line interface coupler type 4A
- Line interface coupler type 4B
- Line interface coupler type 5 (3745 has low-speed integrated modem)
- Line interface coupler type 6 (3745 has high-speed integrated modem).

Line interface coupler type 2, line interface coupler type 3 (V.35), and line interface coupler type 4B (X.21) can operate at speeds of up to 64K bits per second with X.25 NPSI V3R1, and up to 128K bits per second with X.25 NPSI V3R2 and R3.

The following books contain more information on communication scanner type and line set specifications:

- *3720/3721 Communication Controllers Introduction*
- *IBM 3745 Communication Controller Introduction.*

Software Supported

This section describes the software and network environments that support X.25 NPSI along with the operating systems, network control and system support programs, VTAM application programs, and IBM host-resident programs.

Operating Systems

X.25 NPSI runs under the control of the NCP with these operating systems:

- VSE/AF, VSE/SP
- MVS/XA, MVS/SP, MVS/ESA
- VM/XA, VM/SP.

Network Control Program and System Support Program

X.25 NPSI V3R1 works with:

- NCP V5R1
- SSP V3R3.

X.25 NPSI V3R2 works with:

- NCP V5R2
- SSP V3R4.

or

- NCP V5R2.1
- SSP V3R4.1.

X.25 NPSI V3R3 works with:

- NCP V5R3
- SSP V3R5.

Access Methods

X.25 NPSI runs with the same access methods as the corequisite NCP versions and releases. See *Network Program Products Planning* to determine the VTAM and X.25 NPSI versions and releases that run under the NCP.

Application Licensed Programs

The following IBM licensed programs, which support SNA/SDLC communication, can use X.25 NPSI without modification:

- Customer Information Control System/Virtual Storage (CICS/VS)
- Information Management System/Virtual Storage (IMS/VS)
- Time Sharing Option (TSO)
- NetView™ program.[6]

These programs, used in conjunction with the IBM 5973-LO2 Network Interface Adapter or with integrated X.25 features, can provide SNA support for specified cluster controllers and terminals using X.25 PSDNs.

IBM Cryptographic Subsystem and Access Method Support

X.25 NPSI is compatible with the following IBM cryptographic subsystem and access method programs:

- Programmed cryptographic facility licensed program (5740-XY5).
- Cryptographic unit support licensed program (5740-XY6).
- VTAM Version 3 for MVS/SP (5665-313).
- VTAM Version 3 for MVS/XA (5665-289). In a VM/SP environment, X.25 NPSI uses the security features of VM/SP.

Note: IBM line bracketing cryptographic licensed programs (IBM 3845 and IBM 3846 data encryption devices) cannot be used with X.25 NPSI.

Installation Requirements

You must consider the following items when installing the X.25 NPSI licensed program:

- X.25 NPSI source statements
- NCP/EP definition facility (NDF) generation
- Access method.

X.25 NPSI Source Statements

You must code a set of X.25 NPSI source statements to define the X.25 NPSI module for your particular network configuration. Determine which type of X.25 PSDN you are communicating with and define the communicating devices and their links. Instructions for coding these statements can be found in *X.25 NPSI Planning and Installation*.

NDF Generation

The X.25 NPSI source statements are combined with the NCP source statements. This common generation source input is then processed by NDF. NDF creates the NCP load module containing the NCP and X.25 NPSI.

6 NetView is a trademark of IBM Corporation.

Access Method

When the NDF creates access method statements, the statements are placed into the access method source library. The access method uses these statements to communicate with the network resources and to determine the resource network addresses.

X.25 NPSI Version 3 and Systems Application Architecture

X.25 NPSI is part of the IBM Systems Application Architecture™[7] (SAA), because it supports the CCITT Recommendation X.25, which is a part of the common communication support.

SAA is a collection of selected software interfaces, conventions, and protocols, and is the framework for the development of future communication applications in the major IBM computing environments—System/370, Application System/400™[8], and personal computer. SAA consists of four related elements: common user access, common programming interface, common communication support, and common applications.

IBM uses common communication support to interconnect SAA application systems, communication networks, and devices. This is achieved by consistent implementation of designated communication architectures in each of the SAA environments. X.25 NPSI provides System/370 processors with an interface to X.25 environments, which is a part of the common communication support element of an IBM SAA.

Storage and Performance

The functions provided by X.25 NPSI increase the NCP storage requirements. Actual performance levels vary depending upon your particular hardware and software configuration. To evaluate performance capability, you can use IBM tools, such as the IBM 3745 configurator (CF3745).

Storage Estimates

Add the following numbers to your NCP storage requirements:

- X.25 NPSI V3R1 requires 50K to 120K bytes for the executable program, plus approximately 1.2K bytes for each virtual circuit and 2K bytes for each physical circuit.
- X.25 NPSI V3R2 requires 60K to 140K bytes for the executable program, plus approximately 1.2K bytes for each virtual circuit and 2K bytes for each physical circuit.
- X.25 NPSI V3R3 requires 70K to 140K bytes for the executable program, plus approximately 1.2K bytes for each virtual circuit and 2K bytes for each physical circuit.

[7] Systems Application Architecture is a trademark of IBM Corporation.

[8] Application System/400 is a trademark of IBM Corporation.

Performance Considerations

To best demonstrate performance considerations for X.25 NPSI in various communication environments, case scenarios are presented for the following connection examples:

- Connection between SNA host nodes
- Connection between an SNA host and an SNA peripheral node
- Connection between an SNA host and a non-SNA X.25 DTE.

Connection between SNA Host Nodes

Definition

The additional cycles referred to below are defined as:

- The processor cycles from the point where the NCP passes the PIU to X.25 NPSI, until the point where X.25 NPSI:
  - Splits the PIU into packets
  - Sends these packets to the network
  - Receives the required acknowledgments.
- The processor cycles from the point where X.25 NPSI receives the first frame related to a PIU until the point where X.25 NPSI:
  - Assembles all the packets constituting this PIU
  - Makes all the required acknowledgments
  - Passes the PIU to the NCP.

Assumption

The PIU to be transmitted or received is contained in a single packet. Consequently, the maximum RU size must be:

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

Note: A 29-byte difference exists between the packet size and the RU size. The 29 bytes are used by the format identifier (FID4), which contains 26 bytes in the transmission header (TH) and 3 bytes in the request/response header (RH).

Consideration

For a transmitted PIU, additional cycles are needed to:

- Build a packet containing the PIU
- Receive a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

For a received PIU, additional cycles are needed to:

- Receive a packet containing the PIU
- Send a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

Note: Rather than sending a separate Receive Ready frame, X.25 NPSI can piggyback this acknowledgment on the next information frame. Similarly, rather than sending a separate Receive Ready packet, X.25 NPSI can piggyback this acknowledgment on the next data packet. X.25 NPSI's ability to use piggybacking saves processor cycles.

Connection between an SNA Host and an SNA Peripheral Node

Definition — The additional cycles referred to below are defined as:

- The processor cycles from the point where the NCP passes the PIU or segment to X.25 NPSI, until the point where X.25 NPSI:
  - Splits the PIU or segment into packets
  - Sends these packets to the network
  - Receives the required acknowledgments.
- The processor cycles from the point where X.25 NPSI receives the first frame related to a PIU until the point where X.25 NPSI:
  - Assembles all the packets constituting this PIU
  - Makes all the required acknowledgments
  - Passes the PIU to the NCP.

First case

Assumption — The PIU to be transmitted or received (including the TH, RH, and RU) does not exceed the packet size, and the LLC3 communicates with the remote SNA peripheral node.

Consideration — For a transmitted PIU, additional cycles are needed to:

- Build a packet containing the PIU
- Receive a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

For a received PIU, additional cycles are needed to:

- Receive a packet containing the PIU
- Send a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

Second case

Assumption — The PIU to be transmitted or received includes an RU of 256 bytes. The maximum packet size is 128 bytes. Consequently, the PIU is converted to 3 packets.

Consideration — For a transmitted PIU, additional cycles are needed to:

- Build three packets containing the PIU
- Receive up to three Receive Ready packets
- Send up to three Receive Ready frames
- Receive up to three Receive Ready frames.

For a received PIU, additional cycles are needed to:

- Receive three packets containing the PIU
- Send up to three Receive Ready packets
- Send up to three Receive Ready frames
- Receive up to three Receive Ready frames.

Note: Rather than sending a separate Receive Ready frame, X.25 NPSI can piggyback this acknowledgment on the next information frame. Similarly, rather than sending a separate Receive Ready packet, X.25 NPSI can piggyback this acknowledgment on the next data packet. X.25 NPSI's ability to use piggybacking saves processor cycles.

Connection between an SNA Host and a Non-SNA X.25 DTE

Definition: The additional cycles referred to below are defined as:

- The processor cycles from the point where the NCP passes the PIU to X.25 NPSI, until the point where X.25 NPSI:
  - Splits the PIU into packets
  - Sends these packets to the network
  - Receives the required acknowledgments.
- The processor cycles from the point where X.25 NPSI receives the first frame related to a PIU until the point where X.25 NPSI:
  - Assembles all the packets constituting this PIU
  - Makes all the required acknowledgments
  - Passes the PIU to the NCP.

First case

Assumption: The RU size is equal to or less than the packet size.

Consideration: For a transmitted PIU, additional cycles are needed to:

- Build a packet containing the PIU
- Receive a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

For a received PIU, additional cycles are needed to:

- Receive a packet containing the PIU
- Send a Receive Ready packet
- Send a Receive Ready frame
- Receive a Receive Ready frame.

Second case

Assumption: The RU size is three times the packet size.

Consideration: For a transmitted PIU, additional cycles are needed to:

- Build three packets containing the PIU
- Receive up to three Receive Ready packets
- Send up to three Receive Ready frames
- Receive up to three Receive Ready frames.

For a received PIU, additional cycles are needed to:

- Receive three packets containing the PIU
- Send up to three Receive Ready packets
- Send up to three Receive Ready frames
- Receive up to three Receive Ready frames.

Note: Rather than sending a separate Receive Ready frame, X.25 NPSI can piggyback this acknowledgment on the next information frame. Similarly, rather than sending a separate Receive Ready packet, X.25 NPSI can piggyback this acknowledgment on the next data packet. X.25 NPSI's ability to use piggybacking saves processor cycles.

Evaluating Communication Control Unit Utilization

Another performance consideration concerns evaluating the communication control unit (CCU) utilization. To evaluate average CCU utilization for a given configuration, use the CF3720 configurator for the IBM 3720 and the CF3745 configurator for the IBM 3745.

For every packet sent, the results are based on the assumption that the following sequence occurred:

```
X.25 NPSI               Network

--------------------->  Packet OUT
<---------------------  RR Frame IN
<---------------------  RR Packet IN
--------------------->  RR Frame OUT
```

For every packet received, results depend upon the assumption that the following sequence occurred.

```
X.25 NPSI               Network

<---------------------  Packet IN
--------------------->  RR Frame OUT
--------------------->  RR Packet OUT
<---------------------  RR Frame IN
```

If a packet carries acknowledgments going in the opposite direction, fewer frames flow on the lines, and the CCU shows a lower average utilization. The average CCU utilization that is shown is the limit that will be reached if data packets do not carry acknowledgments.

Performance has been improved by optimizing the code and increasing the degree of piggybacking at the LAP and PLP levels. For example, if the LAP or PLP window size exceeds two, piggybacking allows X.25 NPSI to send fewer RR frames and packets to the network.

Migration to X.25 NPSI Version 3

The following sections describe the migration process from X.25 NPSI V1 to X.25 NPSI V3, and the migration process from X.25 NPSI V3R1 and R2 to X.25 NPSI V3R3.

Migration from X.25 NPSI Version 1 to Version 3

Users of X.25 NPSI V1 can migrate to X.25 NPSI V3.

Generation Change

To speed up and simplify the generation process, X.25 NPSI and NCP generation occur in a single job step under NDF. X.25 NPSI preprocessing is no longer required; however, you must make minor changes in the X.25 NPSI source statements.

The NCP OPTION statement enables X.25 NPSI statements to be prepared for VTAM. This is done by coding NEWDEFN=YES. This statement indicates to the NDF that it must build a new generation definition to be used for VTAM input.

VTAM requires that the "X25" portion of the X.25 NPSI statements be separated from the suffix through the use of a period. For example, the X25MCH macro becomes the X25.MCH statement.

Relationship between SVCs and SNA Resources

X.25 NPSI V3 has been restructured to allow the bypassing of a *hung* SNA resource and the support of SVC subarea communication (SVCSC), including short hold mode (SHM). In X.25 NPSI V3, when diagnosing a problem with a virtual circuit, use the NetView program's detail screen to determine the name of the virtual circuit corresponding to the SNA resource.

Migration from X.25 NPSI Version 3 Releases 1 and 2 to Version 3 Release 3

Users of X.25 NPSI V3R1 and R2 can migrate to X.25 NPSI V3R3. The following sections describe the necessary migration adjustments.

Improved Connection Capabilities

A new range of IDBLK keyword variables are assigned to X.25 NPSI V3R3. Consequently, all VTAM switched major nodes using IDBLK=X'003' must be changed so that the VTAM IDBLK definition corresponds to the X.25 NPSI user-defined IDBLK number.

In addition, the VTAM switched major node IDNUM statement definition, which interfaces with X.25 NPSI, must be redefined during generation so that the IDNUMH becomes the first digit of the IDNUM keyword.

Improved Processing for Long Non-SNA Messages

X.25 NPSI V3R3 provides optional support for RU chaining on inbound and outbound flows for non-SNA DTEs. Support of RU chaining is an option, which is specified by coding MBITCHN=YES during X.25 NPSI generation.

Improved Conformance to ISO 7776 and 8208

If your network does not support duplicate facilities, you must code NETTYPE=4 on the X25.NET statement during X.25 NPSI generation.

Glossary, Bibliography, and Index

Glossary

This glossary contains terms and abbreviations related to X.25, X.25 NPSI, SNA, and telecommunications. It includes information from:

- The *American National Dictionary of Information Processing Systems*, copyright 1982 by the Computer and Business Equipment Manufacturers Association (CBEMA). Copies can 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 — Information Processing*, developed by the International Organization for Standardization, Technical Committee 97, Subcommittee 1. Definitions from published sections of this vocabulary are identified by the symbol "(ISO)" following the definition. Definitions from draft international standards, draft proposals, and working papers in development by the ISO/TC97/SC1 vocabulary subcommittee are identified by the symbol "(TC97)," indicating that final agreement has not yet been reached among participating members.
- The *CCITT Eighth Plenary Assembly Red Book, Terms and Definitions*, and working documents published by the International Telegraph and Teiephone Consultative Committee of the International Telecommunication Union, Geneva, l985. These are identified by the symbol "(CCITT/ITU)" following the definition.

For abbreviations, the definition usually consists only of the words represented by the letters; for complete definitions, see the entries for the words.

A

ABM. Asynchronous balanced mode.

access barred. In data communication, a condition in which a data terminal equipment (DTE) cannot call the DTE identified by the selection signals

adapter control block (ACB). In NCP, a control block that contains line control information and the states of I/O operations for BSC lines, SS lines, or SDLC links

alert. (1) In SNA, a record sent to a system problem management focal poin to communicate the existence of an alert condition. (2) In the NetView program, a high priority event that warrants immediate attention. This data base record is generated for certain event types that are defined by user-constructed filters.

ASCII. American National Standard Code for Information Interchange.

asynchronous balanced mode (ABM). An operational mode of a balanced data link in which either combined station can send commands at any time and can initiate transmission of response frames without explicit permission from the other combined station. See also *normal response mode (NRM), asynchronous response mode (ARM).*

asynchronous response mode (ARM). An operational mode of an unbalanced data link in which a secondary station may initiate transmission without explicit permission from the primary station. See also *asynchronous balanced mode (ABM), normal response mode (NRM).*

B

balanced data link. In data communication, a data link between two participating combined stations; for transmissions it originates, each station can transmit both command frames and response frames, organize its data flow, and perform error recovery operations at the data link level. Contrast with *unbalanced data link*.

balanced station. Synonym for *combined station*.

begin bracket. In SNA, the value (binary 1) of the begin-bracket indicator in the request header (RH) of the first request in the first chain of a bracket; the value denotes the start of a bracket. Contrast with *end bracket*. See also *bracket*.

bidder. In SNA, the LU-LU half-session defined at session activation as having to request and receive permission from the other LU-LU half-session to begin a bracket. Contrast with *first speaker*. See also *bracket protocol*.

billing function. An optional function of X.25 NPSI GATE Fast Connect that provides the CTCP with billing information.

binary synchronous communication (BSC). (1) Communication using binary synchronous line discipline. (2) A uniform procedure, using a standardized set of control characters and control character sequences, for synchronous transmission of binary-coded data between stations.

boundary function. (1) A capability of a subarea node to provide protocol support for attached peripheral nodes, such as: (a) interconnecting subarea path control and perip. ɘral path control elements, (b) performing session sequence numbering for low-function peripheral nodes, and (c) providing session-level pacing support. (2) The component that provides these capabilities. See also *boundary node, intermediate routing function, subarea node.*

boundary node. (1) A subarea node with boundary function. See also *boundary function*. (2) The programming component that performs FID2 (format identification type 2) conversion, channel data link control, pacing, and channel or device error recovery procedures for a locally attached station. These functions are similar to those performed by a network control program for an NCP-attached station.

bracket. In SNA, one or more chains of request units (RUs) and their responses that are exchanged between the two LU-LU half-sessions and that represent a transaction between them. A bracket must be completed before another bracket can be started. Examples of brackets are data base inquiries/replies, update transactions, and remote job entry output sequences to work stations. See also *begin bracket, end bracket.*

bracket protocol. In SNA, a data flow control protocol in which exchanges between the two LU-LU half-sessions are achieved through the use of brackets, with one LU designated at session activation as the first speaker and the other as the bidder. The bracket protocol involves bracket initiation and termination rules. See also *bidder, first speaker.*

BSC. Binary synchronous communication.

C

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

call accepted packet. 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. (CCITT/ITU)

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

call collision. A condition that occurs when a data terminal equipment (DTE) transmits a call request signal and a data circuit-terminating equipment (DCE) simultaneously transmits an incoming call signal; neither the DTE nor the DCE receives the expected response. See also *clear collision, reset collision.*

call connected packet. 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. (CCITT/ITU)

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

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

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

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

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

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

call request signal. 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. (CCITT/ITU)

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

CCITT. International Telegraph and Telephone Consultative Committee.

CCU. Central control unit.

central control unit (CCU). The communication controller hardware unit that contains the circuits and data flow paths needed to execute instructions and to control controller storage and the attached adapters.

chaining. (1) A method of storing records in which each record belongs to a list or group of records and has a linking field for tracing the chain. (2) In VSE, a logical connection of sublibraries to be searched by the system for members of the same type, for example, phase or object modules.

channel. See *data communication channel.*

CICS. Customer Information Control System.

circuit. See *data circuit.*

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

circuit switching. 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. * (ISO) Synonymous with *line switching*. See also *message switching, packet switching*.

class of service (COS). In SNA, a designation of the path control network characteristics, such as path security, transmission priority, and bandwidth, that apply to a particular session. The end user designates class of service at session initiation by using a symbolic name that is mapped into a list of virtual routes, any one of which can be selected for the session to provide the requested level of service. See also *user class of service*.

clear collision. A condition that occurs when a data terminal equipment (DTE) and a data circuit-terminating equipment (DCE) simultaneously transmit a clear request packet and a clear indication packet over the same logical channel. See also *call collision, reset collision*.

clear indication packet. 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. (CCITT/ITU)

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

closed user group. 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. (TC97) A data terminal equipment (DTE) can belong to more than one closed user group.

closed user group with outgoing access. A closed user group that has a user assigned 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. (CCITT/ITU)

combined station. (1) In high-level data link control (HDLC), the part of a dat station that supports the combined control functions of the data link, generates commands and responses for transmission, and interprets received commands and responses. (ISO)

Note: Specific responsibilities assigned to a combined station include initialization of control signal interchange, organization of data flow, interpretation of received commands, and generation of appropriate responses and actions regarding error control and error recovery functions at the data link level. (2) A data station that generates commands and responses for transmission over a data link and interprets received commands and responses. (3) Synonymous with *balanced station*. See also *primary station, secondary station*.

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. (TC97)

communication and transmission control program (CTCP). A user-written or IBM-supplied program used in conjunction with the DATE or GATE function of X.25 NPSI to manage virtual circuits. It executes in the host processor. See also DATE CTCP, *fast connect* GATE CTCP, GATE CTCP.

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, public network*.

communication line. Deprecated term for *telecommunication line*.

contention mode. In data communication, a mode of transmission in which any station may transmit whenever the line is available. If stations transmit simultaneously, protocols determine who wins the contention.

cryptographic. Pertaining to transformation of data to conceal meaning.

CSDN. Circuit-switched data network.

CTCP. Communication and transmission control program.

CUD. Call user data field.

CUG. Closed user group.

Customer Information Control System (CICS). An IBM licensed program that enables transactions entered at remote terminals to be processed concurrently by user-written application programs. It also includes facilities for building, using, and maintaining data bases.

CV. Control vector.

CWALL. An NCP threshold of buffer availability, below which the NCP will accept only high-priority path information units (PIUs).

D

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

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

Notes:

1. 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.
2. 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). 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. (TC97) The DCE may be separate equipment or an integral part of other equipment.

data communication channel. (1) A means of one-way transmission. * (ISO) (2) Contrast with *data channel*. A channel may be provided by frequency- or time-division multiplexing. In CCITT terminology, a channel (data communication channel) provides one-way (simplex) transmission; data circuits and "logical channels" provide two-way (duplex) transmission. In data processing terminology, a channel (an I/O channel or data channel), provides two-way transfers of data. This distinction must be kept in mind when documenting the interface.

datagram. 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. (CCITT/ITU)

data link. (1) The assembly of parts of two data terminal equipments that are controlled by a link protocol, and the interconnecting data circuit, that enable data to be transferred from a data source to a data sink. (ISO) (2) The interconnecting data circuit and the link protocol between two or more equipments; it does not include the data source or the data sink. (3) In SNA, synonym for *link*. (4) Contrast with *telecommunication line*.

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*. (TC97)

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

data station. The data terminal equipment (DTE), the data circuit-terminating equipment (DCE), and any intermediate equipment. * (ISO) Synonymous with *data terminal installation*.

data switching exchange (DSE). The equipment installed at a single location to provide switching functions, such as circuit switching, message switching, and packet switching. (ISO)

data terminal equipment (DTE). 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. (TC97)

data terminal installation. Synonym for *data station*.

data transfer. The movement, or copying, of data from one location and the storage of the data at another location.

data transfer phase. The phase of a data call during which data signals can be transferred between data terminal equipments (DTEs) connected through the network. See also *network control phase*.

data transfer rate. The average number of bits, characters, or blocks per unit time passing between corresponding equipment in a data transmission system.

data transmission line. Synonym for *telecommunication line*.

DATE. Dedicated access to X.25 transport extension.

DATE CTCP. A CTCP that is used in conjunction with the DATE function of X.25 NPSI to manage virtual circuits.

D bit. Delivery confirmation bit.

DCE. Data circuit-terminating equipment.

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

DCE/DTE interface. See DTE/DCE *interface*.

deadlock. (1) Unresolved contention for use of a resource. (2) An error condition in which processing cannot continue because each of two elements of the process is waiting for an action by or a response from the other. (3) An impasse that occurs when multiple processes are waiting for the availability of a resource that will not become available because it is being held by another process that is in a similar wait state.

dedicated access to X.25 transport extension (DATE). A function of X.25 NPSI that allows a communication and transmission control program (CTCP) to manage virtual circuits to SNA and non-SNA DTEs by processing qualified data, Interrupt, Call, Clear, and Reset packets. The contents of nonqualified data packets are transferred on the LU-LU session between the application program LU and the virtual circuit LU. Control and qualified data packets are transferred on the LU-LU session between the CTCP LU that manages virtual circuits and the multichannel link (MCH) LU.

dedicated channel. A channel that is not switched.

dedicated circuit. A circuit that is not switched.

definite response (DR). In SNA, a value in the form-of-response-requested field of the request header. The value directs the receiver of the request to return a response unconditionally, whether positive or negative, to that request. Contrast with *exception response, no response*.

definite response mode. A mode of operation in which an LU requires a response to its request.

definition statement. (1) In VTAM, the statement that describes an element of the network. (2) In NCP, a type of instruction that defines a resource to the NCP.

dial-in. Refers to the direction in which a switched connection is requested by any node or terminal other than the receiving host or an NCP.

dial-out. Refers to the direction in which a switched connection is requested by a host or an NCP.

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

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

disconnected mode. Synonym for *disconnected phase*.

disconnected phase. A phase entered by a data circuit-terminating equipment (DCE) when it detects error conditions, recovers from a temporary internal malfunction, or receives a DISC command from a data terminal equipment (DTE). In the disconnected phase, the DCE can initiate link setup but can transmit only DM responses to received frames. See also *information transfer phase*.

DSE. Data switching exchange.

DTE. Data terminal equipment.

DTE busy. Status of a DTE, which is unavailable, because it cannot accept an additional call. (ISO)

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

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

duplex. In data communication, pertaining to a simultaneous two-way independent transmission in both directions. * Synonymous with *full-duplex*.

E

EBCDIC. Extended binary-coded decimal interchange code.

echoplex mode. In data communication, a mode in which characters are automatically returned to the transmitting data terminal equipment (DTE).

ENA. Extended network addressing.

enable presentation (ENP) character. A control character that enables presentation of the following characters to resume after having been stopped by an inhibit presentation (INP) character.

end bracket. In SNA, the value (binary 1) of the end bracket indicator in the request header (RH) of the first request of the last chain of a bracket; the value denotes the end of the bracket. Contrast with *begin bracket*. See also *bracket*.

end-to-end control. 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. (CCITT/ITU)

exception request (EXR). In SNA, a request that replaces another message unit in which an error has been detected.

exception response (ER). In SNA, a value in the form-of-response-requested field of a request header (RH). An exception response is sent only if a request is unacceptable as received or cannot be processed. Contrast with *definite response (DR), no response*.

extended binary-coded decimal interchange code (EBCDIC). A set of 256 characters, each represented by eight bits.

extended network addressing. The network addressing system that splits the address into an 8-bit subarea and a 15-bit element portion. The subarea portion of the address is used to address host processors or communication controllers. The element portion is used to permit processors or controllers to address resources.

F

fallback. On an IBM 3745 with twin CCUs, the action of switching the lines attached to one CCU to the other CCU.

fast connect. An optional extension of the X.25 NPSI GATE function that preestablishes the SNA sessions between the host logical unit (LU) and the simulated LUs in X.25 NPSI.

fast connect GATE CTCP. A CTCP that is used in conjunction with the fast connect GATE function of X.25 NPSI to manage virtual circuits. See also GATE CTCP.

fast select. An option of a virtual call facility that allows inclusion of data in call-setup and call-clearing packets. (ISO)

FCS. Frame check sequence.

first speaker. In SNA, the LU-LU half-session defined at session activation as: (1) able to begin a bracket without requesting permission from the other LU-LU half-session to do so, and (2) winning contention if both half-sessions attempt to begin a bracket simultaneously. Contrast with *bidder*. See also *bracket protocol*.

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

flow control. (1) The procedure for controlling the data transfer rate. (TC97) (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.

formatted system services (FSS). A facility that provides certain system services as a result of receiving a field-formatted command, such as an INITIATE or TERMINATE command. Contrast with *unformatted system services (USS)*.

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) 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. (CCITT/ITU)

frame check sequence (FCS). (1) A field immediately preceding the closing flag sequence of a frame that contains a bit sequence checked by the receiver to detect transmission errors. (2) In SDLC, 16 bits in a frame that contain transmission-checking information.

frame-level interface. 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. (CCITT/ITU) See also *packet level interface*.

full-duplex. Synonym for *duplex*.

G

GATE. General access to X.25 transport extension.

GATE CTCP. A CTCP that is used in conjunction with the GATE function of X.25 NPSI to manage virtual circuits. In addition to managing virtual circuits, a GATE CTCP can be used to relay user data to and from subsystems such as CICS, IMS, and TSO.

general access to X.25 transport extension (GATE). A function of X.25 NPSI that allows a communication and transmission control program (CTCP) to manage virtual circuits to non-SNA DTEs by processing data, qualified data, Interrupt, Call, Clear, and Reset packets.

H

HDLC. High-level data link control.

high-level data link control (HDLC). 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. (CCITT/ITU)

host node. A node providing an application program interface (API) and a common application interface. See *boundary node, node, peripheral node, subarea node*. See also *boundary function, node type*.

I

ICA. integrated communication adapter.

I format. Information format.

I frame. Information frame.

IMS. Information Management System.

incoming call packet. 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. (CCITT/ITU)

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

information (I) frame. A frame in I format used for numbered information transfer. See also *supervisory frame, unnumbered frame*.

Information Management System (IMS). A general purpose system whose full name is Information Management System/Virtual Storage (IMS/VS). It enhances the capabilities of OS/VS for batch processing and telecommunication and allows users to access a computer-maintained data base through remote terminals.

information transfer phase. A phase in which a data circuit-terminating equipment (DCE) can accept and transmit information (I) frames and supervisory (S) frames. See also *disconnected phase*.

inhibit presentation (INP) character. A control character that causes presentation of the following characters to be stopped.

input/output channel. Synonymous with *data channel*.

integrated communication adapter. An integrated adapter that allows connection of one or more telecommunication lines to a processing unit.

integrated services digital network (ISDN). A digital end-to-end telecommunication network that supports multiple services including, but not limited to, voice and data.

Note: ISDNs are used in public and private network architectures.

intermediate routing function. In SNA, a path control capability in a subarea node that receives and routes path information units (PIUs) that neithe originate in nor are destined for network addressable units (NAUs) in that subarea node. See also *boundary function*.

intermediate routing node. In SNA, a subarea node with an intermediate routing function. A subarea node may be a boundary node, intermediate routing node, both, or neither, depending on how it is used in a network.

International Organization for Standardization (ISO). An organization of national standards bodies from various countries established to promote development of standards to facilitate international exchange of goods and services, and develop cooperation in intellectual, scientific, technological and economic activity.

ISDN. Integrated services digital network.

ISO. International Organization for Standardization.

ITU. International Telecommunication Union.

K

keyword. (1) (TC97) A lexical unit that, in certain contexts, characterizes some language construction. (2) * One of the predefined words of an artificial language. (3) One of the significant and informative words in a title or document that describes the content of that document. (4) A name or symbol that identifies a parameter. (5) A part of a command operand that consists of a specific character string (such as DSNAME=). See also *definition statement*.

L

LAP. Link access procedure.

LAPB. Link access procedure balanced. See *link access procedures (*LAP, LAPB*)*.

leased line. Synonym for *nonswitched line*.

line speed. The number of binary digits that can be sent over a telecommunication line in one second, expressed in bits per second (bps).

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. (1) A part of Recommendation X.25 that defines the link protoco used to get data into and out of the network across the full-duplex link connecting the subscriber's machine to the network node. LAP and LAPB are the link access protocols recommended by the CCITT. (2) See *data link level*.

link station. (1) In SNA, the combination of hardware and software that allows a node to attach to and provide control for a link. (2) In VTAM, a named resource within a subarea node that represents another subarea node that is attached by a subarea link. In the resource hierarchy, the link station is subordinate to the subarea link.

LLC. Logical link control.

load module. A program unit that is suitable for loading into main storage for execution; it is usually the output of a linkage editor. (ISO)

logical channel. 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. (CCITT/ITU)

logical circuits. In packet mode operation, a means of duplex transmission across a data link comprising associated send and receive channels. A number of logical circuits can be derived from a data link by packet interleaving. Several logical circuits can exist on the same data link.

logical unit (LU). In SNA, a port through which an end user accesses the SNA network and the functions provided by system services control points (SSCPs). An LU can support at least two sessions—one with an SSCP and one with another LU—and may be capable of supporting many sessions with other LUs. See also *peripheral LU, physical unit (PU), primary logical unit (PLU), secondary logical unit (SLU), system services control point (SSCP)*.

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

LU. Logical unit.

LUSIM. LU simulator.

LU simulator (LUSIM). A function of X.25 NPSI that simulates a logical unit (LU) for a non-SNA DTE so that the application LU or CTCP LU acts as though it is in session with an SNA DTE rather than with a non-SNA DTE. The LU-LU session between the application or CTCP LU and the simulated LU uses LU type 1 protocols.

M

maintenance and operator subsystem (MOSS). A subsystem of an IBM communication controller, such as the 3725 or the 3720, that contains a processor an operates independently of the rest of the controller. It loads and supervises the controller, runs problem determination procedures, and assists in maintaining both hardware and software.

MCH. Multichannel link.

message switching. (1) 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. (TC97)

migration. Installing a new version or release of a program when an earlier version or release is already in place.

MOSS. Maintenance and operator subsystem.

multichannel link (MCH). 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. (CCITT/ITU)

multilink procedure. A procedure for controlling the operation of an MCH that consists of several physical links running in parallel.

Multiple Virtual Storage (MVS). An IBM licensed program whose full name is the Operating System/Virtual Storage (OS/VS) with Multiple Virtual Storage/System Product for System/370. It is a software operating system controlling the execution of programs.

N

NCP. Network Control Program.

NCP/EP definition facility (NDF). A program that is part of System Support Programs (SSP) and is used to generate a partitioned emulation program (PEP) load module or a load module for a Network Control Program (NCP) or for an Emulation Program (EP).

NDF. NCP/EP definition facility.

NDM. Normal disconnected mode.

NEO. Network expansion option.

NetView program. A System/370-based IBM licensed program used to monitor a network, manage it, and diagnose its problems.

network addressable unit (NAU). In SNA, a logical unit, a physical unit, or a system services control point. The NAU is the origin or the destination of information transmitted by the path control network. See also *logical unit (LU), path control (PC) network, physical unit (PU), system services control point (SSCP)*.

network control phase. That phase of a data call during which network control signals are exchanged between a DTE and the network for the purpose of call establishment, call disconnection, or for control signaling during the data phase. (ISO)

Network Control Program (NCP). An IBM licensed program that provides communication controller support for single-domain, multiple-domain, and interconnected network capability. Its full name is Advanced Communications Function for the Network Control Program.

network failure. In a network, any condition that makes a service unavailable because the network or one of its essential components is not functioning correctly.

Network Routing Facility (NRF). An IBM licensed program that resides in the NCP, which provides a path for messages between terminals, and routes messages over this path without going through the host processor.

Network Terminal Option (NTO). An IBM licensed program used in conjunction with NCP that allows certain non-SNA devices to participate in sessions with SNA application programs in the host processor. NTO converts non-SNA protocol to SNA protocol when data is sent to the host from a non-SNA device and reconverts SNA protocol to non-SNA protocol when data is sent back to the device.

NIA. IBM 5973-LO2 Network Interface Adapter.

node. (1) In a network, a point at which one or more functional units connect channels or data circuits. (ISO) (2) In SNA, an endpoint of a link or a junction common to two or more links in a network. Nodes can be distributed to host processors, communication controllers, cluster controllers, or terminals. Nodes can vary in routing and other functional capabilities. (3) In ACF/VTAM, a point in a network defined by a symbolic name.

node type. In SNA, a designation of a node according to the protocols it supports and the network addressable units (NAUs) that it can contain. Five types are defined: 1, 2.0, 2.1, 4, and 5. Type 1, type 2.0, and type 2.1 nodes are peripheral nodes; type 4 and type 5 nodes are subarea nodes.

nonqualified data packet. A data packet in which the Q-bit is set off.

Non-SNA Interconnection (NSI). An IBM licensed program that provides format identification (FID1/4) support for selected non-SNA facilities. Thus, it allows SNA and non-SNA facilities to share SDLC links. It also allows the remote concentration of selected non-SNA devices along with SNA devices.

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*.

no response. In SNA, a value in the form-of-response-requested field of the request header (RH) indicating that no response is to be returned to the request, whether or not the request is received and processed successfully. Contrast with *definite response (DR), exception response (ER)*.

normal response mode (NRM). An operational mode of an unbalanced data link in which the secondary station initiates transmission only as the result of receiving explicit permission from the primary station. See also *asynchronous balanced mode (ABM), asynchronous response mode (ARM)*.

NPSI. X.25 NCP Packet Switching Interface.

NRF. Network routing facility.

NRM. normal response mode.

NTO. Network terminal option.

O

octet. A byte composed of eight binary elements.

Open Systems Interconnection (OSI). (1) The interconnection of open systems in accordance with specific ISO standards. (2) The use of standardized procedures to enable the interconnection of data processing systems.

operating system (OS). Software that controls the execution of programs. An operating system may provide services such as resource allocation, scheduling, input/output control, and data management.

Note: Although operating systems are predominantly software, partial or complete hardware implementations are possible.

optional network facilities. Facilities that a user of a packet switching data network can request when establishing a virtual circuit. See also *closed user group and throughput class negotiation*.

OS. Operating system.

OSI. Open Systems Interconnection.

OUFT. Optional user facility table.

P

pacing. In SNA, a technique by which a receiving component controls the rate of transmission of a sending component to prevent overrun or congestion. See also *session-level pacing, virtual route (VR) pacing*.

packet. A sequence of binary digits, including data and call control signals, that is transmitted and switched as a composite whole. (ISO) The data, call control signals, and error control information are arranged in a specific format. See also *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,* DTE *clear confirmation packet, incoming call packet, nonqualified data packet, permit packet, qualified data packet, reset packet, RNR packet, RR packet*.

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

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, physical level.*

packet level interface. 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. (CCITT/ITU) See also *frame-level interface.*

packet level processor. The part of X.25 NPSI that handles X.25 level 3.

packet mode operation. Synonym for *packet switching.*

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

packet sequencing. 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. (TC97)

packet switched data network (PSDN). A network that uses packet switching as a means of transmitting data.

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

packet switching. (1) 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. On completion of the transmission, the channel is made available for transfer of other packets. (ISO) (2) Synonymous with *packet mode operation.* Contrast with *circuit switching.*

packet window. The maximum number of consecutive data packets that are allowed to flow between a data terminal equipment (DTE) and a data circuit-terminating equipment (DCE) before an acknowledgment is received for a given logical channel.

PAD. Packet assembler/disassembler.

path control (PC) network. In SNA, the part of the SNA network that includes the data link control and path control layers. See SNA *network, user-application network.* See also *boundary function.*

path information unit (PIU). In SNA, a message unit consisting of a transmission header (TH) alone, or of a TH followed by a basic information unit (BIU) or a BIU segment. See also *transmission header.*

PCNE. Protocol converter for non-SNA equipment.

PDN. Public data network.

peripheral link. In SNA, a link that connects a peripheral node to a subarea node. See also *subarea link.*

peripheral LU. In SNA, a logical unit representing a peripheral node.

peripheral node. (1) In SNA, a node that uses local addresses for routing and therefore is not affected by changes in network addresses. A peripheral node requires boundary function assistance from an adjacent subarea node. See also *intermediate routing node, node type, peripheral link, subarea node.*

permanent virtual circuit (PVC). A virtual circuit that has a logical channel permanently assigned to it at each data terminal equipment (DTE). A call establishment protocol is not required.

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

physical circuit. 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, packet level.*

physical unit (PU). In SNA, a type of network addressable unit (NAU). A physical unit (PU) manages and monitors the resources (such as attached links) of a node, as requested by a system services control point (SSCP) through an SSCP-PU session. An SSCP activates a session with the physical unit in order to indirectly manage, through the PU, resources of the node such as attached links.

piggybacking. Act of acknowledging a received frame or packet within the next transmittal.

PIU. Path information unit.

PLP. Packet level processor.

port. An access point for data entry or exit.

port swap. A function of NCP/X.25 NPSI that allows you to install spare ports to be used as backup in case of failure of the original port.

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 logical unit (PLU). In SNA, the logical unit (LU) that contains the primary half-session for a particular LU-LU session. Each session must have a PLU and secondary logical unit (SLU The PLU is the unit responsible for the bind and is the controlling LU for the session. A particular LU can contain both primary and secondary half-sessions for different active LU-LU sessions. Contrast with *secondary logical unit (SLU)*.

primary station. (1) In high-level data link control (HDLC), the part of a data station that supports the primary control functions of the data link, generates commands for transmission, and interprets received responses. (ISO) (2) In SNA, the station on an SDLC data link that is responsible for the control of the data link. There must be only one primary station on a data link. All traffic over the data link is between a primary station and a secondary station. (3) Contrast with *secondary station*. See also *combined station*.

Note: Specific responsibilities assigned to the primary station include initialization of control signal interchange, organization of data flow, and actions regarding error control and error recovery functions at the data link level.

problem determination. The process of identifying the source of a problem; for example, a program component, a machine failure, telecommunication facilities, user or contractor-installed programs or equipment, an environment failure such as a power loss, or a user error.

program temporary fix (PTF). A temporary solution or bypass of a problem diagnosed by IBM in a current unaltered release of the program.

protocol. (1) A specification for the format and relative timing of information exchanged between communicating parties. (CCITT/ITU) (2) The set of rules governing the operation of functional units of a communication system that must be followed if communication is to be achieved. (TC97) (3) In SNA, the meanings of, and the sequencing rules for, requests and responses used for managing the network, transferring data, and synchronizing the states of network components. See also *bracket protocol*.

protocol converter for non-SNA equipment (PCNE). A function of X.25 NPSI that allows attachment of non-SNA X.25 DTEs without the use of a packet assembler/disassembler (PAD). PCNE replaces the packet headers used to receive data from non-SNA X.25 DTEs with the SNA headers used to pass the data to an application LU, and vice versa. The PCNE function uses an LU simulator.

PSDN. Packet switched data network.

PTT. Post Telephone and Telegraph Administration.

PU. Physical unit.

public data network (PDN). See *public network*.

public network. 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*.

PVC. Permanent virtual circuit.

Q

Q bit. Qualified data bit.

qualified data packet. A data packet in which the Q bit is set on.

QLLC. Qualified logical link control.

R

receive leg. The side of a duplex line that is receiving. Contrast with *transmit leg*.

receive not ready packet. See *RNR packet*.

receive ready packet. See *RR packet*.

RECFMS. Record formatted maintenance statistics. See also *packet switching*.

Recommendation X.21 (Geneva 1980). A Consultative Committee on International Telegraph and Telephone (CCITT) recommendation for a general purpose interface between data terminal equipment and data circuit-terminating equipment for synchronous operations on a public data network.

Recommendation X.25 (Geneva 1980). A Consultative Committee on International Telegraph and Telephone (CCITT) recommendation for the interface between data terminal equipment and packet-switched data networks. See also *packet switching*.

Recommendation X.28. A Consultative Committee on International Telegraph and Telephone (CCITT) recommendation for the DTE/DCE interface for a start-stop mode data terminal equipment (DTE) accessing the packet assembly/disassembly (PAD) facility in a public data network situated in the same country.

Recommendation X.29. A Consultative Committee on International Telegraph and Telephone (CCITT) recommendation for procedures for the exchange of control information and user data between a packet assembly/disassembly (PAD) facility and a packet mode data terminal equipment (DTE) or another PAD facility.

Recommendation X.3. A Consultative Committee on International Telegraph and Telephone (CCITT) recommendation for packet assembly/disassembly (PAD) in a public data network.

record formatted maintenance statistics (RECFMS). A statistical record built by an SNA controller and usually solicited by the host.

REJ. Rejected message.

request header (RH). In SNA, control information preceding a request unit (RU). See also *request/response header (RH)*.

request/response header (RH). In SNA, control information, preceding a request/response unit (RU), that specifies the type of RU (request unit or response unit) and contains control information associated with that RU.

request/response unit (RU). In SNA, a generic term for a request unit or a response unit. See also *request unit (RU), response unit (RU)*.

request unit (RU). In SNA, a message unit that contains control information, end-user data, or both.

reset collision. A condition that occurs when a data terminal equipment (DTE) and a data circuit-terminating equipment (DCE) simultaneously transmit a reset request packet and a reset indication packet over the same logical channel. See also *call collision, clear collision*.

reset (of a virtual circuit). Reinitializing 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. (CCITT/ITU)

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

response. In data communication, 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. (TC97)

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. (TC97)

response unit (RU). In SNA, a message unit that acknowledges a request unit; it may contain prefix information received in a request unit. If positive, the response unit may contain additional information (such as session parameters in response to Bind Session), or if negative, contains sense data defining the exception condition.

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

RNR. Receive not ready.

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.

RPOA. Recognized private operating authority.

RR. Receive ready.

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.

RU. Request/response unit.

RU chain. In SNA, a set of related request/response units (RUs) consecutively transmitted on a particular normal or expedited data flow. The request CHAIN is the unit of recovery. If one RU in the chain cannot be processed, the entire chain mus be discarded.

Note: Each request unit belongs to only one chain, which has a beginning and an end indicated through control bits in request/response headers within the RU chain. Each RU can be designated as first-in-chain (FIC), last-in-chain (LIC), middle-in-chain (MIC), or only-in-chain (OIC). Response units and expedited-flow request units are always sent as only-in-chain.

S

SDLC. Synchronous Data Link Control.

SDT. Start data traffic.

secondary logical unit (SLU). In SNA, the logical unit (LU) that contains the secondary half-session for a particular LU-LU session. Contrast with *primary logical unit (PLU)*.

secondary station. (1) In high-level data link control (HDLC), the part of a data station that executes data link control functions as instructed by the primary station and that interprets received commands and generates responses for transmission. (ISO) (2) 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*. See also *combined station*.

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

session-level pacing. In SNA, a flow control technique that permits a receiving session to control the data transfer rate (the rate which it receives request units) on the normal flow. It is used to prevent overloading a receiver with unprocessed requests when the sender can generate requests faster than the receiver can process them. See also *pacing, virtual route (VR) pacing*.

S frame. Supervisory frame.

SHM. Short hold mode.

short hold mode (SHM). A function of X.25 NPSI that allows a virtual connection to be cleared if no traffic is present on the connection for a time interval specified by the user. When traffic resumes, the connection is automatically reestablished.

shutdown. The process of ending operation of a system or a subsystem, following a defined procedure.

SMN. Switched major node.

SNA. Systems Network Architecture.

SNA network. The part of a user-application network that conforms to the formats and protocols of Systems Network Architecture. It enables reliable transfer of data among end users and provides protocols for controlling the resources of various network configurations. The SNA network consists of network addressable units (NAUs), boundary function components, and the path control network.

SNA network interconnect (SNI). The connection, by gateways, of two or more independent SNA networks to allow communication between logical units in those networks. The individual SNA networks retain their independence.

SNI. SNA network interconnect.

SSCP. System services control point.

SSP. (1) System service program. (2) System Support Program.

subaddressing. The mechanism by which the X.25 NPSI logical link control (LLC) or the communication and transmission control program (CTCP) is selected by the value of the last digit of the called DTE address in the incoming call packet.

subarea. A portion of the SNA network consisting of a subarea node, any attached peripheral nodes, and their associated resources. Within a subarea node, all network addressable units, links, and adjacent link stations (in attached peripheral or subarea nodes) that are addressable within the subarea share a common subarea address and have distinct element addresses.

subarea link. In SNA, a link that connects two subarea nodes. See also *peripheral link*.

subarea node. In SNA, a node that uses network addresses for routing and whose routing tables are therefore affected by changes in the configuration of the network. Subarea nodes can provide gateway function, and boundary function support for peripheral nodes. Type 4 and type 5 nodes are subarea nodes. See *boundary node, host node, node, peripheral node*. See also *boundary function, node type*.

supervisory (S) format. A format used to perform data link supervisory control functions, such as acknowledge I frames, request retransmission of I frames, and request temporary suspension of transmission of I frames. See also *information format, unnumbered format*.

supervisory (S) frame. A frame in supervisory format used to transmit supervisory control functions.

SVC. Switched virtual circuit.

SVCSC. Switched virtual circuit subarea communication.

switchback. On an IBM 3745 with twin CCUs, the action of switching the lines currently attached to a CCU, as the result of a fallback, back to the original CCU.

switched connection. (1) A mode of operating a data link in which a circuit or channel is established to switching facilities as, for example, in a public switched network. (ISO) (2) A connection 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 major node. In VTAM, a major node whose minor nodes are physical units and logical units attached by switched SDLC links.

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

switched virtual circuit (SVC). A virtual circuit that is requested by a virtual call. It is released when the virtual circuit is cleared.

switched virtual circuit (SVC) short hold mode. See *short hold mode (SHM)*.

switched virtual circuit subarea communication (SVCSC). A function of X.25 NPSI that, together with appropriate VTAM functions, allows communication over a switched virtual circuit (SVC) between (1) two communication controllers or (2) a communication controller and certain host processors equipped with appropriate hardware and software.

Synchronous Data Link Control (SDLC). A discipline conforming to subsets of the Advanced Data Communication Control Procedures (ADCCP) of the American National Standards Institute (ANSI) and High-level Data Link Control (HDLC) of the International Organization for Standardization (ISO), for managing synchronous, code-transparent, serial-by-bit information transfer over a link connection. Transmission exchanges may be duplex or half-duplex over switched or nonswitched links. The configuration of the link connection may be point-to-point, multipoint, or loop. See also *binary synchronous communications*.

system services control point (SSCP). In SNA, the focal point within an SNA network for managing the configuration, coordinating network operator and problem determination requests, and providing directory support and other session services for end users of the network. Multiple SSCPs, cooperating as peers, can divide the network into domains of control, with each SSCP having a hierarchical control relationship to the physical units and logical units within its domain.

Systems Network Architecture (SNA). The description of the logical structure, formats, protocols, and operational sequences for transmitting information units through and controlling the configuration and operation of networks.

System Support Programs (SSP). An IBM licensed program, made up of a collection of utilities and small programs, that supports the operation of the NCP.

System Support Program Product (SSP). A group of IBM-licensed programs that manage the running of other programs and the operation of associated devices, such as the display station and printer. The SSP also contains utility programs that perform common tasks, such as copying information from diskette to disk.

T

telecommunication line. (1) 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. (TC97) (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. (1) An event that occurs at the end of a predetermined period of time that began at the occurrence of another specified event. (ISO) (2) A time interval allotted for certain operations to occur; for example, response to polling or addressing before system operation is interrupted and must be restarted.

time sharing control task (TSC). In TSO, a system task that handles system initialization, allocation of time shared regions, swapping, and general control of the time sharing operation.

Time Sharing Option (TSO). An optional configuration of the operating system that provides conversational time sharing from remote stations.

trace analysis program (TAP). An SSP program service aid that assists in analyzing trace data produced by VTAM, TCAM, and NCP and provides network data traffic and network error reports.

transmission header (TH). In SNA, control information, optionally followed by a basic information unit (BIU) or a BIU segment, that is created and used by path control to route message units and to control their flow within the network. See also *path information unit (PIU)*.

transmission line. Synonym for *telecommunication line*.

transmit leg. The side of a duplex line that is transmitting. Contrast with *receive leg*.

TSC. Time sharing control task.

TSO. Time Sharing Option.

U

U frame. Unnumbered frame.

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*. (TC97)

unformatted system services (USS). In SNA products, a system services control point (SSCP) facility that translates a character-coded request, such as a logon or logoff request into a field-formatted request for processing by formatted system services and translates field-formatted replies and responses into character-coded requests for processing by a logical unit. Contrast with *formatted system services*.

unnumbered (U) format. A format used to provide additional data link control functions and unnumbered information transfer. See also *information format, supervisory format*.

unnumbered (U) frame. A frame in unnumbered format, used to transfer unnumbered control functions. See also *information frame, supervisory frame*.

USA. Upstream address.

user-application network. 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. A category of data transmission service provided by a data network in which the data signaling rate, the data terminal equipment operating mode, and the code structure, if any, are standardized. (TC97) See also *class of service (COS)*.

V

VC. Virtual circuit.

VCCPT. Virtual circuit control parameter table.

VCM. Virtual circuit manager.

virtual call. See *virtual call facility*.

virtual call facility. 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. (CCITT/ITU)

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

virtual circuit LU. An LU that controls the flow of data over a virtual circuit between X.25 NPSI and a remote DTE. If the DTE is an SNA DTE, the virtual circuit LU is in that DTE. If the DTE is a non-SNA DTE, the virtual circuit LU is in the communication controller that runs X.25 NPSI; it is a simulated LU. See also *LU simulator (LUSIM)*.

Virtual Machine/System Product (VM/SP). An IBM-licensed program that manages the resources of a single computer so that multiple computing systems appear to exist. Each virtual machine is the functional equivalent of a "real" machine.

virtual route (VR) pacing. In SNA, a flow control technique used by the virtual route control component of path control at each end of a virtual route to control the rate at which path information units (PIUs) flow over the virtual route. VR pacing can be adjusted according to traffic congestion in any of the nodes along the route. See also *pacing, session-level pacing*.

Virtual Telecommunications Access Method (VTAM). An IBM licensed program that controls communication and the flow of data in an SNA network. It provides single-domain, multiple-domain, and interconnected network capability.

VM. Virtual machine.

VSE (Virtual Storage Extended). An operating system that is an extension of Disk Operating System/Virtual Storage. A VSE system consists of: (a) licensed VSE/Advanced Functions support, and (b) any IBM-supplied and user-written programs that are required to meet the data processing needs of a user. VSE and the hardware it controls form a complete computing system.

W

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 acknowledgment response.

X

XI. X.25 SNA Interconnection.

Bibliography

X.25 NCP Packet Switching Interface Publications

The following paragraphs briefly describe the library of books associated with *X.25 NCP Packet Switching Interface* Version 3.

X.25 NCP Packet Switching Interface General Information Version 3 (GC30-3469)

This book introduces managers, system designers, programmers, and other data processing personnel to the basic concepts of packet-switching, X.25, and IBM's X.25 NCP Packet Switching Interface licensed program.

X.25 NCP Packet Switching Interface Planning and Installation Version 3 (SC30-3470)

This book provides system programmers and analysts with the information required to plan and implement the installation of X.25 NPSI. The topics include hardware/software requirements, preinstallation system performance considerations, instructions for defining and generating X.25 NPSI, and installation examples.

X.25 NCP Packet Switching Interface Host Programming Version 3 (SC30-3502)

This book is written for application and system programmers to assist them in writing application programs that use the X.25 NCP Packet Switching Interface. Application programmers should have some knowledge of DATE and GATE functions and the operating systems that support them. System programmers should be knowledgeable in SNA architecture.

X.25 NCP Packet Switching Interface Diagnosis, Customization, and Tuning Version 3 (LY30-5610)

This book is written for system programmers to assist them in trouble-shooting and diagnosing problems with the X.25 NCP Packet Switching Interface. It helps programmers to diagnose problems, resolve common errors, and describe problems to and interface with the IBM Support Center.

NCP and Related Products Directory of Programming Interfaces for Customers (GC31-6202)

This book provides a directory to other documents, or sections of documents, that contain the detailed descriptions of programming interfaces. It specifies files or data sets created by NCP and related products and indicates which macros are intended to be used as, or as part of, a programming interface.

Other Network Program Products Publications

For more information about the books listed in this section, see *Network Program Products Bibliography and Master Index*.

Network Program Products Bibliography and Master Index (GC30-3353)

Network Program Products General Information (GC30-3350)

Network Program Products Planning (SC30-3351)

Network Program Products Samples (SC30-3352)

Network Program Products Storage Estimates (SC30-3403)

VTAM Publications

The following list shows the publications for VTAM V3R2.

VTAM Installation and Resource Definition (SC23-0111)

VTAM Customization (LY30-5614)

VTAM Operation (SC23-0113)

VTAM Messages and Codes (SC23-0114)

VTAM Programming (SC23-0115)

VTAM Programming for LU 6.2 (SC30-3400)

VTAM Diagnosis (LY30-5601)

VTAM Data Areas for MVS (LY30-5592)

VTAM Data Areas for VM (LY30-5593)

VTAM Data Areas for VSE (LY30-5594)

VTAM Reference Summary (LY30-5600)

VTAM Directory of Programming Interfaces for Customers (GC31-6403)

SNA Publications

The following publications contain information on SNA:

Systems Network Architecture Concepts and Products (GC30-3072)

Systems Network Architecture Technical Overview (GC30-3073)

Systems Network Architecture Format and Protocol Reference Manual: Management Services (SC30-3346)

Systems Network Architecture Formats (GA27-3136)

NCP Publications

The following publications apply to the libraries of NCP, SSP, and EP.

NCP and EP Reference Summary and Data Areas (LY30-5603)

SSP Customization Guide (LY43-0021)

NCP, SSP, and EP Diagnosis Guide (LY30-5591)

NCP, SSP, and EP Generation and Loading Guide (SC30-3348)

NCP, SSP, and EP Messages and Codes (SC30-3169)

NCP, SSP, and EP Resource Definition Guide (SC30-3447)

NCP, SSP, and EP Resource Definition Reference (SC30-3448)

NCP Migration Guide (SC30-3440)

NCP and EP Reference (LY30-5605)

NCP Customization Guide (LY30-5606)

NCP Customization Reference (LY30-5607)

3745 Publications

The following list shows the publications for the IBM 3745.

IBM 3745 Communication Controller Introduction (GA33-0092)

IBM 3745 Communication Controller Configuration Program (GA33-0093)

IBM 3745 Principles of Operation (SA33-0102)

3720 Publications

The following list shows selected publications for the IBM 3720.

3720/3721 Communication Controllers Introduction (GA33-0060)

3720/3721 Communication Controllers Configuration Guide (GA33-0063)

3720/3725 Communication Controllers Principles of Operation (GA33-0013)

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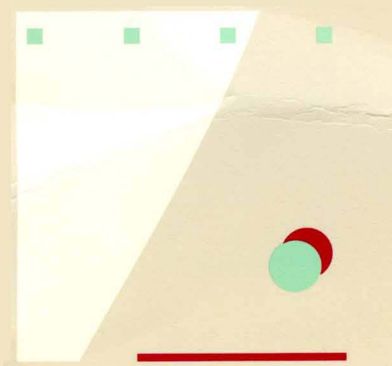

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