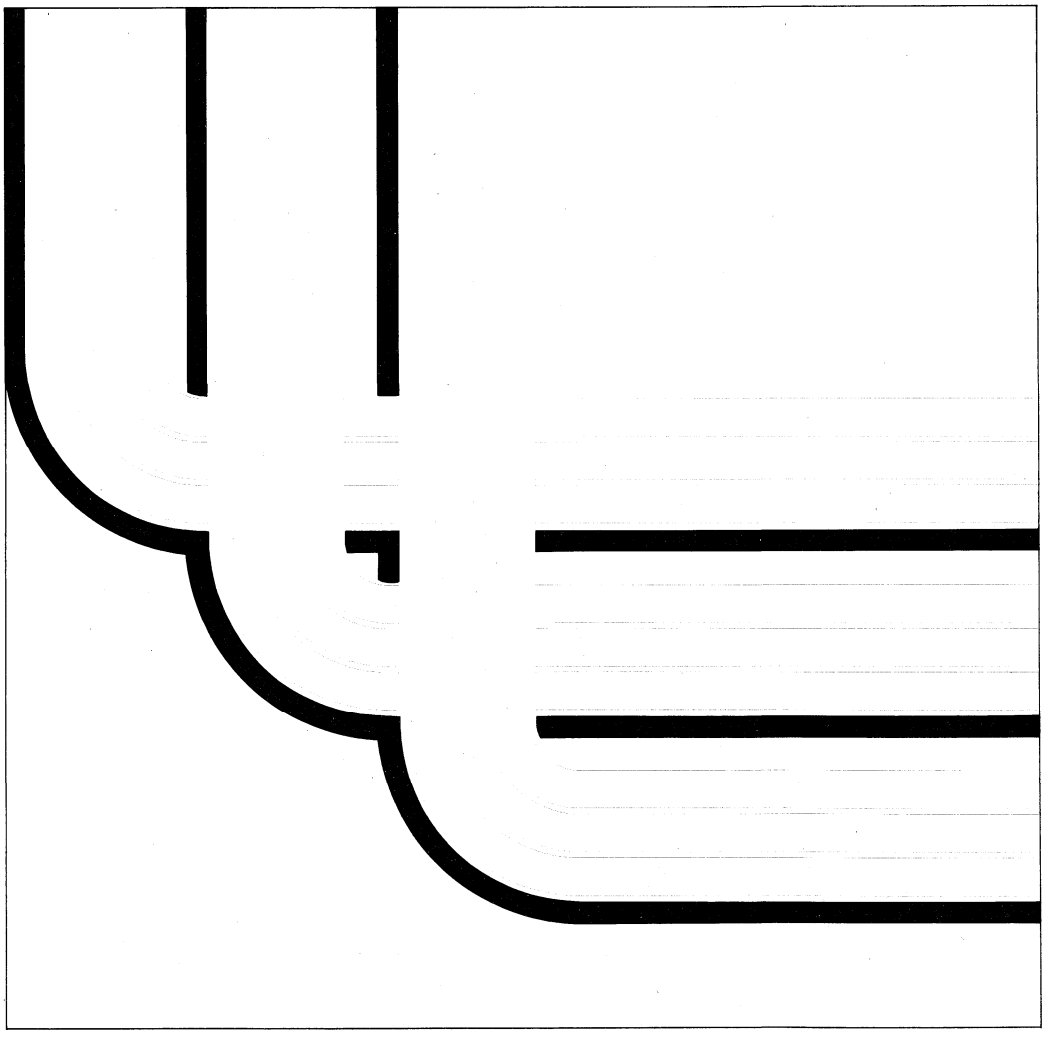
Application System/400

SC41-0005-00

Communications: X.25 Network Guide

Version 2



System and Application Support

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First Edition (May 1991)

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Programming Interface

This network guide is intended to help the customer use the AS/400 system over an X.25 network. It primarily contains information about X.25 configuration. The *X.25 Network Guide* contains no programming interfaces for customers.

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About This Guide

This guide contains information about the X.25 network interface and how to use it on the OS/400 system. This information includes X.25 network concepts, examples, and information on preparation and configuration. Information for communications functions supported on the AS/400 system, such as TCP/IP, OSI, and user-defined communications are described in the related publications referred to in the "Bibliography."

You may need to refer to other IBM manuals for more specific information about a particular topic. The *Publications Guide*, GC41-9678, provides information on all the manuals in the AS/400 library.

For a list of publications related to this guide, see the "Bibliography."

Who Should Use This Guide

This publication is intended for use by system programmers and end users who want to connect AS/400 systems to an X.25 network.

Before using this guide, you must be familiar with the use of the AS/400 system. A knowledge of configuration concepts and X.25 networking would be helpful when using this guide.

You should be familiar with the general communications concepts and communications configuration on the AS/400 system. For more information on general communications concepts, refer to Discover/ IBM AS/400 courses.

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Chapter 1. Introducing X.25

The X.25 interface network is the three-layer interface between packet-mode **data terminal equipment (DTE)**[1] and **data circuit-terminating equipment (DCE)**[2] that exists in a **packet-switching data network (PSDN)**[3] as defined by the International Telegraph and Telephone Consultative Committee (CCITT) and the International Organization for Standardization (ISO).

The layers that comprise the X.25 network are:

Physical Defines how a DTE is physically connected to its corresponding network DCE.

Data link control
Defines the procedures for the connection, error-free transfer of information, and disconnection between the DTE and the network DCE.

Packet Defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections.

This three layer interface is referred to as the X.25 network. CCITT publicizes this interface in a document called **Recommendation X.25** that outlines standards for the connection of processing equipment to a packet-switching data network. ISO defines the data link control layer in Standard 7776 and the packet layer in Standard 8208.

This guide provides an overview of X.25, a discussion of AS/400* system support of X.25, and information on end-to-end connectivity using X.25. Some general information about Recommendation X.25 is provided, but a knowledge of X.25 networks would be helpful when configuring your system.

The following sections provide a general discussion of an X.25 network and information on the parts that comprise the network.

Note: Throughout this publication, the term *DTE* refers to a system (for example, an AS/400 system) or other remote facilities (for example, controllers) that want to communicate through an X.25 network. The term *DCE* refers to the interface of the systems to the X.25 network.

DTE-to-DCE Interface

Even though this DTE-to-DCE interface is standardized, the architecture allows it to be tailored to the specific needs of the DTE and the network. For an interface to work properly, both the DTE owner and the network administrator must configure their equipment according to a previously negotiated network subscription. The network subscription details the specific X.25 options to be used on the DTE-to-DCE interface.

1 Data terminal equipment is a data link that sends data, receives data, and provides the data communications control function according to protocols.

2 Data circuit-terminating equipment is equipment installed at the user's premises that provides all the functions required to establish, maintain, and end a connection, and the signal conversion and coding between the data terminal equipment and the line.

3 Packet-switching data network is a communications network that uses packets to send data.

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All types of packet-mode DTEs may connect to an X.25 network; therefore, each DTE-to-DCE interface supported by the network may have a unique subscription. Because the ultimate goal of a DTE using X.25 is to communicate with a remote DTE, the network must be able to bridge any possible differences between the separate subscriptions of two communicating DTEs.

The X.25 standards define procedures for the connection of one packet-mode DTE directly to another without an intervening network. This connectivity, referred to by CCITT and ISO as DTE-to-DTE, requires that one of the DTEs provide a subset of DCE functions. In the remainder of this section, whenever DTE-to-network connectivity is discussed, the information is also applicable to DTE-to-DTE connectivity, unless specified otherwise.

The DTE-to-DCE interface, illustrated in Figure 1-1, supports the exchange of information among the individual X.25 network subscribers (DTEs).

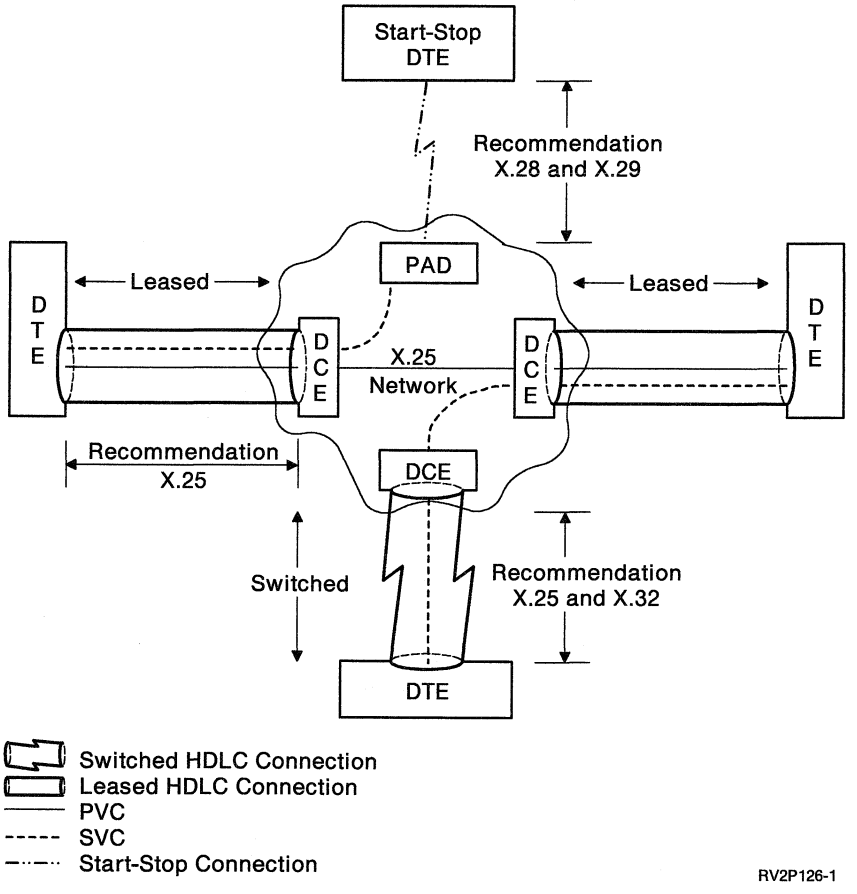

Figure 1-1. DTE to X.25 Network Connectivity

The following sections discuss the X.25 network layers illustrated in Figure 1-1.

Physical Layer

The physical layer defines how a DTE is physically connected to its corresponding network DCE. The medium between the DTE and the network DCE must be capable of duplex transmission.

CCITT Recommendation X.32 defines procedures for using physically-switched mediums for network connectivity. Due to the transient nature of switched

mediums, Recommendation X.32 also includes ways to identify the calling DTE or DCE for billing or security reasons. The physical interface protocols supported by X.25 are defined in other CCITT standards. Some of these standards include:

- Recommendation X.21
- Recommendation X.21 bis
- The V-series recommendations
- Recommendation X.31 (X.25 over integrated services digital networks)

See "AS/400 X.25 Capabilities" on page 2-2 for information on all of the physical interfaces supported by the AS/400 system for X.25.

Data Link Control Layer

The data link control layer defines the procedures for the connection, error-free transfer of information, and disconnection between the DTE and the network DCE. At the data link control layer, the information is transmitted between the two stations in data units called high-level data link control (HDLC) **frames**. Both the DTE and the network DCE are considered peer stations, and the **link access protocol-balanced (LAPB)** (a protocol for using an X.25 network on the data link level) subset of HDLC is used. Because of this peer relationship, constant polling is not required when the HDLC connection is established. **Polling** involves contacting the attached devices to avoid contention, to determine operational status, or to determine readiness to send or receive data. Either station can transmit frames as necessary to carry higher layer information. Depending on the network subscription, either the DTE or network DCE can begin the HDLC connection. However, the DTE normally disconnects the link when network connectivity is no longer required.

Packet Layer

The packet layer defines the procedures necessary for establishing connections (virtual circuits) between DTEs, transferring information (in packets), and clearing connections.

Figure 1-2 illustrates the types of packets used in the X.25 network.

Figure 1-2 (Page 1 of 2). Packet Types

Packet Type from DCE to DTE	Packet Type from DTE to DCE
INCOMING_CALL	CALL_REQUEST
CALL_CONNECTED	CALL_ACCEPTED
CLEAR_INDICATION	CLEAR_REQUEST
DCE_CLEAR_CONFIRMATION	DTE_CLEAR_CONFIRMATION
DCE_DATA	DTE_DATA
DCE_INTERRUPT	DTE_INTERRUPT
DCE_INTERRUPT_CONFIRMATION	DTE_INTERRUPT_CONFIRMATION
DCE_RR	DTE_RR
DCE_RNR	DTE_RNR
RESET_INDICATION	DTE_REJ
RESET_INDICATION	RESET_REQUEST
DCE_RESET_CONFIRMATION	DTE_RESET_CONFIRMATION
RESTART_INDICATION	RESTART_REQUEST

Figure 1-2 (Page 2 of 2). Packet Types

Packet Type from DCE to DTE	Packet Type from DTE to DCE
DCE_RESTART_CONFIRMATION	DTE_RESTART_CONFIRMATION
DIAGNOSTIC	—
REGISTRATION_CONFIRMATION	REGISTRATION_REQUEST

Notice that even though a virtual circuit logically connects two DTEs, the packet layer in each DTE is actually a peer with the packet layer in its corresponding network DCE. This peer relationship between the packet layer in the DTE and the packet layer in the corresponding network DCE enables the network to translate any differences that may exist between the two DTE network subscriptions. However, an effect of this relationship is that X.25 provides no DTE-to-DTE acknowledgment of received data. CCITT has defined a means for DTE-to-DTE packet acknowledgment called the delivery-bit (D bit). However, not all DTEs or networks support this function. Depending on the quality of network service, some higher layer protocols using X.25 may incorporate their own end-to-end acknowledgment scheme.

A DTE can simultaneously have multiple virtual circuits active to multiple DTEs. Each virtual circuit active on a network interface can have different characteristics. For example, maximum packet size or maximum number of outstanding unacknowledged packets can vary among virtual circuits. To enable this multiplexing, each DTE-to-DCE interface identifies individual virtual circuits using a uniquely assigned 12-bit identifier, called a **logical channel**. The assignment of a virtual circuit to a logical channel can be either on demand (switched) or static (permanent), depending on the network subscription.

To enable switched DTE-to-DTE connectivity, each DTE is assigned a unique network address as part of its network subscription. When switched connectivity is desired, the calling DTE initiates a call setup procedure with the network. As part of this procedure, the calling DTE supplies the network with the network address of the remote DTE. The calling DTE assigns logical channels on the calling interface. The DCE assigns logical channels on the called interface. Because logical channels are unique on each network interface, it is possible that the actual values used on each end of the switched virtual circuit (SVC) are different.

At call setup time, SVC characteristics are established. These characteristics are determined by the network subscription and the presence or absence of special fields in the call setup packets called **facilities**. These facility fields allow the DTE and DCE to negotiate SVC characteristics by determining which optional user facilities will be in effect. Certain user facilities allow transmission of call user data between DTEs on call setup packets. Several higher layer protocols, those layers not defined by X.25, reserve the first byte of this call user data as a protocol identifier. The protocol identifier allows the called DTE to determine the exact higher layer protocol needed by the calling DTE.

Nonswitched DTE-to-DTE connectivity is established through permanent virtual circuits (PVC). PVC characteristics and their logical channels are statically defined in the network subscription. Provided the DTE-to-DCE interface on each end of a PVC is active at the packet layer, the virtual circuit is considered ready for information transfer.

One major network management function of the packet layer is the ability to send and receive status information on either a specific virtual circuit or all SVCs. This status information is carried in the cause and diagnostic code fields of certain packet types.

Network Support of Non-X.25 DTEs

CCITT standardized an interface and procedures for the attachment of start-stop mode (asynchronous) DTEs to an X.25 network in Recommendation X.28. The DTE communicates with the X.25 network through a packet assembler/disassembler (PAD) facility. The PAD maps the X.28 protocol from the DTE to X.25 in the network direction, and from X.25 to X.28 in the DTE direction. Recommendation X.29 defines how a packet-mode DTE on the network can remotely tailor the configuration of the PAD facility to meet the specific needs of the asynchronous DTE (for example, how and when data from the DTE should be forwarded to the network).

Other nonstandard equipment exists that performs PAD-like functions for DTEs supporting non-X.25 protocols other than asynchronous communications.

Advantages of Using X.25 for Communications

The layers of X.25 together provide many advantages including networking, multiplexing, information integrity, and dynamic negotiation of connection. The following sections describe some of these advantages.

Networking

X.25 allows DTE-to-DTE connectivity. The individual network subscribers are only responsible for the configuration, and perhaps attachment to the network (depending on the network subscription), of their DTEs. The network administration is responsible for maintaining the equipment and transmission mediums inside the network to ensure connectivity.

Multiplexing

X.25 has no requirement on what higher layer protocol uses the virtual circuits provided by the packet layer. **Multiplexing** means that of the several virtual circuits potentially active over a given interface at a particular time, each could be supporting different higher layer protocols.

Because the X.25 packet layer supports many virtual circuits on a single network interface, equipment cost is reduced.

Information Integrity

The X.25 data link control layer ensures the integrity of all information passed to the packet layer and to all higher layers.

Dynamic Negotiation of Connection Characteristics

If negotiation is allowed by the network subscription, different SVC characteristics can be established from call to call. This function allows the DTE to tailor its resources to the demand. For example, during periods when large numbers of SVCs are active, the packet sizes can be decreased to reduce DTE storage demands.

Some communications applications have additional requirements not addressed by X.25. These requirements include:

- End-to-end acknowledgment of received data
- Transaction-based processing
- Data translation
- Multiplexing within a virtual circuit

Many communication applications do not interface directly to X.25. Instead, a higher layer protocol is used in a virtual circuit provided by X.25. Many higher layer protocols are designed to operate in X.25 virtual circuits. These protocols include:

- Asynchronous
- Open systems interconnection (OSI)
- Systems Network Architecture (SNA)
- Transmission Control Protocol/Internet Protocol (TCP/IP)
- User-defined communications

The choice of which higher layer protocol, if any, to use on a given X.25 virtual circuit depends on the protocols supported by each of the communicating DTEs and the particular requirements of the application program.

See "AS/400-Supported Protocols on an X.25 Virtual Circuit" on page 3-9 for more information on the higher layer protocols supported by the AS/400 system that can make use of the connectivity provided by X.25.

X.25 Service Charges

Specific X.25 charging information (**tariffs**) is network-dependent. However, the most common method is a periodic subscription fee that covers network access and any subscribed PVCs. For SVCs, charging is similar to the access charges of a public-switched telephone network. If allowed by the subscription, the calling DTE can request, through a special facility code, that the SVC charges be reversed to the called DTE. The called DTE is informed that the calling DTE is requesting reverse charging and can choose to accept or clear the call.

The subscription fee may not cover the physical medium or communications equipment (the modem) used to access the network interface by a DTE. For example, if a switched voice-grade line is used for X.25 network access, the customer can be billed separately by the public-switched telephone network.

The choice between using an SVC or a PVC for connectivity to a particular DTE is made by estimating cost and use. According to Recommendation X.32, if any PVCs are to be requested in the network subscription, the physical medium to the network interface must be nonswitched. If only SVCs are required, then another estimation of cost and use can help determine whether the medium to the network should be physically switched.

Chapter 2. AS/400 Support of X.25

The AS/400 implementation of X.25 conforms to the protocol described in International Telegraph and Telephone Consultative Committee (CCITT) Recommendation X.25 (1988 level) and International Organization for Standardization (ISO) Standards 7776 and 8208.

An AS/400 X.25 line can be connected to the packet-switching data network (PSDN) or to an adjacent remote system using either a nonswitched or switched physical line. A **switched line** connection is one that is established on demand between the AS/400 system and the X.25 network. On nonswitched line connections, the AS/400 system supports both **switched virtual circuits (SVCs)** (virtual circuits that are requested by a virtual call) and **permanent virtual circuits (PVCs)** (virtual circuits that have a logical channels permanently assigned to them at each data terminal equipment (DTE)). Only SVCs are supported on switched physical lines. See "X.25 Switched Line Considerations" on page 2-6 for a description of switched line support on the AS/400 system.

X.25 Virtual Circuit Support

One X.25 line supports one or more virtual circuits. Each virtual circuit can support one of the following:

- One or more Systems Network Architecture (SNA) sessions that can include advanced program-to-program communications (APPC), SNA upline facility (SNUF), remote work station, or finance communications.
- One connection to an asynchronous communications **host system** (the primary or controlling computer in a communications network).
- One connection to an asynchronous device through the X.25 network packet assembler/disassembler (PAD) facility.
- One connection to an asynchronous communications host system through AS/400 PAD emulation.
- One user-defined communications facility.
- One Transmission Control Protocol/Internet Protocol (TCP/IP) link to an adjacent IP node or **gateway** (a device used to connect two systems that use two different communications protocols).
- One open systems interconnection (OSI) path to an adjacent node. This node may be an OSI end system or intermediate system.

Several different applications running over different virtual circuit facilities (for example, SNA, asynchronous, TCP/IP, OSI, or user-defined communications) can be used on the same X.25 line.

Connections to the X.25 network and to remote data terminal equipment (DTE) are configured on the AS/400 system using line descriptions and controller descriptions. These objects relate to X.25 as follows:

Line description

The AS/400 line description defines the physical connection between the AS/400 system and the X.25 packet-switched network.

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SNA and asynchronous controller descriptions
Each SNA or asynchronous controller description defines one remote DTE and the virtual circuit through the X.25 network.

Network controller description
A network controller defines many virtual circuits to adjacent IP nodes or gateways, adjacent OSI nodes, and adjacent systems using the user-defined protocol.

Device descriptions describe aspects of the protocol, such as SNA, running above X.25.

On the AS/400 system, each X.25 line description has a logical channel table; this table, which can have a maximum of 32 entries, contains the logical channel subscription information. Each logical channel entry defines one possible active virtual circuit.

AS/400 X.25 Capabilities

Figure 2-1 lists the maximum data rates (in bits per second) and CCITT interfaces supported by the AS/400 system for a given X.25 line.

Figure 2-1. Maximum Data Rates

Maximum Data Rate	Interface
19 200 bps	CCITT Recommendation X.21 bis/V.24 EIA Recommendation RS-232/V.24
64 000 bps	CCITT Recommendation X.21 bis/V.35 CCITT Recommendation X.21

There is a limit to the total number of X.25 logical channels that can be defined for a communications controller. That limit is the sum of the logical channels defined for all lines on that communications controller, as follows:

- The combined total of virtual circuits on active X.25 lines in a single multiline communications controller on the 9406 System Unit cannot exceed 64. The allocation of these logical channels is further restricted according to the number of lines used. Figure 2-2 lists the maximum number of circuits that can be used according to the number of lines used.

Figure 2-2. Logical Channel Allocation - 9406 Multiline Communications Controller

Number of Lines	Number of Circuits
1	32 maximum
2	32 maximum for each line
3	16 maximum for each line

- The combined total of virtual circuits on active X.25 lines in a single three-line communications controller on the 9402 System Unit and the 9404 System Unit cannot exceed 48. The allocation of these logical channels is further limited according to the number of lines used. Figure 2-3 on page 2-3 lists the maximum number of circuits that can be used according to the number of lines used.

Figure 2-3. Logical Channel Allocation - 9402 and 9404 Three-Line Communications Controllers

Number of Lines	Number of Circuits
1	32 maximum
2	32 maximum for one line; 16 maximum for second line

- The combined total of virtual circuits on active X.25 lines in a single six-line communications controller on the 9402 System Unit, the 9404 System Unit, and the 9406 System Unit cannot exceed 96. For data rates greater than 19 200 bps, the maximum number of lines suggested is 3. Figure 2-4 lists the maximum number of circuits that can be used according to the number of lines used.

Figure 2-4. Logical Channel Allocation - 9402, 9404, and 9406 Six-Line Communications Controllers

Number of Lines	Number of Circuits
1	32 maximum
2	32 maximum for each line
3	32 maximum for each line
4	32 maximum for two lines; 16 maximum for remaining two lines
5	32 maximum for one line; 16 maximum for remaining four lines
6	16 maximum for each line

- The single X.25 line in the multiple function I/O processor on the 9402, 9404, and 9406 System Units is limited to 16 virtual circuits.

Note: There is no correlation between the maximum number of active virtual circuits and the maximum number of X.25 SVC controller descriptions that can exist on the AS/400 system. You can have as many SVC controller descriptions defined on the system as you want.

For more information about the number of lines and the aggregate speed supported by each controller, see the *Communications Management Guide*.

X.25 Line Description Configuration Considerations

An X.25 line description describes the X.25 interface between the AS/400 DTE and the data circuit-terminating equipment (DCE) in the network. A major portion of this interface depends on the actual subscription contracted with the network supplier.

An X.25 line description can also describe the X.25 interface between an AS/400 system acting as a DCE and another system acting as a DTE. In this case, only a modem eliminator (or its equivalent) separates the DCE and the DTE. Configuration considerations for the AS/400 system are discussed in "Connecting Systems without a Network (DCE-to-DTE)" on page 2-7.

All SNA AS/400 controller descriptions that can be created and attached to a synchronous data link control (SDLC) line can also be attached to an X.25 line. Asynchronous communications controllers can be attached to an X.25 line if the corresponding remote DTE is either an asynchronous communications host system

or is attached to a PAD facility. TCP/IP, OSI, and user-defined connections can be established with remote DTEs supporting this type of connection. The X.25 portion of these controller descriptions describes the run-time characteristics of the associated virtual circuit, and for SNA, logical link control (LLC) parameters are provided to allow the logical link station characteristics to be tailored.

The following sections discuss the capabilities, limitations, and values you should be aware of when configuring X.25 lines on your system.

Network Subscription Considerations (DTE-to-DCE)

For describing the interface between a DTE (your AS/400 system, in this case) and a DCE (when the DCE is in an X.25 PSDN), most of the X.25 line description parameters depend on the following information being provided by your network supplier:

DCE clocking rate

The value to be used in the line speed (LINESPEED) parameter of the line description. See Figure 2-1 on page 2-2 for the maximum data rates supported by the AS/400 system over the varying CCITT physical interfaces.

DTE local network address

The value to be used in the local network address (NETADR) parameter of the line description. This address can be 1 to 15 decimal digits.

If your network subscription includes the type of address/numbering plan identification address subscription facility, however, this address can be up to 17 decimal digits. If this facility is subscribed, the first digit is the type of address subfield, and the second digit is the numbering plan Identification subfield.

Logical channel configuration

Information for each logical channel subscribed to in your network subscription includes:

- The logical group and channel numbers.
- The type of logical channel circuit being used (a permanent or switched virtual circuit, abbreviated as PVC or SVC). For SVCs, this includes whether it supports incoming calls, outgoing calls, or both.
- When a PVC is used, the remote DTE to which data over this logical channel is to be routed to and from the network.

With this information, you can specify all the logical channel entries on the logical channel entries (LGLCHLE) parameter in the X.25 line description. For the type of each logical channel circuit (or virtual circuit), you specify one of the following values: *PVC, *SVCIN, *SVCBOTH, or *SVCOUT. Given the PVC routing information, you can correctly associate the PVC controller descriptions with their corresponding PVC logical channels.

When more than one type of virtual circuit is specified in the LGLCHLE parameter, all of the entries for each type should be grouped together. For more information about entering logical channel entries in the X.25 line description, see the description of this parameter in the *OS/400* Communications Configuration Reference* manual.

Physical interface provided

The value to be used for the physical interface (INTERFACE) parameter of the line description.

HDLC link-level modulus

For high-level data link control (HDLC), the AS/400 system supports a frame link-level modulus of 8; this value cannot be configured.

HDLC link-level maximum send and receive window size

The AS/400 system supports an HDLC maximum send and receive window size of 7; this value cannot be configured.

Maximum and default send and receive packet sizes

The maximum packet size supported by the X.25 network, up to the AS/400 system limit of 1024 bytes. Separate transmit and receive values (independent from each other) must be specified in the packet size parameters. These values are specified in the maximum packet size (MAXPKTSIZE) parameter in the line description, and should be greater than or equal to the corresponding values specified in the default packet size (DFTPKTSIZE) parameter. This default packet size value is used for all logical channels defined for an X.25 line. If a different value is supplied in a controller description or in the OSI or user-defined configuration, that value will be used on the associated logical channel.

Packet-level modulus

The value to be used in the modulus (MODULUS) parameter of the line description. Allowed values are 8 and 128.

Default packet-level send and receive window size

The values to be used in the default window size (DFTWDWSIZE) parameter of the line description. Separate transmit and receive values (independent from each other) must be specified in the default window size parameter. Packet-level window size specifies the maximum number of unacknowledged packets that can be outstanding at a given time. Values 1 through 7 are valid if MODULUS(8) is specified; values 1 through 15 are valid if MODULUS(128) is specified. The default value is 2. This window size is used for all logical channels on an X.25 line. If a different value is supplied in a controller description, or in the OSI or user-defined configuration, that value is used on the associated logical channel.

DCE processing overhead and spreading delay of medium to network

These values for either satellite or communications lines, together with the line speed and maximum packet size, are used to determine the idle timer (IDLTMR) parameter value in the line description. For example:

$$IDLTMR \geq (2*p + (MAXPKTSIZE*8)/LINESPEED + o) * 10$$

where:

p = Propagation delay of medium to network (in seconds). For ground lines, p is usually unimportant; for satellites, p can be significant.

o = DCE processing overhead (in seconds).

See the *OS/400* Communications Configuration Reference* manual for the acceptable idle timer values for various combinations of line speeds and packet sizes.

Quality of the communications line to the network

Depending on the line quality (the amount of noise on the X.25 line), the value in the frame retry (FRAMERTY) parameter of the line description can be adjusted. Larger values can allow transparent recovery (to the application program) on a given line during a particularly noisy period. However, too large a value lengthens error reporting time for permanent errors.

Insertion of local network address by the network

Indicates whether it is necessary for the AS/400 system to insert its local network address into every call request and call accept packet. If *YES (the default) is specified in the insert network address in the packets (ADRINSERT) parameter of the X.25 line description, the AS/400 system inserts its local network address in all call request and call accept packets transmitted on the line.

Level of network support available

Specifies whether the network supports the CCITT X.25 Recommendation at the 1980, 1984, or 1988 levels. This value is required for the X.25 network level (NETLVL) parameter when creating SNA controller descriptions.

X.25 Switched Line Considerations

If a switched physical line is used to connect the AS/400 system to the network by specifying CNNTYPE(*SWTPP), the following considerations must be made:

Manual or automatic dial (AUTODIAL parameter)

The call can be established manually or automatically. See the *OS/400* Communications Configuration Reference* manual for a description of manual dial procedures. Automatic dial is accomplished using an automatic call unit (AUTOCALL(*YES)) or using a V.25 bis-capable modem (DIALCMD(*V25BIS)).

Automatic call unit (AUTOCALL parameter)

Automatic dialing can be performed using an automatic call unit. Duplex modems are required to use X.25, while most modems requiring automatic call units are half-duplex.

Connection number (CNNNBR parameter)

The connection number specifies the telephone number of the remote DCE to be dialed if automatic dial or an automatic call unit is being used.

Call immediate (CALLIMMED parameter)

The call immediate parameter specifies whether the AS/400 system is to call the network immediately when the line is varied on. This parameter should be used when the network does not support dialing the AS/400 system and when the remote DTEs may initiate connections (through SVCs) with the AS/400 system.

Generally, the switched disconnect (SWTDSC) parameter should be *NO when the call immediate parameter is specified as *YES.

Switched disconnect (SWTDSC parameter)

The switched disconnect parameter specifies that the switched line should be disconnected when no virtual circuits are active on the line. The switched disconnect timers (SWTDSCTMR parameter) specify the minimum time the line must be connected and the time to wait before switched disconnection. The minimum amount of time the switched line will be connected is:

```
minimum connect timer + disconnection delay timer
```

The default value for the switched disconnect timer is (170,0). Each time a switched line is connected, the connection is maintained for 170 seconds, even if there are no active virtual circuits on the line. If active virtual circuits exist after 170 seconds, the connection is maintained until all virtual circuits become inactive, at which time the switched line is immediately disconnected.

Note: In some countries, the public switched telephone networks restrict the length of time that a voice-grade line can be left connected with no activity on the line. The SWTDSCTMR parameter values may have to be reduced to meet these requirements.

Disconnect timers of (0,0) can be specified; however, this is not recommended because there is not enough time for an incoming SVC to be established before the physical link is disconnected.

If switched disconnection is specified for a line, all active SVCs must be disconnected before the disconnection delay timer starts. For more information on SVC disconnections, see the disconnect timer (DSCTMR) and switched disconnect timer (SWTDSC) parameters in the *OS/400* Communications Configuration Reference* manual.

Network user identification (NETUSRID parameter)

Many networks use the network user identification (NUI) on switched lines for accounting and identification purposes. Contact your network administrator for more information on NUIs. If the NETUSRID parameter is specified, the system encodes the NUI facility on every call request initiated on the line.

The remaining line description parameters do not depend on your network subscription.

Connecting Systems without a Network (DCE-to-DTE)

As described earlier, you can connect your AS/400 system to a DTE by going through a switched or nonswitched modem eliminator (or its equivalent) instead of going through an X.25 network. When this method is used, the AS/400 system acts as a DCE to the remote DTE, and the remote DTE acts as though it is attached to an X.25 network (even though it is not). The remote DTE in this example could be a System/36, System/38, or another AS/400 system. When configuring an AS/400 DCE in this manner, the following considerations apply:

X.25 DCE support (X25DCE parameter)

The AS/400 system should specify *YES for the X25DCE parameter in the line description.

Connection initiation (CNNINIT parameter)

In the DCE line description, specifying *LOCAL for the CNNINIT parameter causes infinite polling of the remote DTE. When *LOCAL is specified, the remote DTE system must specify *NO for X.25 DCE support and specify either *WAIT or *REMOTE for its CNNINIT parameter, or their equivalent values for non-AS/400 systems.

With each line configured as described, either line can be varied on first. The remote system waits for the local system to contact it. If the local system has X.25 DCE support and CNNINIT(*LOCAL) for connection initiation, it will poll the remote system indefinitely or until the remote system responds. Vary the line off if you do not want to establish a connection.

Matching logical channel tables (LGLCHLE parameter)

The logical channel identifiers and types that are specified on the LGLCHLE parameter should match between the AS/400 DCE and the directly attached DTE. For SVCs, this is possible because the channel ordering with X25DCE(*YES) is *SVCOUT, *SVCBOTH, and *SVCIN.

Insert network address into packets (ADRINSERT parameter)

If SVCs are used when connecting an AS/400 system as a DCE without a network to another DTE, both systems must specify ADRINSERT as *YES (or its equivalent) in the line description.

Chapter 3. End-to-End Connectivity Considerations

Just as an X.25 line description describes the interface between data terminal equipment (DTE) and data circuit-terminating equipment (DCE), AS/400 system controller descriptions describe characteristics of remote DTEs. This chapter discusses the controller descriptions and values unique to the X.25 line.

X.25-Specific Values

Several of the values in the controller descriptions are unique to X.25 and depend on the network subscription information. For each of the remote DTEs with which your AS/400 system is communicating, you must determine certain characteristics and configure them in the associated controller descriptions.

Regardless of whether the AS/400 system is connected to the remote DTE through a packet-switching data network (PSDN) or connected directly through a modem eliminator, the remote considerations in this topic are the same. The following characteristics about the remote DTEs determine some of the X.25-specific values for the controller description parameters:

Note: These characteristics are not applicable for users of a network controller, such as Transmission Control Protocol/Internet Protocol (TCP/IP), open systems interconnection (OSI), or user-defined communications.

Type of virtual circuit

Specify whether the connection to the remote DTE is by a permanent virtual circuit (PVC) or a switched virtual circuit (SVC). Your choice of either a PVC or an SVC should be determined by cost and use. The type of virtual circuit is determined by the logical channel entry (LGLCHLE) parameter on the X.25 line description. See "PVC Functions" on page 3-2 or "SVC Functions" on page 3-3 for more information about PVCs or SVCs.

Closed user group identifier of remote DTE

An AS/400 system can call a remote DTE that is subscribed to a closed user group in the network. The value for the initial connection (INLCNN) parameter on the controller description must be *DIAL. The X.25 user group identifier (USRGRPID) parameter in the SVC controller description must match the user group identifier assigned by the network to the remote DTE.

Billing intentions

An AS/400 system normally does not request or accept reverse charging. **Reverse charging** allows the data terminal equipment (DTE) to request that the cost of a communications session be charged to the DTE that is called.

However, the AS/400 system can be configured to request X.25 reverse charging (RVSCRG parameter on the controller description) on outgoing calls, to accept reverse charging on incoming calls, or both. You must determine the type of billing policy to be used for virtual calls to correctly configure your system to handle reverse charging. Reverse charging applies to SVCs only.

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Additional user facilities to be requested

The AS/400 system allows you to request additional network user facilities (besides closed user group, reverse charging, and packet or window size negotiation) by entering the hexadecimal representation of the facilities into the user facility (USRFCL parameter) field of controller descriptions. If the network user identification parameter (NETUSRID) is specified in the line description, the network user identification (NUI) facility is encoded and joined with the facilities listed in the USRFCL parameter of the controller description. The joined NUI facility is then placed in the facility field of CALL REQUEST packets. User facilities apply to SVCs only.

The remaining controller description parameters are dependent on the protocol that is being used on each of the X.25 virtual circuits defined for a line description. See "AS/400-Supported Protocols on an X.25 Virtual Circuit" on page 3-9 for more information about the higher layer protocols that can be used with AS/400 X.25 communications. The following discussions provide a general overview of using X.25 PVCs and SVCs on the AS/400 system.

PVC Functions

PVCs are defined in the line description and may be attached to a controller description. If the PVCs are defined in the line description and not attached to a specific controller, the PVCs become eligible for any application using the network controller that is attached to the line and varied on.

The virtual circuit is established when requested by an application using the network controller or when the controller assigned to the PVC is varied on.

After a PVC has been defined and established, data is transmitted on that PVC as if it were a nonswitched line. Because no call establishment or completion procedures are required on a PVC, it is faster to establish PVCs than SVCs. Therefore, when using X.25 DCE-to-DTE communications over nonswitched lines, it is recommended that PVCs be used whenever possible to eliminate SVC overhead.

When configuring an X.25 logical channel as a PVC, you must be certain that the configuration parameters that are entered on the AS/400 system match the X.25 network subscription characteristics for that logical channel. Parameters such as packet size, packet window size, and modulus must be coordinated before doing the configuration. In addition, the higher layer protocol to be used on each virtual circuit must be coordinated by the two communicating DTEs. If these parameters do not agree, errors can occur either when the virtual circuit connection is first established, or in some cases, only after the local AS/400 system, the network, or a remote DTE detects some violation of this agreement.

The AS/400 system does not support PVCs on physically switched X.25 lines.

SVC Functions

The following topics describe some considerations for the three types of SVC functions supported by the AS/400 system. These types are specified on the logical channel entries (LGLCHLE) parameter in the X.25 line description. The SVC types are:

- SVC incoming call (*SVCIN)
- SVC outgoing call (*SVCOUT)
- SVC incoming and outgoing call (*SVCBOTH)

On a given switched logical channel, a variety of different higher layer protocols are possible at different times. For example, an SVC may be established using the SNA protocol for a short period of time. After that virtual call is ended, another call can be made on the same logical channel. This time, the asynchronous protocol may be used. Later, the protocol could be TCP/IP, OSI, or user-defined.

The higher layer protocol of a call is determined by the first byte of the user data field, called the protocol identifier, in the CALL REQUEST packet. Figure 3-1 defines the hexadecimal protocol identifiers supported by the AS/400 system.

Figure 3-1. AS/400-Supported Protocol Identifiers

Identifier	Protocol
00	OSI connectionless-mode network service inactive subset
01	Asynchronous packet assembler/disassembler (PAD) communications. This ID is sent by an asynchronous PAD or an AS/400 system emulating PAD communications.
03-3F	OSI network connection management subprotocol
81	OSI connectionless-mode network service
C0	Asynchronous host communications
C3	Qualified logical link control (QLLC) with nonextended cause codes (pre-1984 CCITT network level)
C6	Enhanced logical link control (ELLC) with nonextended cause codes (pre-1984 CCITT network level)
CB	QLLC with extended cause codes (CCITT 1984 or 1988 network level)
CE	ELLC with extended cause codes (CCITT 1984 or 1988 network level)
CC	TCP/IP
F0 to FE	OSI Communications Subsystem/400 connection-mode network service on a 1980 X.25 network
None	OSI connection-mode network service
Others	Routed to user-defined communications support

SNA protocol identifiers are derived from the X.25 link protocol (LINKPCL) and X.25 network level (NETLVL) parameters of the controller description for outgoing calls. Incoming calls are screened according to the same parameters. Asynchronous protocol identifiers are derived according to the PAD emulation (PADEML) parameter of the asynchronous controller description. TCP/IP calls always use a protocol identifier of hex CC.

The AS/400 system allows for security when connecting to an X.25 packet-switched network by screening incoming calls according to fields in a CALL REQUEST packet.

Access to an AS/400 system from the X.25 network through any SVC is controlled by the calling DTE network address, together with the protocol identifier and password (SNA only), all of which are located in the 12-byte user data field of an X.25 INCOMING CALL packet.

Figure 3-2 shows the format of the user data field for SNA and asynchronous calls. Note that this field, other than the protocol identifier, will be different for incoming calls associated with TCP/IP, OSI, and user-defined communications. See the *TCP/IP Guide* for a description of the user data field in a CALL REQUEST packet for TCP/IP, the *OSI Communications Subsystem/400 Configuration and Administration Guide* for a description of the user data field in a CALL REQUEST packet for OSI, or the *System Programmer's Communications Interface Guide* for a description of the user data field in a CALL REQUEST packet for user-defined communications.

Figure 3-2. User Data Fields for an SNA and Asynchronous CALL REQUEST Packet

Byte Number	Length (Bytes)	Description of User Data Field
0	1	Protocol identifier. See Figure 3-1 on page 3-3 for a list of possible values.
1	1	Password indicator. Possible hexadecimal values are: 00 No password was sent. 01 A password follows.
2	1	Call or recall indicator, used by ELLC only. Possible hexadecimal values are: 00 Initial call (All non-SNA protocols). 01 Recall to establish a broken connection.
3	1	Reserved (set to 00).
4	8	X.25 network password (SNA only), taken from the X.25 connection password (CNNPWD) parameter of the controller description used for an SVC outgoing call or recall. If the password is less than 8 characters, it is left-justified and padded with blanks. Before a connection can be completed for SVC incoming calls, the password sent by the remote DTE in the incoming call or recall packet must match the password specified in the controller description that describes that remote DTE. Blank or *NONE indicates that a password will not be used; the network password field contains blanks.

Figure 3-3 on page 3-5 illustrates user data formats for a CALL REQUEST packet, created and accepted by the AS/400 system when either no value or *NONE is specified for the CNNPWD parameter of the associated SNA controller description. The CNNPWD parameter contains blanks if a create controller description command is used without specifying this parameter. The CNNPWD parameter contains *NONE if the change controller description command is used. These two values are equivalent.

```
                Byte:   0 1 2 3 4

   Created for *NONE:   pi 01 ci 00 4040404040404040

   Accepted as *NONE:   pi 01 ci 00 4040404040404040
                        pi 00 ci 00
                        pi 00 ci
                        pi 00
                        pi
```

pi SNA protocol identifier

ci Call (or recall) indicator

Figure 3-3. User Data Field Formats for a CALL REQUEST Packet

In the cases where a password is not supplied in the call data, the AS/400 system creates its equivalent of an *NONE password, which is eight blanks (hex 4040404040404040), as shown in Figure 3-3. If this password is used and no corresponding controller is found, the call is rejected and a message is displayed to the local system operator, indicating an incoming call with a password of eight blanks was rejected.

SVC Incoming Call Function

The SVC incoming call (*SVCIN) function, similar to an automatic answer function, includes the automatic answering of calls received on any one of the lines specified in the switched line list (SWTLINLST) parameter of the controller description. The AS/400 system must be prepared to respond to an incoming call.

On the logical channel entry (LGLCHLE) parameter of the Create X.25 Line (CRTLINX25) or the Change X.25 Line (CHGLINX25) command, at least one logical channel entry must be configured as either *SVCIN or *SVCBOTH and cannot already be in use on the active X.25 line. The associated controller description must be varied on (in a vary on pending status) at the time of the call. INLCNN parameter values of *ANS or *DIAL for the controller description are both acceptable for answering incoming calls.

To prepare the AS/400 system to support SVC incoming calls, you must vary on the line, controller, and device descriptions. The following items are also necessary:

- The switched connection number (CNNNBR) parameter on the controller description must match the network address of the calling DTE.

  A controller can be configured to accept any incoming call by creating the controller description with a connection number of *ANY. This does not apply to network controllers. In this case, if the controller description specifies APPN(*YES), the minimum switched status (MINSWTSTS) parameter should be specified as *VRYON so that **advanced peer-to-peer networking (APPN)** (a data communications support that routes data in a network between two or more APPC systems) does not attempt to use this controller for routing unless a connection is already established.

- For SNA, the X.25 link protocol (LINKPCL) parameter in the controller description must match that used by the remote system; for example, *QLLC or *ELLC. However, depending on the network level supported by the remote DTE, two scenarios can occur:

- If a call is received with a protocol identifier (PI) field of hex C3 (QLLC before 1984) and the controller on the AS/400 system is QLLC (at the 1984 or 1988 level), then the call is accepted, but pre-1984 QLLC is used.
- If a call is received with a PI field of hex C6 (ELLC before 1984) and the AS/400 controller is ELLC (at the 1984 or 1988 level), the call is accepted, but pre-1984 ELLC is used.

Note: **QLLC** and **ELLC** are X.25 protocols that allow the transfer of data link control information between two adjoining SNA nodes that are connected through an X.25 packet-switching data network. The QLLC provides the qualifier "Q" bit in X.25 data packets to identify packets that carry logical link protocol information and ELLC enhances error detection and recovery.

- For SNA controller descriptions, the controller that is used to answer the call must contain the associated line name in its switched line list (SWTLINLST). Also, the value supplied for the X.25 connection password (CNNPWD) parameter must match, including use of uppercase or lowercase characters. If the connection password does not match, the call is rejected with a diagnostic message of `Connection identifier mismatch` (hex error code).
- If the call request indicates reverse charging is requested, the X.25 reverse charging (RVSCRG) parameter must indicate support of reverse charging. This does not apply to network controllers.
- A protocol identifier of C0 or 01 causes an attempt to locate an asynchronous controller in the switched controller list of the associated line description. The CNNNBR of one or more of the asynchronous controllers must match the network address of the calling DTE. Otherwise, the CNNNBR of the asynchronous controller must be specified as *ANY. No X.25 connection passwords are used in selecting non-SNA controllers.
- The AS/400 system performs *packet size* negotiation on incoming calls by using the minimum value of the following:
  - The X.25 default packet size (DFTPKTSIZE) parameter in the answering controller description (or in the line description if the value is *LIND). For protocols using the network controller description, the default packet size is obtained from the protocol-specific configuration.
  - The value (if any) included in the incoming call.
  - The X.25 maximum packet size (MAXPKTSIZE) parameter specified in the line description.

  The same negotiation occurs for the *window size* using the following:
  - The X.25 default window size (DFTWDWSIZE) parameter from the answering controller description (or in the line description if the value is *LIND). For protocols using the network controller description, the default window size is obtained from the protocol-specific configuration.
  - The value (if any) included in the incoming call.
  - A maximum of 7 if MODULUS (8) is specified or 15 if MODULUS (128) is specified.

  The resulting negotiated packet and window sizes in use on an active logical channel (with the exception of network controllers) can be displayed using the Display Controller Description (DSPCTLD) command.

The AS/400 system answers an incoming call without intervention. A message confirms this to the system operator. If an error occurs, an error message is displayed to the system operator.

SVC Outgoing Call Function

The SVC outgoing call (*SVCOUT) function includes the automatic selection of a line that is included in the switched line list (SWTLINLST) parameter of the controller description and is available for use.

You can control the line selection method by configuring the X.25 switched line selection (SWTLINSLCT) parameter of the controller description. However, network controllers cannot be switched over X.25 lines.

If *FIRST is specified in the SWTLINSLCT parameter of a controller description, the AS/400 system attempts to use the first line from the switched line list. If the first line is not in the proper state, the AS/400 system moves through the switched line list until an eligible line is found. If no eligible line exists, an error message is sent to the QSYSOPR message queue.

If *CALC is specified in the SWTLINSLCT parameter, the AS/400 system attempts to select a nonswitched line that is varied on or is active with an unused logical channel available for an outgoing call. If no such line is found, the AS/400 system then looks for a switched line that has already established a connection. If a candidate line is still not found, a switched line in connect pending state is selected. If no eligible line exists, an error message is sent to the QSYSOPR message queue.

If a switched line in connect pending state is selected and a subsequent dial fails, a message is displayed in QSYSOPR. This message allows you to cancel the dial, retry the dial, or select the next eligible line from the SWTLINLST according to the line selection method used. If no lines in the SWTLINLST are eligible for selection, an error message is displayed in QSYSOPR.

The AS/400 system must be prepared to place a call establishing the logical link. At least one logical channel entry must be configured as either *SVCOUT or *SVCBOTH, and cannot already be in use on the active X.25 line. The associated controller description must specify INLCNN(*DIAL).

To prepare the AS/400 system to support SVC outgoing calls, you must vary on the line, controller, and device descriptions. The following parameters of the controller description have critical relationships:

- The value in the X.25 default packet size (DFTPKTSIZE) parameter must not be greater than the value in the maximum packet size (MAXPKTSIZE) parameter of the associated line description. This applies to the transmit and receive values, respectively.
- The value in the X.25 default window size (DFTWDWSIZE) parameter must not be greater than 7 if MODULUS(8) is specified in the line description (or 15, if MODULUS(128) is specified). This applies to the transmit and receive values, respectively.
- For SNA, the value in the X.25 link protocol (LINKPCL) parameter in the controller description must match that used by the remote DTE; the value can be either *QLLC or *ELLC. However, depending on the network level supported by the remote DTE, two variations can occur:

- If the AS/400 system makes a call using hex CB (QLLC at 1984 or 1988 level) in the protocol identifier field and the remote DTE rejects the call, the call is tried again using hex C3 (QLLC before 1984).
- If the AS/400 system makes a call using hex CE (ELLC at 1984 or 1988 level) and the remote DTE rejects the call, the call is tried again using hex C6 (ELLC before 1984).

This ability to retry a failing call request allows the AS/400 system to connect to remote SNA DTEs that may not support the DTE-originated extended cause codes defined for CCITT 1984 or 1988, even though 1984 or 1988 was specified in the X.25 network level (NETLVL) parameter of the controller.

- Either an *SVCOUT or *SVCBOTH logical channel must be available when the connection is attempted.
- The program used to communicate with the remote device must be started. You should be aware that starting the subsystem does not start the SVC connection.

  Note: For a user-defined application, you must issue the OPEN command to display the file associated with a device. The device must be configured using the DROP(*NO) option (the file must be closed to cause the SIGNON display to be shown).

  Non-SNA (asynchronous) controllers that use PAD emulation support, by specifying *YES on the PADEML parameter, will not have an SVC connection established at the time the program is started. Instead, connections are established (or disconnected) by CCITT X.28 commands issued within the program to the PAD support. For more information about PAD emulation support, see the *Asynchronous Communications Programmer's Guide*.

After the call request has been sent, the remote DTE answers the call, a connection is established, and a message is displayed to the system operator. If an error occurs, the connection is not established and an error message is displayed to the system operator.

Status Information

There are several configuration status commands that you can use to show dynamically defined configuration values and status information for objects associated with X.25 communications. These include the following:

- The Work with Configuration Status (WRKCFGSTS) command can be used to show the current status of X.25 configuration objects and their connection. A connection between an SVC controller description (not including network controllers) and a line description exists only if the controller has answered or called on that line.

  Network controller descriptions representing SVCs act different than other AS/400 SVC controller descriptions. A network controller description will always have a connection to an associated line description. Therefore, when using the WRKCFGSTS command for a line description, any associated network controller descriptions will always be displayed as being connected to the line description.
- To show the active connections for a network device description on TCP/IP, OSI, or user-defined communications, use the Display Connection Status (DSPCNNSTS) command for the device. When using a network controller and device with an X.25 line, each of these connections corresponds to a connection on a different virtual circuit.

- The Display Controller Description (DSPCTLD) command is used to display the packet and window sizes in use on SVC controllers. These SVC controllers must have a virtual circuit already established (either the controller was varied on or has active controller status).
- The Display Line Description (DSPLIND) command can be used to show the logical channels used by active SVC controllers.

For information about configuration status, see the *Communications Management Guide* and the *OS/400* Communications Configuration Reference* manual.

AS/400-Supported Protocols on an X.25 Virtual Circuit

The AS/400 system supports several different protocols for each virtual circuit. The protocol that is used depends on the definitions given to a particular virtual circuit. For a PVC, both the local and remote DTEs must agree on the higher layer protocol that will be used after HDLC and X.25 communications are established. For SVCs, the value of the protocol identifier in a CALL REQUEST packet dynamically determines the protocol (see Figure 3-1 on page 3-3 for a list of valid protocol identifiers).

The AS/400 system supports SNA, asynchronous, TCP/IP, OSI, and user-defined protocols on a given virtual circuit. The following discussions outline considerations for each of these protocols.

SNA Considerations

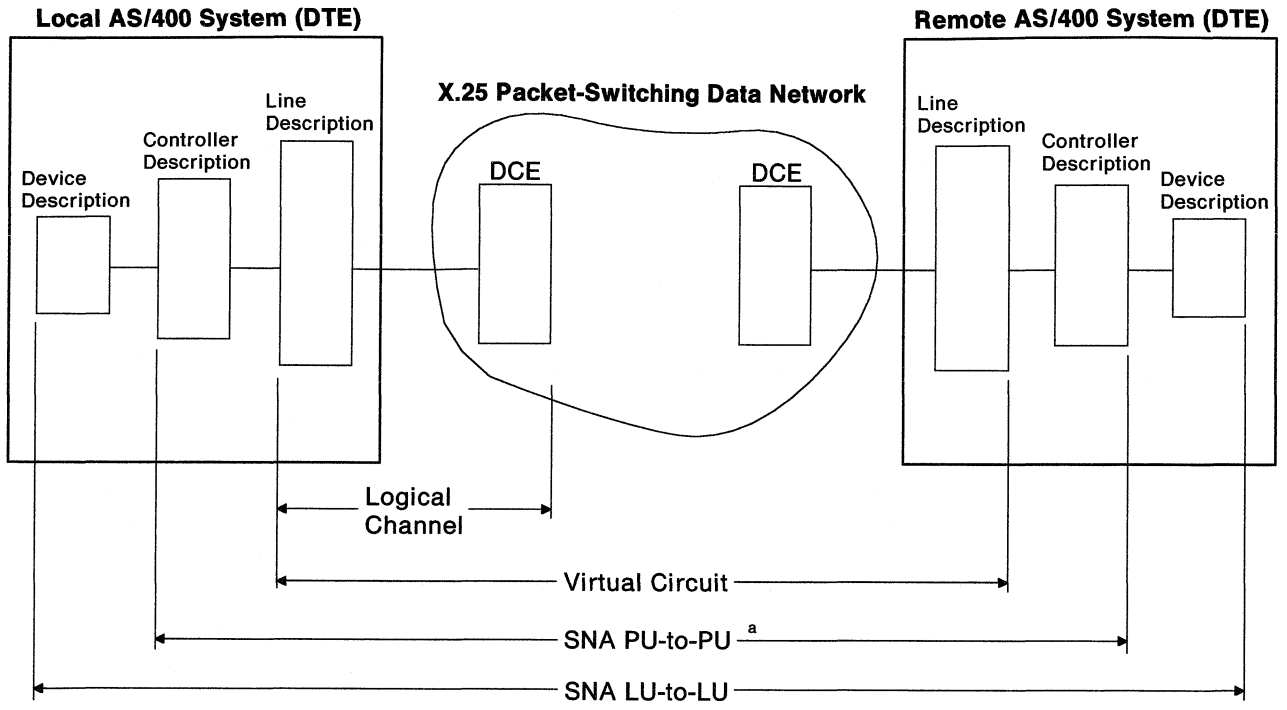
An AS/400 system can communicate with a variety of DTEs using SNA over X.25, both in hierarchical and peer networks. SNA host, remote work station, APPC, finance, and retail controllers all use the SNA protocol and can be configured to use an X.25 line description.

Each AS/400 X.25 line description supports multiple logical channels. The AS/400 X.25 logical channels support virtual circuits, which in turn support logical links, which in turn support the SNA sessions. (Figure 3-4 on page 3-10 illustrates these relationships.)

SNA over X.25

SNA originally operated over transmission mediums using the synchronous data link control (SDLC) protocol. Some of the function performed by SDLC for SNA is not supported by X.25. A layer called the logical link control (LLC) exists between the SNA layers and the X.25 packet layer on a given virtual circuit, and adds the function required by SNA to communicate with the X.25 virtual circuit. Two examples of LLC protocols are qualified logical link control (QLLC) and enhanced logical link control (ELLC).

The LLC layers of two DTEs communicating on a given virtual circuit are sometimes referred to as **adjacent logical link stations**. The information units passed between these stations are called link protocol data units (PDUs). Link PDUs are transported as one or more logically associated packets by the network to the adjacent logical link station.



[a] This is equivalent to a logical link level.
PU = Physical Unit
LU = Logical Unit

RSLN453-3

Figure 3-4. Virtual Circuits in an SNA X.25 Network

In the SNA environment, virtual circuits are viewed as logical links supporting multiple sessions. Several sessions, depending on the SNA controller, may be active over a single virtual circuit. Virtual circuits can be viewed as the logical equivalent of SDLC point-to-point nonswitched or switched lines.

On the AS/400 system, using X.25 with SNA DTEs does not require any additional application programming. After you configure your system for X.25 by creating an X.25 line description and the appropriate controller and device descriptions, no changes are required in any of your existing SNA communications application programs. All SNA session types, including remote job entry (RJE), are supported by the AS/400 implementation of X.25.

The following characteristics about the remote DTEs determine some of the X.25 SNA-specific controller description parameter values that are required to use SNA over an X.25 virtual circuit:

Level of CCITT X.25 support by DTE

If the remote DTE supports only the CCITT 1980 level of X.25, the X.25 network level (NETLVL) parameter in the controller description should specify 1980. If the DTE supports the 1984 or 1988 level, the value of the NETLVL parameter should reflect the level supported by the network (either 1980, 1984, or 1988 level). The following figure shows the recommended value for the NETLVL parameter when different levels of support are specified for the DTE and the network.

Figure 3-5. Level of CCITT X.25 Support

Level of DTE[1]	Level of Network	Suggested NETLVL Value
1980	1980	1980
1980	1984 or 1988 [2]	1980, 1984, or 1988 [3]
1984 or 1988	1980	1980
1984 or 1988	1984 or 1988	1984 or 1988
1988	1988	1988

Notes:

1 If you cannot determine the level of the DTE or the network, specify 1980 for the NETLVL parameter value.
2 The 1988 level can be used in any application where the 1984 level can be used.
3 For PVCs, the 1980 level must be used. For SVCs, either the 1980, 1984, or 1988 level can be used.

Maximum link PDU acceptable by an SNA DTE

In SNA, the maximum length of the protocol data unit (PDU) frame value includes the transmission and request headers, the user data in the request unit (RU), the logical link header (if ELLC is used), plus a constant of 9 bytes. This maximum value can be configured by using the maximum frame size (MAXFRAME) parameter on the create commands for APPC, finance, remote work station, or SNA host controllers. This value can also be changed using the respective controller change commands.

For X.25, this value is limited to a maximum of 1033 bytes regardless of the maximum packet size used. The default value is 1033 where the 9-byte constant that the AS/400 system uses is subtracted, resulting in 1024. This length is used by X.25. This 9-byte constant is also subtracted from the other SDLC lengths that are valid for X.25. For example, 521 − 9 = 512 bytes. For more information about the use of SNA RUs with X.25, see "Request Unit Sizes" on page 3-13.

For best performance, it is recommended that the default of 1033 be used if the remote DTE can support a PDU length that long.

Logical data link role for SNA DTEs (APPC only)

The data link role (ROLE) parameter of the remote DTE can be specified as primary (*PRI), secondary (*SEC), or negotiable (*NEG). If *NEG is used, the AS/400 system dynamically negotiates the link station roles during logical link establishment with the remote DTE.

Exchange identifier of remote DTEs

If the exchange identifier value is supplied in the exchange identifier (EXCHID) parameter of the controller description and if that value is different from the exchange identifier received from the remote DTE, the AS/400 system will not establish a connection.

Logical link protocol used for SNA communications

The AS/400 system supports two logical link control (LLC) protocols:

Qualified The qualified logical link control (QLLC) protocol provides additional function required for SNA connections that is not available in X.25. QLLC has very low protocol overhead; however, it provides no end-to-end (DTE-to-DTE) acknowledgment of logical link control protocol data units (LLC PDUs) carrying user data. QLLC provides an efficient logical link control when used in a reliable network.

Enhanced The enhanced logical link control (ELLC) protocol performs the same base function as QLLC. In addition, it includes enhanced logical link error recovery procedures (using transparent recovery for recoverable failures), additional checksum protection, and sequencing (to guard against lost or duplicate data). The intent is to compensate for an unreliable network.

This, however, is not without additional effects on performance that are caused by protocol overhead and by longer delays before failures are reported.

Your protocol choice depends on what protocol the remote DTE is limited to, cost, and network reliability. The protocol selected for the remote DTE must be reflected in the X.25 link protocol (LINKPCL) controller description parameter.

Logical Link Control Parameters

The following logical link timer parameters in the controller description apply to both the QLLC and ELLC protocols:

X.25 frame retry (X25FRMRTY parameter)

This value is the maximum number of times that a PDU of data or of logical link disconnection can be transmitted if no acknowledgment is received from the adjacent logical link station in the remote DTE during the time specified by the X.25 response time (X25RSPTMR) parameter.

This parameter applies principally to controllers specifying LINKTYPE(*ELLC), and represents the ELLC PDU retry timer. For controllers specifying LINKTYPE(*QLLC), this parameter applies only to logical link disconnection timing because data PDUs are never retransmitted DTE-to-DTE. Valid values are 0 (no frames retransmitted) through 21. The default is 7.

If this retry limit is reached, the controller is considered inoperative and second-level error recovery procedures are started.

X.25 connection retry (X25CNNRTY parameter)

This value is identical to the X.25 frame retry (X25FRMRTY) parameter value except that this value applies only to LLC connection establishment. Values are 0 (no frames retransmitted) through 21. The default is 7.

This parameter is valid only if the ROLE parameter does not specify *PRI, and the X.25 delayed connection timer (X25DLYTMR) parameter specifies *CALC.

X.25 response timer (X25RSPTMR parameter)

This value is the maximum amount of time allowed (in intervals of 0.1 second each) between sending a command and the receipt of a corresponding acknowledgment from the adjacent link station on the remote DTE. This parameter applies to controllers specifying LINKTYPE(*ELLC). The X25RSPTMR parameter represents the ELLC PDU response timer used to detect the failure to receive a required acknowledgment or response from the remote link station. For LINKTYPE(*QLLC), this parameter applies only to logical link disconnection timing.

The parameter should be set to exceed the DTE-to-DTE delay plus the DTE processing overhead. Values are 1 through 2550. The default is 300 (or 30 seconds).

X.25 connection timer (X25CNNTMR parameter)

This value is identical to the X.25 response timer, except that this value applies only to establishing the LLC connection. Values are 1 through 2550, in 0.1 second intervals. The default is 300.

This parameter is valid only if the ROLE parameter does not specify *PRI, and the X25DLYTMR parameter specifies *CALC.

X.25 delayed connection timer (X25DLYTMR parameter)

This value is the time between retries when the system is trying to establish a connection to the remote controller. Values other than the default (*CALC) can be specified only for permanent virtual circuits (PVCs) for which the role of the remote DTE is not primary. If the initial attempt to establish a connection is not successful, periodic attempts are made to contact the remote controller. This timer helps to minimize peer system coordination at vary-on time.

Valid values are from 1 through 32 767 (in 0.1 second intervals) or the default value *CALC. For example, a value of 20 for this parameter means that the time between retries is 2 seconds. *CALC means the AS/400 system uses the values specified for the X25CNNRTY and X25CNNTMR parameters in the controller description to determine how often and how long to try to establish the connection. Values other than *CALC result in the AS/400 system attempting to establish a connection indefinitely, using the given value as the time-out between retries.

When you are testing a new configuration, you should use *CALC for this parameter until you have finished testing. If you were to specify any value other than *CALC, it is possible that a configuration error could be undetected.

ELLC Parameters

If the ELLC protocol is chosen, the following controller description parameters also should be considered:

X.25 acknowledgment timer (X25ACKTMR parameter)

This value is the maximum time allowed between the receipt of the LLC PDU and sending a corresponding acknowledgment. This value is used to make maximum use of sending acknowledgments in outgoing LLC PDUs. The value selected must be considerably less than the ELLC PDU response timer of the remote station so that the remote station response timer does not end before the delayed acknowledgment arrives.

```
Local DTE LT2     <   Remote DTE LT1
(in X25ACKTMR)        (in X25RSPTMR)
```

Acceptable values are 0 and 20 through 2550. Zero indicates no waiting; the acknowledgment is to be sent immediately. Values 20 through 2550 specify the delay time (in 0.1 second intervals) between receiving the LLC PDU and sending back the acknowledgment. The default value is 20 (or 2 seconds).

X.25 inactivity timer (X25INACTMR parameter)

This value is the maximum amount of time that a link station allows the connection to remain in a NO TRAFFIC state. ELLC uses this timer to detect an inoperable condition in the remote link station or media after the link connection is established. Valid values are 1 through 2550 (0.1 through 255 seconds, in 0.1 second intervals). The default is 1050 (or 105 seconds).

Request Unit Sizes

The AS/400 system allows you to specify a value for the RU size, or it will dynamically generate an optimum value. If you specify the value *CALC (the default) for the maximum length RU (MAXLENRU) parameter in a mode (APPC) description or in device descriptions that have this parameter, the AS/400 system determines the best RU size to be used for devices attached to an X.25 controller.

When specifying values other than *CALC, you should try to use RU sizes that, together with your packet size and protocol, minimize communications costs. For example, assume that your subscription requires 128-byte packets and the protocol to be used between the DTEs is ELLC (which requires 6 bytes for the LLC header). If you specify an RU value of 241, the data, together with the 9 bytes of SNA headers and the 6 bytes for the LLC header, fills two packets exactly. Specifying a larger RU size creates the need for a third packet to accommodate the excess over the 256 bytes contained in two packets. See the chart of optimal maximum RU sizes under the MAXLENRU parameter of the Create Mode Description (CRTMODD) command in the *CL Reference* manual.

Figure 3-6 shows how user data in RUs is mapped into HDLC frames.

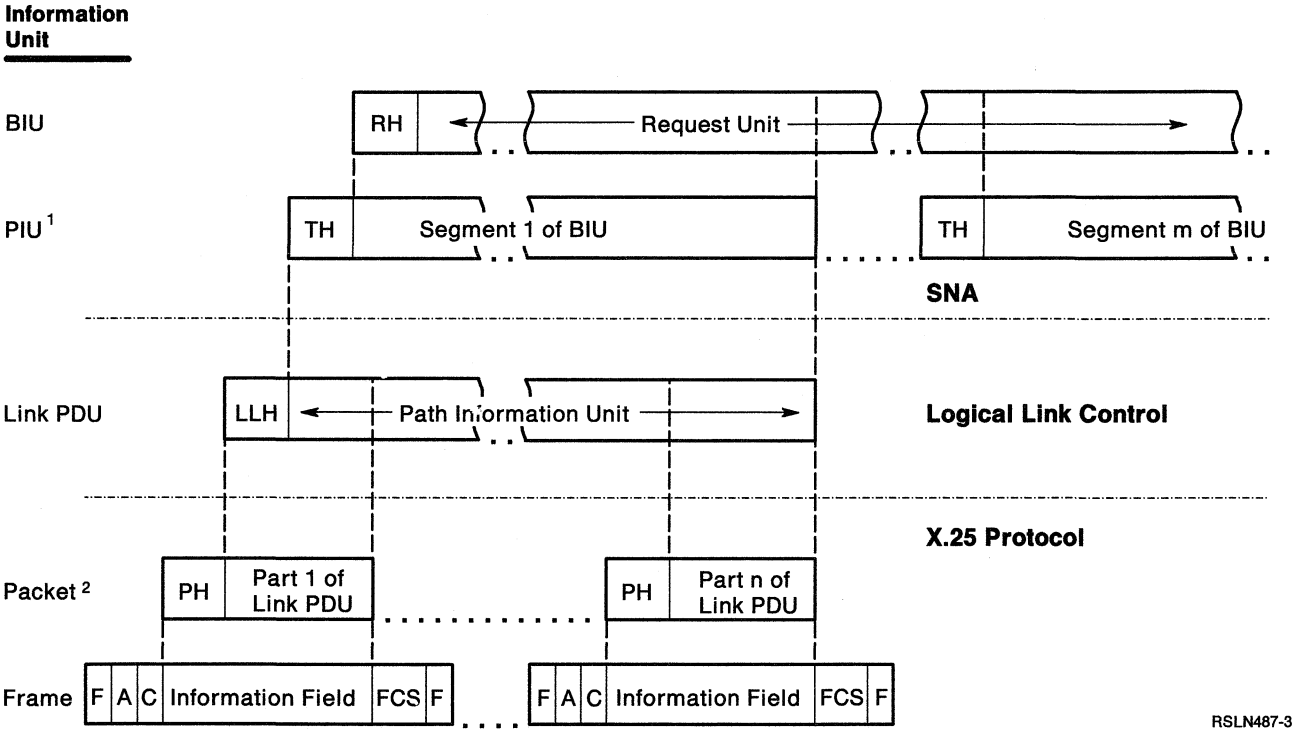


Figure 3-6. Mapping of SNA User Data Sent or Received over an X.25 Line

Abbreviation	Description
BIU	Basic information unit
RH	Request header (3 bytes)
RU	Request unit (length is less than or equal to the value in the MAXLENRU parameter of either the mode or device description)
PIU	Path information unit
TH	Transmission header (6 bytes, for example, when APPC is used)
Link PDU	Logical link control (LLC) protocol data unit (length is less than or equal to the value in the MAXFRAME parameter in the controller description, *less 9 bytes*)
LLH	Logical link header (0 bytes for QLLC; 6 bytes for ELLC)
PH	Packet header (3 bytes if MODULUS(8) is specified in the line description; 4 bytes if MODULUS(128) is specified)
F, A, C	Flag, address, and control fields (1 byte each)
FCS	Frame checking sequence field (2 bytes)

Notes:

1. In the SNA level, BIUs can be divided into several segments called path information units (PIUs). Segmenting occurs whenever the size of the request unit (RU) to be sent is greater than the maximum frame size specified in the MAXFRAME parameter of the corresponding controller description, less the 18 bytes for QLLC, or 24 bytes for ELLC.
2. In the X.25 level, packets are created (disassembled) from the PDUs that were created in the logical link control level. Packet disassembly is the process of breaking up link PDUs into individual packets to send through the X.25 network. This process occurs when the Link PDU size is greater than the X.25 default transmit packet size specified in the DFTPKTSIZE parameter of the corresponding controller description or the line description. The length of each packet, less the packet header (PH) length, is less than or equal to the value in the DFTPKTSIZE parameter in the line description.

Figure 3-6 on page 3-14 shows the different levels of breaking basic information units (BIUs) into smaller PIUs at the SNA level, into PDUs at the logical **link level** (a link protocol used to get data into and out of the network across the duplex line connecting the subscriber's equipment to the network), and into packets and X.25 HDLC frames at the X.25 level.

Asynchronous Communication Considerations

The AS/400 system supports connections to asynchronous communications host systems and to asynchronous devices through the X.25 network PAD facility. An AS/400 system also provides an integrated PAD function that allows you to configure the AS/400 system to perform PAD emulation. Asynchronous communications can be used on both SVCs and PVCs over an X.25 line. You can create asynchronous controllers and devices that are associated with one or more X.25 line descriptions. For more information about asynchronous communications using X.25, see the *Asynchronous Communications Programmer's Guide*.

When a PVC is established, asynchronous communications can be started. No special PVC initiation protocol is needed. The configuration characteristics to be used on the PVC must be coordinated between the local AS/400 system and the remote DTE. These characteristics must match the network subscription information assigned to each DTE. After the configuration has been completed, the PVCs defined for asynchronous communications should be ready for use.

When an SVC connection is established, characteristics for SVCs may be dynamically negotiated. There are several considerations that apply to starting and configuring an SVC to allow asynchronous communications.

Switched asynchronous controllers can be configured to accept calls from a specific group of selected network addresses. In this case, you must create a separate SVC controller and device for each remote DTE that the AS/400 system is to accept calls from. The AS/400 system then accepts calls from a remote DTE that has a network address with the following traits:

- The address matches the connection number parameter in a switched asynchronous controller that is in the proper state.
- The controller is in the switched controller list (SWTCTLLST) of the associated line description.

On your system, you can configure generic switched asynchronous communications controllers and devices. The use of these configurations allows the AS/400 system

to accept calls from remote DTEs whose network addresses are not specifically configured. The first available generic controller specified in the switched control list (SWTCTLLIST parameter) of the line description is used to accept the call. For more information on configuring generic controllers and devices, see the *Asynchronous Communications Programmer's Guide*.

When the call is accepted, the local location name associated with the call becomes the remote location name of the asynchronous device attached to the controller accepting the call.

When the AS/400 system makes outgoing calls for the X.25 network using asynchronous communications, the protocol identifier is placed in the CALL REQUEST packet based on the setting of the pad emulation (PADEML) parameter in the selected controller description. The X.25 line description over which the call will be made is selected from the switched line list (SWTLINLST parameter) in the controller description. See "SVC Outgoing Call Function" on page 3-7 for more information about the line selection process.

TCP/IP Considerations

The AS/400 system supports connections to a remote TCP/IP-capable host system over X.25 switched virtual circuits. Each network controller on the AS/400 system defines one or more virtual circuits through an X.25 packet-switched network to adjacent IP nodes or gateways. All virtual calls that are associated with TCP/IP use a protocol identifier of hex CC.

For more information about TCP/IP communications using X.25, see the *TCP/IP Guide*.

OSI Considerations

OSI support on the AS/400 system allows connections to processors and other equipment (nodes) in an OSI network using X.25 communications. The nodes in the OSI network may be homogeneous, or they may be a collection of heterogeneous systems (produced by IBM* or other equipment manufacturers). AS/400 support of OSI allows communications to other nodes on the network using the OSI protocol established by the International Organization for Standardization (ISO).

OSI communication using X.25 is allowed on SVCs. Each network controller on the AS/400 system defines one or more virtual circuits through an X.25 packet-switching data network (PSDN). The virtual circuits defined by a network controller may be used for TCP/IP, user-defined, or OSI communications.

Similar to other protocols using X.25 on the AS/400 system, OSI also uses the X.25 protocol ID to filter inbound calls. On the AS/400 system, if an inbound call is received that has one of the SNA or asynchronous protocol IDs, the AS/400 system attempts to route the call to the SNA or asynchronous applications. If an SNA or asynchronous controller description with a matching network address is not found, the call is routed to TCP/IP, OSI, or user-defined communications support. See Figure 3-1 on page 3-3 for a list of AS/400-supported protocol identifiers.

OSI also accepts calls with no protocol ID when X.25 at the CCITT 1984 level is used. For more information about using the OSI protocol in an X.25 network, see the *OSI Communications Subsystem/400 Configuration and Administration Guide*.

User-Defined Communications

User-defined communications support provides a functional interface that allows an application program to use specific data or functions of the system or licensed program. This **application program interface (API)** is used to access data link control support on the AS/400 system. The interface supports X.25 and local area networks (token-ring or Ethernet) and uses network controllers and devices. User-defined communications using X.25 is allowed on SVCs and PVCs. This API allows users to write applications written for a user-defined protocol to communicate with other systems which use the same protocol.

Since the protocol is user-defined, the content of the X.25 calls (for example, protocol ID) and other X.25 packets is supplied by the user-defined application.

For more information about user-defined communications using X.25, see the *System Programmer's Communications Interface Guide*.

Chapter 4. Performance Considerations

The total data **throughput** (the traffic between stations over a period of time) for a given X.25 line on an AS/400 system is defined to be the sum of the user data transmissions that occur in both directions (X.25 is always duplex) across the data link. Because this value is determined by several limiting factors, total saturation of the **bandwidth** (the capacity of the communications line) provided by a given line speed is unlikely. Some of these limiting factors include:

- Line speed (DCE clocking rate), which provides the upper limit on throughput
- Efficiency of the logical link control (LLC) and packet protocols (the ratio of user data to protocol overhead bits)
- Packet processing capacity of the AS/400 X.25 communications controller
- Processing load on the AS/400 system and the DCE

For more information about X.25 performance considerations, see the *Communications Management Guide* where various data link protocol considerations are discussed.

Line Speed

Line speed is the bit-per-second rate of the line to the network (DCE clock speed). This value is usually negotiable with the network supplier. The line speed determines the maximum upper limit of data throughput in one direction. An increase in the line speed may not increase data throughput because of other limiting factors.

Protocol Efficiency

The packet and the logical link protocols create an overhead in the transmission of user data. Because this overhead is constant, increasing the packet size to the limit allowed by the network improves performance without increasing the packet overhead.

The maximum packet size is not a DTE-to-DTE restriction for most networks. DTE-to-DCE is the common restriction and is limited by the network supplier. For example, when attaching the DTE with a maximum packet size of 64 bytes to an AS/400 system through an X.25 network with a maximum packet size of 1024 bytes, the AS/400 system can send 1024-byte packets on the logical channel to the remote DTE. It is the responsibility of the network to create the X.25 packets so that they contain a maximum of 64 bytes for the remote DTE, if the remote DTE subscription indicates a maximum packet size of 64 bytes.

Packet Processing Capacity

The packet level protocol provides the multiplexing support for multiple virtual circuits for a given X.25 line. It should be noted that each virtual circuit competes for the total bandwidth available on the line to the network. As the number of virtual circuits is increased, it is possible that the throughput of the individual virtual circuits will decrease.

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Processing Loads

For each X.25 communications controller, the AS/400 system has some processing limitations that affect the number of lines, the line speeds, and the total number of virtual circuits that can be used. Overhead can be reduced by observing these limitations. For more information on the limitations and capabilities of the X.25 communications controller on the AS/400 system, see "AS/400 X.25 Capabilities" on page 2-2.

Chapter 5. X.25 Error Recovery and Problem Isolation

Errors can occur on any of the three layers of X.25. Errors associated with X.25 communications are reported in the **system operator message queue** (QSYSOPR), which logs the error messages sent from the system. These errors can occur at the physical layer, the data link control layer, or at the packet layer.

Physical Layer Errors

The physical interface is how a data terminal equipment (DTE) is physically connected to its corresponding network data circuit-terminating equipment (DCE). Errors that occur on this layer are the result of problems with the medium. For example, these errors can be caused by a modem or cable that is not installed correctly or is defective. Frequently, physical interface errors result in signalling problems such as data set ready, clear to send, or request to send errors and drops.

Data Link Control Errors

The high-level data link control (HDLC) layer is the layer used to support X.25 communications. The AS/400 system uses a subset of HDLC, called link access protocol-balanced (LAPB), for X.25 data link control. Link level errors can occur at the data link layer for a variety of reasons. Errors such as HDLC retry limits reached, frame reject sent or received, or a disconnect (DISC) sent or received are just a few examples of some common HDLC layer errors. These errors can be caused by modem or cable problems, configuration problems, or mismatched network subscription and AS/400 configuration problems. Information in the QSYSOPR message queue should provide an indication of what type of error is occurring and possible causes.

Errors related to the HDLC layer do not produce any cause and diagnostic codes. These errors must be isolated using information provided in the QSYSOPR message queue.

X.25 Packet Layer Errors

There are several possible causes for X.25 packet layer errors. Some of the errors may be a part of normal X.25 communications. Other errors may be caused by configuration mismatches or network problems.

To isolate and identify the cause of errors, a set of International Telegraph and Telephone Consultative Committee (CCITT) and Systems Network Architecture (SNA) cause and diagnostic codes are defined. These codes should help you understand why and where X.25 packet layer errors are occurring. These cause and diagnostic codes are sent or received in CLEAR, RESET, RESTART REQUEST or INDICATION, or DIAGNOSTIC packets. These cause and diagnostic codes are very valuable in isolating X.25-related errors.

The CCITT recommendation for X.25 defines 200 seconds as the time-out value during, which time a corresponding acknowledgment must be received for a CALL REQUEST, CLEAR REQUEST, or RESET REQUEST. The AS/400 X.25 adapter supports these CCITT-defined time-outs.

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Note: These codes may be application-specific for user-defined communications applications.

Because the Vary Configuration (VRYCFG) command has a much shorter relative time duration, a situation can develop where the X.25 controller is performing the time-out at the same time that the AS/400 system considers the virtual circuit closed and available for work.

Because of this situation, it is possible for subsequent vary-on operations in the time-out interval to fail. For a switched virtual circuit (SVC), this can only occur if all defined SVC circuits are active, including those still in recovery. For a permanent virtual circuit (PVC), an attempt to vary on the same controller may fail. This is a temporary problem. Subsequent retries, after approximately 400 seconds (the original packet acknowledgment time-out plus one retry), should work.

It is important to note that these long time-out values usually occur as the result of a configuration error. The AS/400 system sends a message to QSYSOPR after all time-out intervals have ended. You should wait the appropriate amount of time to receive the proper failure message. At that time, the message sent to QSYSOPR describes the failure and provides some possible causes. This time might be anywhere from a few seconds to 7 minutes for errors that require 400 second time-out periods.

Finding Cause and Diagnostic Codes

On the AS/400 system, cause and diagnostic codes can be retrieved in a variety of ways, which include:

- Looking at the message help in the QSYSOPR message queue

  When you use the command DSPMSG QSYSOPR, the first level text of the message queue QSYSOPR is displayed. Move the cursor to a specified message and press the Help key to display the second level text of the message. Also shown with the second level text is the message ID, the error log ID, and other vital data. The X.25 cause and diagnostic codes are contained in the X.25-related error messages or in the error log.

- Taking a communications trace during an X.25 communications error

  Included in the data field of all CLEAR, RESET, RESTART REQUEST or INDICATION, and DIAGNOSTIC packets are 2 bytes of data. The first byte of data is the cause code field, and the second byte of data is the diagnostic code field. It is also important to notice whether the AS/400 system has sent or received a packet containing cause or diagnostic codes. The meaning of the codes can then be determined.

Determining the Meaning of Cause and Diagnostic Codes

The X.25 cause code can be used to determine the source of an error, while the diagnostic code is used to supply further information about why the packet was transmitted. See Chapter 6 for information about the meanings of X.25 cause codes. See Chapter 7 for information about the meanings of X.25 diagnostic codes. Note that the figures in Chapter 6 and Chapter 7 are included for reference only and may vary according to the implementation of different networks and DTEs. These codes may also vary as the CCITT and ISO-8208 standards are changed.

Note: When using user-defined communications applications, these codes may be application-specific.

The cause and diagnostic code figures in Chapter 6 and Chapter 7 are arranged according to the source of the errors, such as AS/400-generated, non-AS/400 DTE-generated, or network-generated codes. Also, because the SNA and the CCITT and ISO-8208 diagnostic codes may differ slightly in meaning, both figures are included in the reference topics.

After gathering the cause and diagnostic code information from messages or communications traces, you can use the figures that show the cause and diagnostic codes in Chapter 6 to determine the meanings for the codes.

Chapter 6. X.25 Cause Codes

The International Telegraph and Telephone Consultative Committee (CCITT) has defined 1-byte cause and diagnostic code fields to indicate why CLEAR, RESET, and RESTART REQUEST or INDICATION packets are transmitted for the X.25 protocol. The source of the error, such as the remote data terminal equipment (DTE) or X.25 network data circuit-terminating equipment (DCE), can be determined by the value of the cause code. The AS/400 system uses **cause codes** to communicate that the error condition was detected by a DTE (the AS/400 system in this case). Cause codes do not necessarily denote the reason for the error, as do **diagnostic codes**, cause codes denote only the source of the error.

Specific information about errors can be determined by the value of the diagnostic code. Chapter 7 contains diagnostic error codes and information about their significance. DIAGNOSTIC packets are created only by the X.25 network and contain only a diagnostic code.

X.25 Cause Codes Generated by the AS/400 System

This section explains the X.25 cause codes generated by the AS/400 system. Cause codes produced by the X.25 network or the remote DTE can have different meanings than those produced by the AS/400 system.

The AS/400 system generates two values for the X.25 cause code field. These hexadecimal values, as displayed by the AS/400 system, are shown in Figure 6-1.

Figure 6-1. X.25 Cause Codes Generated by the AS/400 System

Code	Description
00	CCITT 1980 DTE-generated cause code. Used if the controller description on the AS/400 system has 1980 selected in the X.25 network level (NETLVL) parameter, and if TCP/IP, OSI, user-defined, or asynchronous communications using X.25 protocol is being used.
80	CCITT 1984 DTE generated extended cause code. Used if the controller description on the AS/400 system has 1984 or 1988 selected in the X.25 network level (NETLVL) parameter. This cause code value is **not** used for TCP/IP, OSI, user-defined, or asynchronous communications using X.25.

A value of 1980 should be used when the X.25 network does not support the CCITT 1984 level. Otherwise, the choice depends on the level of support by the remote DTE.

Any other cause code value should be interpreted as being generated by the X.25 network. The network administrator should be able to identify the meaning of the cause code.

When using SNA communications and enhanced logical link control (ELLC) as the logical link protocol, the AS/400 system uses X.25 cause codes received in RESTART, RESET, and CLEAR INDICATION packets to determine if a failure is recoverable. An error is not considered recoverable if the cause code is interpreted as being generated by the DTE. However, if the cause code is interpreted as being generated by the network, ELLC attempts recovery. An incorrect setting of the X.25 network level (NETLVL) parameter in the controller description can delay ELLC recovery procedures.

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Note: The AS/400 system attempts to recall any calls (using the CCITT 1980 level) that are rejected by a remote DTE and are defined in the controller description to support the CCITT 1984 level. If the call using the 1980 level is also rejected, the AS/400 system indicates that the call was cleared.

CCITT X.25 and ISO-8208 Cause Codes

The following figures show the CCITT X.25 and ISO-8208 cause codes. These cause codes can be produced by the X.25 network or the remote DTE and can be received in CLEAR, RESET, or RESTART INDICATION packets. Note that these cause codes are defined by the standards and can be defined differently by networks or remote DTEs not conforming to CCITT X.25 and ISO-8208 standards. The standardized cause codes provided here will help with problem analysis. Because the CCITT X.25 and ISO-8208 standards are subject to change, the information provided may vary.

Figure 6-2 shows the hexadecimal cause codes in CLEAR INDICATION packets.

Figure 6-2. CCITT X.25 and ISO-8208 Cause Codes in CLEAR INDICATION Packets

Public Data Network	Private Network or DTE	Cause Code Description
	00	1980 DTE-originated (See diagnostic code for more information.)
	80	1984 DTE-originated (See diagnostic code for more information.)
01	81	Number busy
03	83	Facility request not valid
05	85	Network congestion
09	89	Out of order
0B	8B	Access barred
0D	8D	Not obtainable
11	91	Remote procedure error
13	93	Local procedure error
15	95	Recognized Private Operating Agency out of order (1)
19	99	Reverse charging acceptance not subscribed (1)
21	A1	Destination not compatible
29	A9	Fast select acceptance not subscribed (1)
39	B9	Ship absent
	C1	Gateway-detected procedure error
	C3	Gateway congestion

Note:

Blanks indicate that codes do not apply.

(1) Indicates receipt only if the optional user facility is used by the network.

Figure 6-3 shows the hexadecimal cause codes in RESET INDICATION packets.

Figure 6-3. CCITT X.25 and ISO-8208 Cause Codes in RESET INDICATION Packets

Public Data Network	Private Network or DTE	Cause Code Description
	00	1980 DTE-originated (See diagnostic code for more information.)
	80	1984 DTE-originated (See diagnostic code for more information.)
01	81	Out of order (1)
03	83	Remote procedure error
05	85	Local procedure error
07	87	Network congestion
09	89	Remote DTE operational (1)
0F	8F	Network operational (1)
11	91	Destination not compatible
1D	9D	Network out of order (1)
C1	C1	Procedure error detected by gateway
C3	C3	Gateway congestion
C7	C7	Gateway operational

Note:

Blanks indicate that codes do not apply.

(1) Applicable to permanent virtual circuits only.

Figure 6-4 shows the hexadecimal cause codes in RESTART INDICATION packets.

Figure 6-4. CCITT X.25 and ISO-8208 Cause Codes in RESTART INDICATION Packets

Public Data Network	Private Network or DTE	Cause Code Description
00	80	DTE originated (1)
01	81	Local procedure error
03	83	Network congestion
07	87	Network operational
7F		Registration or cancelation confirmed (2)

Note:

(1) This restarting cause applies only to a DTE-to-DTE environment. All others apply only to a DTE-to-DCE environment.

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

Chapter 7. X.25 Diagnostic Codes

The interpretation of diagnostic code values is slightly different for Systems Network Architecture (SNA) using X.25 versus International Telegraph and Telephone Consultative Committee (CCITT) and International Organization for Standardization (ISO) X.25 recommendations. The selection of the two types by the AS/400 system depends on the situation. The standardized diagnostic codes provided here will help with problem analysis. Because the CCITT X.25 and ISO-8208 standards are subject to change, the information provided may differ slightly from later standards documents.

For more information about diagnostic codes being received by the AS/400 system, see the following topics, "Diagnostic Codes Generated by the X.25 Network" on page 7-6, "SNA Diagnostic Codes Generated by the DTE" on page 7-8, or "CCITT X.25 and ISO-8208 Diagnostic Codes" on page 7-11.

X.25 Diagnostic Codes Generated by the AS/400 System

Figure 7-1 on page 7-2 shows the SNA and the CCITT and ISO X.25 hexadecimal diagnostic codes generated by the AS/400 system, along with their descriptions and possible causes. The AS/400 system uses CCITT/ISO diagnostic codes for failures that cannot be attributed to any certain controller description. For errors associated with a certain asynchronous X.25 controller description or a network controller description, the AS/400 system uses CCITT/ISO diagnostic codes as well. For all other controller description types, the AS/400 system generates SNA diagnostic codes.

For messages indicating a failure on a particular controller description, the X.25 diagnostic code type, if present, reflects the controller description type, as indicated in the previous paragraph. Otherwise, CCITT/ISO diagnostic codes can be assumed. Note the considerations for the following figure:

- The diagnostic codes are listed in hexadecimal format, as displayed by the AS/400 system.
- The possible causes are listed in the order they are likely to occur. The explanations for possible causes follow the figure.
- Some CCITT/ISO diagnostic codes could appear in multiple entries of the figure. The associated causes from all the duplicate entries should be considered as possible causes. Use the diagnostic code description to help determine what the most likely causes of the errors are.
- Not applicable (NA) means an equivalent diagnostic code is not defined.

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Figure 7-1 (Page 1 of 3). X.25 Diagnostic Codes Generated by the AS/400 System

SNA	CCITT/ISO	Diagnostic Code Description	Possible Cause (Explanation follows figure)
00	00	Normal communication ending	
0C	NA	Logical link control (LLC) type not valid	13, 12
11	11	Packet type received in state r1 not valid	2
13	13	Packet type received in state r3 not valid	2
14	14	Packet type received in state p1 not valid	4, 2
15	15	Packet type received in state p2 not valid	2
16	16	Packet type received in state p3 not valid	2
17	17	Packet type received in state p4 not valid	2
18	18	Packet type received in state p5 not valid	2
1A	1A	Packet type received in state p7 not valid	2
1B	1B	Packet type received in state d1 not valid	4, 2
1D	1D	Packet type received in state d3 not valid	2
24	34	DCE indicated that the local system did not respond in time to a previously sent RESTART INDICATION packet.	7, 1
31	31	Time-out on CALL REQUEST packet	4, 2, 20
32	32	Time-out on CLEAR REQUEST packet	4, 2, 20
33	33	Time-out on RESET REQUEST packet	4, 2
34	34	Time-out on RESTART REQUEST packet	7, 2
50	NA	Unexpected general error (QLLC or ELLC)	3, 2, 1
51	NA	Control field in received link PDU is not defined (QLLC or ELLC).	3
52	NA	Control field in received link PDU is not expected (QLLC or ELLC).	3
53	NA	Information field missing from received link PDU (QLLC or ELLC)	3
54	NA	Information field in received link PDU is not defined (QLLC or ELLC).	3
55	NA	Information field in received link PDU is too long (QLLC or ELLC).	3
56	NA	Link PDU frame reject received (QLLC or ELLC)	1, 3
57	NA	LLC header not valid (QLLC or ELLC)	3, 2
58	NA	Data received in incorrect state (QLLC or ELLC)	13, 3
59	NA	No response received in required time (QLLC or ELLC)	18, 3, 12
5A	NA	Number received sequence count, for example, N(r) in received link PDU is not valid (ELLC).	3
5B	NA	Logical link recovery rejected or ended (ELLC)	3, 1

Figure 7-1 (Page 2 of 3). X.25 Diagnostic Codes Generated by the AS/400 System

SNA	CCITT/ISO	Diagnostic Code Description	Possible Cause (Explanation follows figure)
A0	2B	INTERRUPT CONFIRM packet received but not authorized	3, 2
A1	A5	Nonfull packet indicates more data follows, for example, the M(ore)-bit is on.	5, 15, 2
A3	23	Packet received on PVC not valid	4, 2
A4	24	Packet received on unassigned logical channel	4, 2
A5	A5	DIAGNOSTIC packet received (never transmitted)	4, 1
A6	26	Received packet too short	2, 1
A7	27	Received packet exceeds configured size.	5, 15, 2
A8	28	Received packet has a general format identifier (GFI) that is not valid.	7, 2
A9	21	Received packet is not identifiable.	2
AA	21	Received packet is not supported.	22, 2
AB	01	Number sent sequence count, for example, P(s) in received packet is not valid.	8, 16, 2, 1
AC	02	Number received sequence count, for example, P(r) in received packet is not valid.	2, 1
AD	A6	D(elivery)-bit setting not valid or unexpected	3, 2
AE	53	Q(ualified)-bit setting not valid or unexpected	13, 3
C1	F4	Virtual circuit termination pending on logical channel	21, 1
C5	F4, A3	Physical unit (PU) is not available or resources are temporarily not available. The CCITT/ISO diagnostic code A3 is used only for switched virtual circuits (SVCs).	19, 21
C7	46	The line and controller configurations are not compatible.	10, 9
D0	NA	Resources are not currently available.	21, 1
D2	F5, A3	Packet exceeds maximum supported size.	6, 25, 2
E0	20, 4C	Unexpected general error	3, 2, 1, 24
E1	20	Packet received on logical channel other than zero prior to completion of RESTARTING procedure	2
E2	29	RESTART or DIAGNOSTIC packet received on logical channel other than zero	2
E3	22	Incoming call received on incorrect logical channel	4, 2
E4	42	Facility not subscribed or allowed	23
E5	24	Packet other than RESTART or DIAGNOSTIC received on logical channel zero, when zero is not configured for use	4, 2
E6	42	Facility parameter is not supported or allowed	17

Figure 7-1 (Page 3 of 3). X.25 Diagnostic Codes Generated by the AS/400 System

SNA	CCITT/ISO	Diagnostic Code Description	Possible Cause (Explanation follows figure)
E7	41, A4	Requested facility is not supported. The CCITT/ISO diagnostic code A4 is used when the requested facility was fast select.	22
E8	46	Identified DTE not expected	19, 11, 9, 21
E9	20	D(elivery)-bit procedure not supported	22
EB	NA	Protocol identifier not valid, for example, PSH	22
EC	NA	Connection identifier mismatch	14, 19, 21
F0	A2	Internal system failure	1

The following are explanations for the possible cause codes listed in Figure 7-1:

1. Possible local system problem.
2. Possible X.25 network data circuit-terminating equipment (DCE) problem.
3. Possible remote data terminal equipment (DTE) problem — for example, configuration, system problem, and resources.
4. The logical channel entries (LGLCHLE) parameter in the line description does not match the X.25 network subscription — for example, number and type of logical channels.
5. The X.25 default packet size (DFTPKTSIZE) parameter in the line description does not match the X.25 network subscription. Some network subscriptions allow different packet sizes for different logical channels on the same network interface.
6. The X.25 maximum packet size (MAXPKTSIZE) parameter in the line description does not match the X.25 network subscription. The largest packet size supported by the AS/400 system is 1024 bytes.
7. The packet level modulus (MODULUS) parameter in the line description does not match the X.25 network subscription.
8. The X.25 default window size (DFTWDWSIZE) parameter of the line description does not match the X.25 network subscription. Some network subscriptions allow different window sizes for different logical channels on the same interface. The user may have deleted or re-created the line description but did not re-create the controller description.
9. If using asynchronous communications over the X.25 line, the switched controller list (SWTCTLLST) parameter in the line description does not include the corresponding asynchronous and X.25 controller description name. The user may have specified a controller and line description with the same name. If the user deletes the line description and then re-creates it without deleting and re-creating the controller description, the line description fails.
10. The switched line list (SWTLINLST) parameter of the controller description does not include the name of the line description over which the call was received.
11. The switched connection number (CNNNBR) parameter of the controller description does not match the local network address of the remote DTE.
12. If using anything other than asynchronous communications over X.25, the X.25 network level (NETLVL) parameter of the controller description does not match that CCITT level supported by the network or the remote DTE. This only applies

to permanent virtual circuits (PVCs) and incoming calls on switched virtual circuits (SVCs). For outgoing calls on SVCs, the AS/400 system has the ability to negotiate the network level using a re-call attempt.

13. If using anything other than asynchronous communications over X.25, the X.25 link protocol (LINKPCL) parameter in the controller description does not match the link protocol used by the remote DTE.
14. If using anything other than asynchronous communications over X.25, the X.25 connection password (CNNPWD) parameter in the controller description does not match the password used by the remote DTE.
15. The X.25 default packet size (DFTPKTSIZE) parameter in the controller description does not match the X.25 network subscription. If the value is *LIND, then see possible cause 5 on page 7-4.
16. The X.25 default window size (DFTWDWSIZE) parameter in the controller description does not match the X.25 network subscription. If the value is *LIND, then see possible cause 8 on page 7-4.
17. The X.25 reverse charging (RVSCRG) parameter in the controller description does not match the call billing intentions requested by the remote DTE.
18. If using anything other than asynchronous communications over X.25, the X.25 response timer (X25RSPTMR) or X.25 connection timer (X25CNNTMR) parameter in the controller description does not consider the round-trip time between the local system and the DTE.
19. The corresponding controller description is not in the correct state to be used — for example, vary off or recovery pending.
20. If the local AS/400 system is attached to another AS/400 system without an X.25 network (for example, one configured with the X.25 DCE support (X25DCE) parameter selected in the line description), both systems attempted to call simultaneously. This is not recommended. However, if SVCs are to be used in this configuration (not X.25 network), one system should be configured to only answer incoming calls.
21. The local system is completing the termination (or ELLC recovery) of a previously active virtual circuit. This is a temporary condition.
22. A requested option is not supported by the AS/400 system — for example, the physical services header LLC protocol, fast-select function, REGISTRATION packet, or delivery confirmation bit (D bit).
23. The extended network address (EXNNETADR) parameter in the line description does not match the X.25 network subscription. An incoming call containing an extended type of address/numbering plan identification address format was received, but the EXNNETADR parameter is set to *NO.
24. The extended network address (EXNNETADR) parameter in the line description does not match the X.25 network subscription. An incoming call containing a nonextended address format was received, but the EXNNETADR parameter is set to *YES.
25. The MAXFRAME parameter in the controller description is less than the length of the received PIU. The remote DTE sent a PIU that is greater than the maximum PIU size supported by the AS/400 system (1024 bytes) or the MAXFRAME parameter is not correct.

Diagnostic Codes Generated by the X.25 Network

Figure 7-2 figure shows the hexadecimal diagnostic codes generated by the X.25 network in CLEAR, RESET, and RESTART indication and diagnostic packets. These values may differ slightly according to network implementations.

Figure 7-2 (Page 1 of 2). Diagnostic Codes Generated by the X.25 Network

Diagnostic Code	Code Description
00	**No additional information**
01	Packet send count not valid
02	Packet receive count not valid
10	**Packet type not valid**
11	Packet type not valid for state r1
12	Packet type not valid for state r2
13	Packet type not valid for state r3
14	Packet type not valid for state p1
15	Packet type not valid for state p2
16	Packet type not valid for state p3
17	Packet type not valid for state p4
18	Packet type not valid for state p5
19	Packet type not valid for state p6
1A	Packet type not valid for state p7
1B	Packet type not valid for state d1
1C	Packet type not valid for state d2
1D	Packet type not valid for state d3
20	**Packet not allowed**
21	Unidentifiable packet
22	Call on one-way logical channel
23	Packet type on a PVC not valid
24	Packet on unassigned logical channel
25	Reject not subscribed to
26	Packet too short
27	Packet too long
28	General format identifier not valid
29	Restart or registration packet on nonzero logical channel
2A	Packet type not compatible with facility
2B	Interrupt confirmation not authorized
2C	Interrupt not authorized
2D	Reject not authorized
30	**Timer ended**
31	Timer ended for INCOMING_CALL
32	Timer ended for CLEAR_INDICATION

Figure 7-2 (Page 2 of 2). Diagnostic Codes Generated by the X.25 Network

Diagnostic Code	Code Description
33	Timer ended for RESET_INDICATION
34	Timer ended for RESTART_INDICATION
35	Timer ended for call deflection
40	**Call setup, call clearing, or registration problem**
41	Facility or registration code not allowed
42	Facility or registration parameter not allowed
43	Called address not valid
44	Calling address not valid
45	Facility or registration length not valid
46	Incoming call barred
47	No logical channel available
48	Call collision
49	Duplicate facility requested
4A	Nonzero address length
4B	Nonzero facility length
4C	Facility not provided when expected
4D	CCITT-specified DTE facility not valid
4E	Maximum number of call redirections or deflections exceeded
50	**Miscellaneous errors**
51	Improper cause code from DTE
52	Octet not aligned
53	Q-bit setting not consistent
54	NUI problem
60	**Not assigned**
70	**International problem**
71	Remote network problem
72	International protocol problem
73	International link out of order
74	International link busy
75	Transit network facility problem
76	Remote network facility problem
77	International routing problem
78	Temporary routing problem
79	Unknown network called DNIC
7A	Maintenance action
80	**Reserved for network-specific tests**

SNA Diagnostic Codes Generated by the DTE

Figure 7-3 shows the hexadecimal diagnostic codes generated by the DTE using SNA over X.25 in CLEAR, RESET, and RESTART indication and diagnostic packets. These values may differ slightly according to network implementations.

See Figure 7-3 for a explanation of the possible error or system failure that may occur during processing if the AS/400 system receives a diagnostic code on a virtual circuit using SNA and the cause code indicates that the remote DTE has generated the diagnostic code.

Figure 7-3 (Page 1 of 4). SNA Diagnostic Codes Generated by the DTE

Diagnostic Code	Code Description
00	**Normal initialization or end**
01	Packet send count not valid
02	Packet receive count not valid
03	LLC type not valid
10	**Packet type not valid**
11	Packet type not valid for state r1
12	Packet type not valid for state r2
13	Packet type not valid for state r3
14	Packet type not valid for state p1
15	Packet type not valid for state p2
16	Packet type not valid for state p3
17	Packet type not valid for state p4
18	Packet type not valid for state p5
19	Packet type not valid for state p6
1A	Packet type not valid for state p7
1B	Packet type not valid for state d1
1C	Packet type not valid for state d2
1D	Packet type not valid for state d3
20	**DCE timer ended**
21	Incoming call
22	Clear indication
23	Reset indication
24	Restart indication
2B	Interrupt-confirmation not authorized
2C	Interrupt not authorized
30	**DTE timer ended**
31	Call request
32	Clear request
33	Reset request
34	Restart request

Figure 7-3 (Page 2 of 4). SNA Diagnostic Codes Generated by the DTE

Diagnostic Code	Code Description
40	**Unassigned (General)**
50	**QLLC error (General)**
51	Control field not defined
52	Control field not expected
53	Missing information field
54	Information field not defined
55	Information field too long
56	Frame reject received
57	Header not valid
58	Data received in wrong state
59	Time-out condition
5A	Number received (Nr) not valid
5B	Recovery rejected or ended
5C	Exchange identifier (XID) negotiation in wrong state
5D	ELLC time-out condition
5E	Q-bit discrepancy
60	**PSH error (General)**
61	Sequence error
62	Header too short
63	PSH format not valid
64	Command not defined
65	Protocol not valid
66	Data received in wrong state
69	Time-out condition
70	**Packet assembler/disassembler (PAD) error (General)**
71	PAD access facility failure
72	SDLC frame check sequence error
73	SDLC time-out
74	SDLC frame not valid
75	Information field too long
76	SDLC sequence error
77	SDLC frame canceled
78	SDLC FRMR received
79	SDLC response not valid
7B	Packet type not valid
7F	PAD not operable
80	**DTE-specific (General)**
81	8100_DPPX specific

Figure 7-3 (Page 3 of 4). SNA Diagnostic Codes Generated by the DTE

Diagnostic Code	Code Description
82-8F	INN_QLLC specific
90	**Network specific**
91	DDX-P RNR packet received
A0	**Packet not allowed (General)**
A1	M-bit packet sequence not valid
A2	Packet type received not valid
A3	Packet on permanent virtual circuit not valid
A4	Logical channel not assigned
A5	Diagnostic packet received
A6	Packet too short
A7	Packet too long
A8	General format identifier not valid
A9	Not identifiable
AA	Not supported
AB	Packet sent count not valid
AC	Packet receive count not valid
AD	D-bit received not valid
AE	Q-bit received not valid
B0	**DTE-specific (NCP packet-switching interface gate or date) (General)**
B1	No LU-LU session
B2	Abnormal End 703 in progress
B3	Cancel CHAIN command
C0	**DTE-specific (General)**
C1	End pending
C2	Channel not operative
C3	Interrupt confirmation not authorized
C4	Interrupt request not authorized
C5	PU not available
C6	Inactivity time-out
C7	Line configuration not compatible
C8	RESET_INDICATION for PAD, translated from signal
C9	DTE not operational
D0	**Resources (General)**
D1	Buffers depleted
D2	Path information unit too long
E0	**Local procedure error (General)**
E1	Packet with LC = 0 not received

Figure 7-3 (Page 4 of 4). SNA Diagnostic Codes Generated by the DTE

Diagnostic Code	Code Description
E2	RESTART, DIAGNOSTIC, REGISTRATION on logical channel identifier not equal to 0
E3	INCOMING_CALL received on wrong logical channel
E4	Facility not subscribed
E5	Packet not RESTART or DIAGNOSTIC on logical channel identifier equal to 0
E6	Facility parameters not supported
E7	Facility not supported
E8	Calling DTE not expected
E9	D-bit request not valid
EA	RESET indication on virtual call
EB	Protocol identifier not valid
EC	Connection identifier mismatch
ED	Missing cause or diagnostic code
F0	**Remote procedure error (General)**

CCITT X.25 and ISO-8208 Diagnostic Codes

Figure 7-4 shows the coding of standard CCITT X.25 and ISO-8208 hexadecimal diagnostic codes in CLEAR, RESET, and RESTART indication and diagnostic packets. These values may differ slightly according to network implementations. Because the CCITT X.25 and ISO-8208 standards are subject to change, the information provided may vary.

See Figure 7-4 for a explanation of the possible error or system failure that may occur during processing if the AS/400 system receives a diagnostic code on a virtual circuit that is not using SNA and the cause code indicates that the error codes have been generated by the remote DTE. See Chapter 6 for more information on cause codes.

Figure 7-4 (Page 1 of 4). CCITT X.25 and ISO-8208 Diagnostic Codes

Diagnostic Code	Code Description
00	**No additional information**
01	Packet send count not valid
02	Packet receive count not valid
10	**Packet type not valid**
11	Packet type not valid for state r1
12	Packet type not valid for state r2
13	Packet type not valid for state r3
14	Packet type not valid for state p1
15	Packet type not valid for state p2
16	Packet type not valid for state p3

Figure 7-4 (Page 2 of 4). CCITT X.25 and ISO-8208 Diagnostic Codes

Diagnostic Code	Code Description
17	Packet type not valid for state p4
18	Packet type not valid for state p5
19	Packet type not valid for state p6
1A	Packet type not valid for state p7
1B	Packet type not valid for state d1
1C	Packet type not valid for state d2
1D	Packet type not valid for state d3
20	**Packet type not valid**
21	Packet not identifiable
22	Call on one-way logical channel
23	Packet type on PVC not valid
24	Packet on unassigned logical channel
25	REJECT not subscribed to
26	Packet too short
27	Packet too long
28	General format identifier (GFI) not valid
29	Restart or registration with logical channel indicator not equal to 0
2A	Packet type not compatible with facility
2B	Interrupt confirmation not authorized
2C	Interrupt not authorized
2D	Reject not authorized
30	**Timer ended (or limit surpassed)**
31	For INCOMING_CALL (or CALL_REQUEST)
32	FOR CLEAR_INDICATION (or REQUEST)
33	For RESET_INDICATION (or RESET_REQUEST)
34	For RESTART_INDICATION (or REQUEST)
35	For call deflection
40	**Call setup, clearing, or registration problem**
41	Facility or registration code not allowed
42	Facility or registration parameter not allowed
43	Called address not valid
44	Calling address not valid
45	Facility or registration length not valid
46	Incoming call barred
47	No logical channel available
48	Call collision
49	Duplicate facility requested
4A	Nonzero address length

Figure 7-4 (Page 3 of 4). CCITT X.25 and ISO-8208 Diagnostic Codes

Diagnostic Code	Code Description
4B	Nonzero facility length
4C	Facility not provided when expected
4D	CCITT-specified DTE facility not valid
4E	Maximum redirections or deflections exceeded
50	**Miscellaneous errors**
51	Improper cause code from DTE
52	Non-octet aligned
53	Q-bit settings not consistent
54	Network user identification (NUI) problem
60	**Not assigned**
70	**International problem**
71	Remote network problem
72	International protocol problem
73	International link out of order
74	International link busy
75	Transit network facility problem
76	Remote network facility problem
77	International routing problem
78	Temporary routing problem
79	Unknown network called DNIC
7A	Maintenance action
80	**Not assigned**
90	**Timer ended (or limit surpassed)**
91	For INTERRUPT_CONFIRMATION
92	For DATA packet retransmission
93	For REJECT packet retransmission
A0	**DTE-specific signals**
A1	DTE-operational
A2	DTE not operational
A3	DTE resource limitation
A4	Fast select not subscribed
A5	Partially full DATA packet not valid
A6	D-bit procedure not supported
A7	Registration or cancelation confirmed
B0	**Not assigned**
E0	**Network service problem on open systems interconnection (OSI)**
E1	Disconnection (transient condition)
E2	Disconnection (permanent condition)

Figure 7-4 (Page 4 of 4). CCITT X.25 and ISO-8208 Diagnostic Codes

Diagnostic Code	Code Description
E3	Connection rejection, unspecified reason (transient condition)
E4	Connection rejection, unspecified reason (permanent condition)
E5	Connection rejection, requested quality of service not available (transient condition)
E6	Connection rejection, requested quality of service not available (permanent condition)
E7	Connection rejection, OSI network address unreachable (transient problem)
E8	Connection rejection, OSI network address unreachable (permanent problem)
E9	Reset, reason unspecified
EA	Reset, congestion
EB	Connection rejection, OSI network address unknown (permanent condition)
F0	**Higher layer initiated**
F1	Normal disconnection
F2	Abnormal disconnection
F3	Disconnection due to incompatible information in user data
F4	Connection rejection, reason unspecified (transient condition)
F5	Connection rejection, reason unspecified (permanent condition)
F6	Connection rejection, requested quality of service not available (transient condition)
F7	Connection rejection, requested quality of service not available (permanent condition)
F8	Connection rejection, incompatible information in user data
F9	Connection rejection, unrecognizable protocol identifier in user data
FA	Reset, resynchronization

Chapter 8. X.25 Configuration Examples

The following major configuration examples are described in this chapter:

- "Example 1: AS/400 System-to-X.25 PSDN Network Configuration" on page 8-2 describes the configuration of a local AS/400 system for X.25 communications with several remote systems and devices, including another AS/400 system. In this example (as shown in Figure 8-1 on page 8-3), both AS/400 systems are 9406 System Units. This X.25 configuration is for communications through an X.25 packet-switching data network (PSDN).
- "Example 2: AS/400 System-to-AS/400 System X.25 Non-PSDN Configuration" on page 8-28 describes the configuration of an AS/400 system for X.25 communications with another AS/400 system when they are connected using a V.35 modem eliminator instead of an X.25 PSDN. In this example (as shown in Figure 8-6 on page 8-28), one AS/400 system is a 9406 System Unit, and the other AS/400 system is a 9404 System Unit.
- "Example 3: AS/400 System-to-System/38 X.25 Non-PSDN Configuration" on page 8-30 describes the configuration of an AS/400 system for X.25 communications with a System/38 when they are connected using a V.24 modem eliminator instead of an X.25 PSDN. In this example (as shown in Figure 8-7 on page 8-30), the AS/400 system is a 9406 System Unit.
- "Example 4: AS/400 System-to-AS/400 System X.25 PSDN Switched Line Configuration" on page 8-32 describes the configuration for X.25 communications through PSDN using switched lines shown in Figure 8-8 on page 8-33.

The following configuration examples have unique identifiers for some of the systems. These identifiers (such as 499 for the local AS/400 system, and HOST for the remote System/370* used as the host system) are shown in a different type font simply to make them easy for you to find as you use the examples. These identifiers are typical of what a system administrator might use to identify each system instead of using the system *types*—especially if there are many systems being used in the network that are of the same type. These identifiers are shown in the illustrations of the configured networks, in the text describing the example configurations, and (where applicable) in the coding of the commands.

For information and configuration examples for OSI communications, see the *OSI Communications Subsystem/400 Configuration and Administration Guide*. For information and configuration examples for TCP/IP communications, see the *TCP/IP Guide*. For information and configuration examples for user-defined communications, see the *System Programmer's Communications Interface Guide*.

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Example 1: AS/400 System-to-X.25 PSDN Network Configuration

In this example, a system administrator at the local AS/400 system wishes to connect to several remote data terminating equipment (DTEs) (with their corresponding X.25 adapters) by means of an X.25 packet-switching data network (PSDN). The local AS/400 system is identified as system 499, and the remote DTEs (systems and devices) to be connected to are:

- Another AS/400 system, identified as system 603

  This link will be an advanced peer-to-peer networking (APPN) link with the AS/400 system 603 operating as an end node, that is, the NODETYPE parameter in the network attributes for AS/400 system 603 is set to *ENDNODE. This link will be continuously and fully used, so a permanent virtual circuit (PVC) is justified. The X.25 PSDN provides reliable service. However, this link is to be used for very sensitive data, so the extra end-to-end logical link level error detection and recovery provided by the enhanced logical link control (ELLC) protocol is desired.

  Also, because the AS/400 system 499 and the remote AS/400 system 603 may be turned off for periodic maintenance, the X.25 delayed connection timer (X25DLYTMR) parameter in both controller descriptions is set to a value other than *CALC. This ensures that the system that remains turned on (or is turned on first) will, without user intervention, continue to poll the other system until it is turned on and logical link connection occurs.

  For more information about APPN links with an AS/400 system, see the *APPN Guide*.

- A System/370 host system (identified as HOST), with a 3725 controller

  Because this link will also be continuously and fully used, a PVC is justified. Various host application programs will be run using customer information control systems (CICS) and time-sharing option (TSO); therefore, the AS/400 system 499 will perform 3270 emulation. Occasionally, users on System/370 display stations will use the Host Command Facility (HCF) to acquire a sign-on to the AS/400 system 499.

- A System/36, identified as system 024

  This link will be an APPN link with the System/36 024 operating as a networking node. The AS/400 system 499 will start the call to the System/36 and will be charged for the call. System/36 024 does not support the extended cause code options of the International Telegraph and Telephone Consultative Committee (CCITT) 1984.

- A System/38, identified as system 258

  This link will be an APPN link with the System/38 258 operating as a low-end networking node. The AS/400 system 499 will start the call to the System/38 and will pay the charges.

- A 5394 controller with an attached 5251 display station

  The 5251 display station user will call the AS/400 system 499, with the billing charges reversed. The 5394 controller is located in a secure location; therefore, the extra protection of an X.25 connection password (CNNPWD) is not required.

- A 3274 controller with an attached 3279 display station

  The 3279 display station user will call the AS/400 system 499 from a nonsecure location and will be responsible for the call charges. An X.25 connection pass-

word (CNNPWD) is required, and the controller's XID (hex 017000C1 in this case) is also verified by the AS/400 system 499 while establishing the connection.

Figure 8-1 shows the virtual circuit configuration between AS/400 system 499 and all of the specified remote DTEs in an X.25 PSDN network.

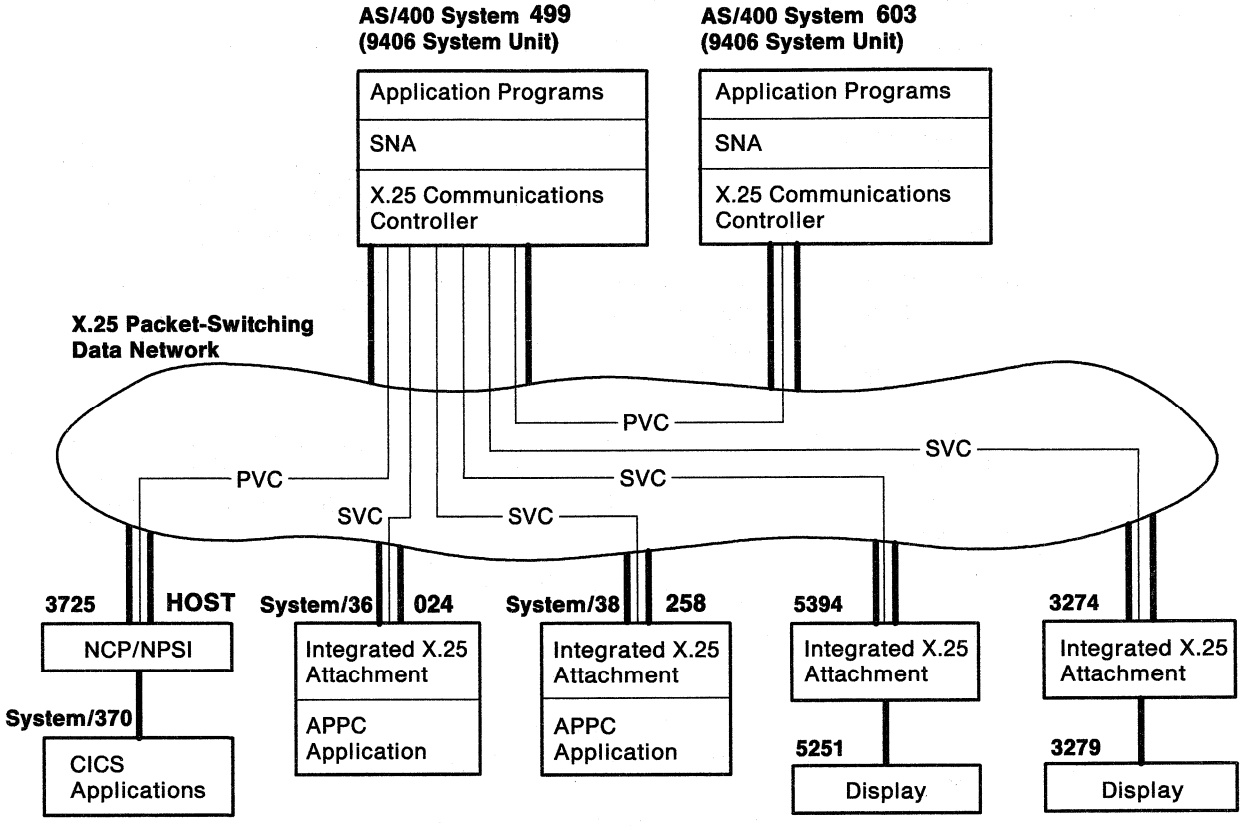

Figure 8-1. Example 1: X.25 Virtual Circuits between AS/400 System 499 and the Remote DTEs

Notice that all the communications links defined in this example are only between the AS/400 system 499 and each of the other (remote) systems that are shown, but *not* between any of the remote systems. Although any of these remote systems can be configured to communicate with any of the other remote systems, this example does not provide the coding for those connections.

Configurations on Local AS/400 System 499

The following configurations are created by the system administrator on the local AS/400 system 499 to allow it to communicate with all the other systems and devices through the X.25 network.

First, the network attributes are changed as follows:

```
CHGNETA  SYSNAME(RCHSX499)  LCLNETID(RPC)  LCLCPNAME(RCHSX499)
         LCLLOCNAME(RCHSX499)  NODETYPE(*NETNODE)
```

The Change Network Attributes (CHGNETA) command allows you to change the system attributes. When using this command, you can specify new input and output files, system names, node types, and similar attributes. This allows you to work with different sets of values without configuring the entire network again.

Note: After changing the attributes using the CHGNETA command, you should refresh your system to ensure that the attributes you changed to are used for processing instead of those that were specified or defaulted when the session was started.

The following information was obtained by the system administrator for the network subscription purchased for the local system 499. This information describes the interface between the system 499 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00000499.
- Logical channel configuration:

001	PVC routed to AS/400 system 603
002	PVC routed to host System/370 (HOST)
003-008	Currently unassigned PVCs
009-010	SVCs handling incoming calls from the network
011-01B	SVCs handling both incoming and outgoing calls
019-020	SVCs handling outgoing calls from the AS/400 system 499

- Network addresses of the remote DTEs:

00000024	System/36 024
00000258	System/38 258
00005394	5394 controller
00003274	3274 controller

- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 128.
- Maximum packet size supported is 1024.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 15.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

Using this network subscription information, the line description for AS/400 system 499 is created using the CRTLINX25 displays. You can access these X.25 line description displays by typing CRTLINX25 on any command line and then pressing F4 (Prompt). The Create Line Description displays illustrate this procedure.

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Line description . . . . . > LX25022     Name
Resource name  . . . . . . > LIN022      Name
```

```
                    Specify More Values for Parameter LGLCHLE

Type choices, press Enter.

Logical channel entries:
  Logical channel identifier . . > 001        001-FFF, *PROMPT
  Logical channel type . . . . . > *PVC       *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .       _____      Name

  Logical channel identifier . . > 002        001-FFF, *PROMPT
  Logical channel type . . . . . > *PVC       *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .       _____      Name

  Logical channel identifier . . > 003        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCIN     *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .       _____      Name

  Logical channel identifier . . > 004        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .       _____      Name
                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

                                 _
  Logical channel identifier . . > 005        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCOUT    *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .       _____      Name
            + for more values _
Local network address  . . . . > 00000499
Connection initiation  . . . . . > *LOCAL     *LOCAL, *REMOTE, *WAIT
Online at IPL  . . . . . .       *YES       *YES, *NO
Physical interface . . . . . .   *X21BISV24  *X21BISV24, *X21BISV35...
Connection type  . . . . . .     *NONSWTPP   *NONSWTPP, *SWTPP
Vary on wait . . . . . .         *NOWAIT     *NOWAIT, 15-180 (1 second)
Line speed . . . . . .           9600        600, 1200, 2400, 4800...
Exchange identifier  . . . . .   05600499    05600000-056FFFFF, *SYSGEN
Extended network addressing  . .  *NO        *YES, *NO


                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Default packet size:
  Transmit value . . . . . .   128          64, 128, 256, 512, 1024
  Receive value  . . . . . .   *TRANSMIT    *TRANSMIT, 64, 128, 256...
Maximum packet size:
  Transmit value . . . . . . > 1024         *DFTPKTSIZE, 64, 128, 256...
  Receive value  . . . . . .   *TRANSMIT    *DFTPKTSIZE, *TRANSMIT, 64...
Modulus  . . . . . . . . . . > 128          8, 128
Default window size:
  Transmit value . . . . . . > 15           1-15
  Receive value  . . . . . .   *TRANSMIT    1-15, *TRANSMIT
Insert net address in packets  *YES         *YES, *NO
Text 'description' . . . . . > 'X.25 line description'
_____

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

As shown in the LIND parameter, this X.25 line description is named LX25022. This name is used to associate this line description with each of the six remote controllers that are a part of this X.25 network. Thus, in the create controller commands that follow, the LX25022 line name is specified in the LINE parameters of the first two (PVC-related) controller commands and in the SWTLINLST parameters of the last four (SVC-related) controller commands. Also, all these commands indicate the link type as *X25, in the LINKTYPE parameter.

As shown in the LGLCHLE parameter, the first two logical channel entries (001 and 002) specify that PVCs are used, one with AS/400 system 603 and one with the 3275 host system. The same channel entry numbers are also specified in the first two create controller commands, in their LGLCHLID parameters.

The LGLCHLE parameter also specifies many of the logical channel entries as SVCs, which can be used for switched virtual circuits to the other four remote DTEs in this example. The create controller commands for these four DTEs all specify *YES for their SWITCHED parameters, and they each have the network address of the corresponding remote DTE specified in their switched connection number (CNNNBR) parameters.

- When the AS/400 system *calls* one of these four remote DTEs, it inserts the value specified in the CNNNBR parameter of the associated controller into the called DTE network address field of the call request packet to be sent.
- When the AS/400 system *answers* a call from one of these four remote DTEs, it attempts to locate a controller description that has a VARY ON PENDING status and a CNNNBR parameter value that matches the calling DTE network address in the incoming call packet. For SNA calls to be accepted, the password contained in the call user data of the incoming call request must also match that value specified in the X.25 connection password (CNNPWD) parameter of the controller description.

As an example of these network address identifiers, the remote System/38 in this example (known as system 258) has a network address of 00000258. On the AS/400 system 499, this value is specified in the CNNNBR parameter of the Create APPC Controller (CRTCTLAPPC) command used to configure the AS/400 system for communications with the System/38. (On the System/38, this 00000258 network address

value is also specified in the LCLNETADR parameter of the System/38 Create Line Description (CRTLIND) command, which is shown on page 8-22.)

Remote AS/400 System Configuration

The controller description representing the remote AS/400 system 603 is created on the local AS/400 system using the following displays. The displays can be accessed by typing CRTCTLAPPC and pressing F4 (Prompt). The Create Controller Description displays illustrate this procedure.

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

Controller description . . . . . > CX25S603P     Name
Link type . . . . . > *X25         *IDLC, *LAN, *LOCAL, *SDLC...
Online at IPL . . . . . *YES       *YES, *NO
Switched connection . . . . . *NO  *NO, *YES
APPN-capable . . . . . *YES        *YES, *NO
Attached nonswitched line . . . > LX25022    Name
Maximum frame size . . . . . *LINKTYPE  265-16393, 265, 521, 1033...
Remote network identifier . . . *NETATR     Name, *NETATR, *NONE
Remote control point . . . . . > RCHSX603   Name
Exchange identifier . . . . . _____         00100000-FFFFFFFF
Data link role . . . . . *NEG       *NEG, *PRI, *SEC
X.25 network level . . . . . > 1984         1980, 1984, 1988
X.25 link level protocol . . . . > *ELLC    *QLLC, *ELLC
X.25 logical channel ID . . . . 001         001-FFF
APPN CP session support . . . . *YES        *YES, *NO
APPN node type . . . . . *ENDNODE   *ENDNODE, *LENNODE...
                                                              More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

APPN transmission group number     1          1-20, *CALC
Text 'description' . . . . . > 'X.25 controller for system 603'
_____
```

Note: The AS/400 system automatically creates the devices for controllers of type APPC when the APPN parameter specifies *YES (as it does in this case). Because *YES is the default, it was not coded in the CRTCTLAPPC command.

Remote Host System/370 Configuration

The controller, emulation device, and distributed host command facility (DHCF) device descriptions for the remote System/370 HOST are created on the local AS/400 system using the following displays.

```
                    Create Ctl Desc (SNA Host) (CRTCTLHOST)

Type choices, press Enter.

Controller description . . . . . > CX25HOSTP      Name
Link type . . . . . > *X25        *IDLC, *LAN, *SDLC, *X25
Online at IPL . . . . . *YES      *YES, *NO
Switched connection . . . . . *NO *NO, *YES
APPN-capable . . . . . > *NO      *YES, *NO
Attached nonswitched line . . . > LX25022     Name
Maximum frame size . . . . . *LINKTYPE  265-16393, 265, 521, 1033...
Remote network identifier . . . *NETATR   Name, *NETATR, *NONE
Remote control point . . . . . _______    Name
SSCP identifier . . . . . _____________   050000000000-05FFFFFFFFF
X.25 network level . . . . . > 1984       1980, 1984, 1988
X.25 link level protocol . . . . *QLLC    *QLLC, *ELLC
X.25 logical channel ID . . . . > 002     001-FFF
Recontact on vary off . . . . . *YES      *YES, *NO
Text 'description' . . . . . > 'Remote S/370 host system controller'
_____
                                                                  Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Device Desc (SNA Host) (CRTDEVHOST)

Type choices, press Enter.

Device description . . . . . > DX25HOST1    Name
Local location address . . . . . > 01       01-FF
Remote location . . . . . > DX25HOST        Name
Online at IPL . . . . . *YES                *YES, *NO
Attached controller . . . . . > CX25HOSTP   Name
Application type . . . . . > *EML           *RJE, *EML, *PGM
Maximum length of request unit *CALC        *CALC
Emulated device . . . . . 3278              3278, 3284, 3286, 3287...
Emulated keyboard . . . . . *UPPER          *UPPER, *LOWER
Emulated numeric lock . . . . . *NO         *NO, *YES
Emulation work station . . . . . *ANY       Name, *ANY
Text 'description' . . . . . > 'Remote System/370 host system'
_____
                                                                  Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Device Desc (Display) (CRTDEVDSP)

Type choices, press Enter.

Device description . . . . . > DX25HOST2      Name
Device class . . . . . > *RMT         *LCL, *RMT, *VRT
Device type  . . . . . > 3277         3101, 3151, 3161, 3162...
Device model . . . . . > *DHCF        0, 1, 2, 4, 11, 12, 23...
Local location address . . . . . > 02         00-FE
Online at IPL  . . . . . *YES         *YES, *NO
Attached controller  . . . . . CX25HOSTP    Name
Keyboard language type . . . . . *SYSVAL      *SYSVAL, AGB, AGI, BLI...
Drop line at signoff . . . . . *YES         *YES, *NO
Text 'description' . . . . . > 'Remote System/370 host system device'
_____

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Remote System/36 Configuration

The controller description representing the remote System/36 024 is created on the local AS/400 system using the following displays.

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

Controller description . . . . . > CX25S024S    Name
Link type  . . . . . > *X25         *IDLC, *LAN, *LOCAL, *SDLC...
Online at IPL  . . . . . *YES         *YES, *NO
Switched connection  . . . . . > *YES         *NO, *YES
APPN-capable . . . . . *YES         *YES, *NO
Switched line list . . . . . > LX25022      Name
          + for more values _____
Maximum frame size . . . . . *LINKTYPE    265-16393, 265, 521, 1033...
Remote network identifier  . . .  *NETATR      Name, *NETATR, *NONE
Remote control point . . . . . > RCH36024     Name
Exchange identifier  . . . . . 03E00024     00100000-FFFFFFFF
Initial connection . . . . . *DIAL        *DIAL, *ANS
Connection number  . . . . . > 00000024
Data link role . . . . . *NEG         *NEG, *PRI, *SEC
X.25 network level . . . . . 1980         1980, 1984, 1988
X.25 link level protocol . . . .  *QLLC       *QLLC, *ELLC
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

X.25 connection password . . . .   _______      Character value
APPN CP session support  . . . .   *YES         *YES, *NO
APPN node type . . . . . . . . . > *NETNODE     *ENDNODE, *LENNODE...
APPN transmission group number . > *CALC        1-20, *CALC
APPN minimum switched status . .   *VRYONPND    *VRYONPND, *VRYON
Text 'description' . . . . . . . > "Remote System/36 controller'
_____

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Remote System/38 Configuration

The controller description representing the remote System/38 258 is created on the local AS/400 system using the following displays.

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

Controller description . . . . . > CX25S258S    Name
Link type  . . . . . . . . . . . > *X25         *LAN, *SDLC, *TDLC, *TRLAN...
Online at IPL  . . . . . . . . .   *YES         *YES, *NO
Switched connection  . . . . . . > *YES         *NO, *YES
APPN-capable . . . . . . . . . .   *YES         *YES, *NO
Switched line list . . . . . . . > LX25022      Name
            + for more values      _______
Maximum frame size . . . . . . .   *LINKTYPE    265-8156, 265, 521, 1033...
Remote network identifier  . . .   *NETATR      Name, *NETATR, *NONE
Remote control point . . . . . . > RCH38258     Name
Exchange identifier  . . . . . .   02200258     00100000-FFFFFFFF
Initial connection . . . . . . .   *DIAL        *DIAL, *ANS
Connection number  . . . . . . . > 00000258
Data link role . . . . . . . . .   *NEG         *NEG, *PRI, *SEC
X.25 network level . . . . . . . > 1984        1980, 1984
X.25 link level protocol . . . .   *QLLC        *QLLC, *ELLC
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

X.25 connection password . . . .   _______      Character value
APPN CP session support  . . . .   *YES         *YES, *NO
APPN node type . . . . . . . . . > *LENNODE     *ENDNODE, *LENNODE...
APPN transmission grp number . . > *CALC        1-20, *CALC
APPN minimum switched status . .   *VRYONPND    *VRYONPND, *VRYON
Text 'description' . . . . . . . > 'Remote System/38 controller'
_____
```

Remote 5394 Controller Configuration

The controller and device descriptions representing the remote 5394 controller and its attached 5251 display station are created on the local AS/400 system using the following displays.

```
                    Create Ctl Desc (Remote WS) (CRTCTLRWS)

Type choices, press Enter.

Controller description . . . . . > CX25RWSS      Name
Controller type  . . . . . . . . > 5394          3174, 3274, 5251, 5294, 5394
Controller model . . . . . . . . > 1             0, 1, 0001, 2, 0002, 12, 0012
Link type  . . . . . . . . . . . > *X25          *IDLC, *LAN, *SDLC, *X25
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
Switched connection  . . . . . . > *YES          *NO, *YES
Switched line list . . . . . . . > LX25022       Name
          + for more values
Maximum frame size . . . . . . .   *LINKTYPE     265-1994, 261, 265, 521...
Exchange identifier  . . . . . .                 00100000-FFFFFFFF
Initial connection . . . . . . .   *DIAL         *DIAL, *ANS
Connection number  . . . . . . . > 00005394
X.25 network level . . . . . . . > 1984          1980, 1984, 1988
X.25 link level protocol . . . .   *QLLC         *QLLC, *ELLC
X.25 connection password . . . .                 Character value

                                                                        More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Ctl Desc (Remote WS) (CRTCTLRWS)

Type choices, press Enter.

Text 'description' . . . . . . . > 'Remote 5394 controller'
```

```
                    Create Device Desc (Display) (CRTDEVDSP)

Type choices, press Enter.

Device description . . . . . . . > DX25RWSS1     Name
Device class . . . . . . . . . . > *RMT          *LCL, *RMT, *VRT
Device type  . . . . . . . . . . > 5251          3101, 3151, 3161, 3162...
Device model . . . . . . . . . . > 11            0, 1, 2, 4, 11, 12, 23...
Local location address . . . . . > 00            00-FE
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
Attached controller  . . . . . . > CX25RWSS      Name
Drop line at signoff . . . . . .   *YES          *YES, *NO
Allow blinking cursor  . . . . .   *YES          *YES, *NO
Printer  . . . . . . . . . . . .                 Name
Text 'description' . . . . . . . > 'Remote work station device description'

                                                                        Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Remote 3274 Controller Configuration

The controller and device descriptions representing the remote 3274 controller and its attached 3279 display station are created on the local AS/400 system using the following displays.

```
                    Create Ctl Desc (Remote WS) (CRTCTLRWS)

Type choices, press Enter.

Controller description . . . . . > CX25RAS       Name
Controller type  . . . . . . . . > 3274          3174, 3274, 5251, 5294, 5394
Controller model . . . . . . . . > 0             0, 1, 0001, 2, 0002, 12, 0012
Link type  . . . . . . . . . . . > *X25          *IDLC, *LAN, *SDLC, *X25
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
Switched connection  . . . . . . > *YES          *NO, *YES
Switched line list . . . . . . . > LX25022       Name
              + for more values
Exchange identifier  . . . . . . > 017000C1      00100000-FFFFFFFF
Initial connection . . . . . . .   *DIAL         *DIAL, *ANS
Connection number  . . . . . . . > 00003274
X.25 network level . . . . . . .   1980          1980, 1984, 1988
X.25 link level protocol . . . .   *QLLC         *QLLC, *ELLC
X.25 connection password . . . . > 3274          Character value
Text 'description' . . . . . . . > 'Remote 3274 controller'


                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                  Create Device Desc (Display) (CRTDEVDSP)

Type choices, press Enter.

Device description . . . . . . . > DX25RAS3      Name
Device class . . . . . . . . . . > *RMT          *LCL, *RMT, *VRT
Device type  . . . . . . . . . . > 3279          3101, 3151, 3161, 3162...
Device model . . . . . . . . . . > 0             0, 1, 2, 4, 11, 12, 23...
Local location address . . . . . > 02            00-FE
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
Attached controller  . . . . . . > CX25RAS       Name
Keyboard language type . . . . .   *SYSVAL       *SYSVAL, AGB, AGI, BLI...
Drop line at signoff . . . . . .   *YES          *YES, *NO
Text 'description' . . . . . . . > 'Remote 3274 display device'


                                                                      Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Configurations on Remote AS/400 System 603

The following configurations are created by the system administrator on the remote AS/400 system 603 to allow it to communicate through the X.25 network with the local AS/400 system 499.

First, the network attributes are changed as follows:

```
CHGNETA  SYSNAME(RCHSX603)  LCLNETID(RPC)  LCLCPNAME(RCHSX603)
         LCLLOCNAME(RCHSX603)  NODETYPE(*ENDNODE)
         NETSERVER((RPC RCHSX024) (RPC RCHSX499))
```

The following information was obtained by the system administrator for the network subscription purchased for the remote AS/400 system 603. Remember that this information describes the interface between the system 603 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00000603.
- Logical channel configuration:

001	PVC routed to AS/400 system 499
002-004	Currently unassigned PVCs
005-008	SVCs handling incoming calls from the network
009-00C	SVCs handling both incoming and outgoing calls
00D-010	SVCs handling outgoing calls from the AS/400 system 603

- Network address of the remote DTE is not applicable for this DTE; no SVCs (switched virtual circuits) will exist between AS/400 systems 499 and 603.
- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 8.
- Maximum packet size supported is 64.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 2.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

Using this network subscription information, the line description for AS/400 system 603 is created on that system using the following command:

```
CRTLINX25  LIND(LX25021)  RSRCNAME(LIN021)  LGLCHLE((001 *PVC)
           (002 *PVC) (003 *PVC) (004 *PVC) (005 *SVCIN) (006 *SVCIN)
           (007 *SVCIN) (008 *SVCIN) (009 *SVCBOTH) (00A *SVCBOTH)
           (00B *SVCBOTH) (00C *SVCBOTH) (00D *SVCOUT) (00E *SVCOUT)
           (00F *SVCOUT) (010 *SVCOUT))   NETADR(00000603)
           CNNINIT(*LOCAL)  EXCHID(05600603)  DFTPKTSIZE(64)
```

The controller description representing the AS/400 system 499 is created on system 603 using the following command:

```
CRTCTLAPPC  CTLD(CX25S499P)  LINKTYPE(*X25)  LINE(LX25021)
            RMTCPNAME(RCHSX499)  NETLVL(1984)  LINKPCL(*ELLC)
            LGLCHLID(001)  NODETYPE(*NETNODE)  TMSGRPNBR(*CALC)
            X25DLYTMR(20)
```

For an example of creating line and controller descriptions using displays, refer to "Configurations on Local AS/400 System 499" on page 8-4.

Configurations on Host System

The following NCP configurations are created by the host system administrator on the System/370 HOST to allow it to communicate with the AS/400 system 499 through the X.25 network.

The following information was obtained by the system administrator for the network subscription purchased for the host System/370. Remember that this information describes the interface between the host DTE and the network DCE to which the host is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00000370.
- Logical channel configuration:

001	PVC routed to AS/400 system 499
002-008	Currently unassigned PVCs
009-010	SVCs handling incoming calls from the network
011-018	SVCs handling both incoming and outgoing calls
019-020	SVCs handling outgoing calls from the System/370 HOST

- Network address of the remote DTE is not applicable for this DTE; no SVCs (switched virtual circuits) will exist between AS/400 system 499 and the host System/370.
- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 128.
- Maximum packet size supported is 1024.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 7.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

Using the above network subscription information, the following is created on the host System/370 as source input for stage 1 of the NCP configuration for the X.25 characteristics:

```
*************************************************************************
*   Macro definition for X.25 line R1102                                *
*************************************************************************
R1102    X25MCH   ADDRESS=102,          Line at addr 102
                  ANS=STOP,             Shutdown PUs if NCP ans shutdn
                  CSBTYPE=3,
                  DBIT=NO,              No delivery confirmation bit
                  DIRECT=NO,            Line is modem attached
                  DSABLTO=3.0,          Delay to DSR signal to go off
                  ENABLTO=3.0,          Delay to DSR signal to come on
                  FRMLGTH=1028,         MAXPKTL + 4
                  GATE=NO,              Gate and date not supported
                  LCGDEF=0(32),         32 logical channels defined
                  LCN0=USED,            Logical channel 0 used as VC
                  LLCLIST=(LLC3),       LLC3=QLLC
                  MWINDOW=7,            Window size
                  NCPGRP=R1X25G08,      Name for NCP group macro
                  NDRETRY=2,            NP/TP sequence
                  NPRETRY=7,            Retrans TP time-out recover
                  PAD=NO,               No PAD support
                  PKTMODL=128,          Modulus 128
                  PROTCOL=LAPB,         X.25 level 2 protocol
                  SPEED=9600,           Line speed
                  SPNQLLC=NO,           No RETD network with HDLC PAD
                  STATION=DTE,          Operate as DTE
                  TDTIMER=3,            Internal delay timer
                  TPTIMER=6.0           T1 timer
*************************************************************************
*   Macro definition for logical channel group 0                        *
*************************************************************************
         X25LCG   LCGN=0
*************************************************************************
*   Macro definitions for PVCs                                          *
*************************************************************************
L8VC0    X25LINE LCN=1,                Logical channel 1
                  TYPE=PERMANENT,       PVC
                  LLC=LLC3,             SNA DTE using QLLC
                  RETVCTO=30,           Timer between retrans phys serv
                  RETVCCT=3,            Nbr retrans of phys serv command
                  COMMITO=4,            Idle VC commit time-out
                  VCCINDX=8             Index in X25VCCPT
L8VC0A   X25PU ADDR=C1,
                  ISTATUS=INACTIVE,     Initial status
                  MAXDATA=1024,         MAXPIU for this PVC
                  PUTYPE=2,             PU type 2
                  MODETAB=LOGMOD38,     VTAM logmode table name
                  PACING=7,
                  LUDR=NO,              Per X.25 manual
                  PUDR=NO               Per X.25 manual
L8VC0A01 X25LU LOCADDR=1,              LU with address of 1
                  ISTATUS=INACTIVE
L8VC0A02 X25LU LOCADDR=2,              LU with address of 2
                  ISTATUS=INACTIVE
```

Figure 8-2. Source Input for Stage 1 of System/370 NCP Configuration for X.25

The following represents the X.25-related portion of the output, produced by stage 1 generation, that is used as input for stage 2 of the NCP configuration:

```
R1102    LINE  UACB=(X25A102X,X25A102R),ADDRESS=(102,FULL),SPEED=9600
XC102    SERVICE ORDER=XP102
XP102    PU    ADDR=01,MAXDATA=1024,ANS=STOP,PUTYPE=1
XU102    LU    LOCADDR=0,ISTATUS=INACTIVE
R1X25G09 GROUP LNCTL=SDLC,BERPROC=BALNMBER,LEVEL2=BALNAML2,LEVEL3=BALNA*
               ML3,USERID=(5668981,BALNBDT,NORECMS),LEVEL5=NCP,TYPE=NCP*
               ,TIMER=(BALLAP4,,BALLAP4,BALLAP4),COMPACB=YES,XIO=(BALNA*
               MXL,BALNAMXS,BALNAMXI,BALNAMXK),DIAL=NO,ISTATUS=INACTIVE
L8VC0    LINE  IPL=NO,UACB=XA102000
XC102000 SERVICE ORDER=L8VC0A
L8VC0A   PU    ADDR=C1,MAXDATA=137,PACING=7,MODETAB=LOGMOD38,ISTATUS=IN*
               ACTIVE,PUDR=NO,LUDR=NO,PUTYPE=2
L8VC0A01 LU    LOCADDR=1,ISTATUS=INACTIVE
L8VC0A02 LU    LOCADDR=2,ISTATUS=INACTIVE
```

Figure 8-3. Output Produced from Stage 1 of System/370 NCP Configuration for X.25

Note: The configurations shown are for a host that is running VTAM* Version 3 Release 1.1 with NCP Version 4 Release 2. Changes may be necessary for configurations created on hosts running VTAM/NCP at different versions or releases.

Configurations on System/36 024

The following configurations are created by the system administrator on System/36 024 to allow it to communicate with AS/400 system 499 through the X.25 network. The major parts of the configuration include:

- Line member configuration
- Subsystem member configuration
- X.25 member configuration
  - X.25 network and logical channel configuration
  - X.25 virtual circuit configuration

System/36 Line Member Configuration

The following sequence of System/36 displays shows the contents of the configuration line member LX25005. The CNFIGICF procedure command is used on the System/36 to display this information.

Note: For each display, only the top portion that is relevant to the example is shown; the function keys are not.

```
 1.0          SSP-ICF CONFIGURATION MEMBER DEFINITION                  W1
1. Configuration member name . . . . . . . . . . . . . . . . . LX25005
2. Library name . . . . . . . . . . . . . . . . . . . . . . . . CMNCFG
3. Select one of the following:
     1. Create new member
     2. Edit existing member
     3. Create new member from existing member
     4. Remove a member
     5. Review a member
   Option . . . . . . . . . . . . . . . . . . . . . . . . 1-5  5
```

```
 2.0              SSP-ICF CONFIGURATION MEMBER TYPE          LX25005     W1
Select one of the following options:
      1. Intra
      2. BSC
      3. SNA
      4. Async
      5. PC Support/36
   Option: 3
```

```
 4.0                SNA CONFIGURATION MEMBER TYPE            LX25005     W1
1. SNA member type  . . . . . . . . . . . . . . . . . . . . 1-4  3
      1. SNA subsystem member
      2. SNA/SDLC line member
      3. SNA/X.25 line member
      4. SNA/IBM Token-Ring Network line member
2. Will APPC or APPN be used? . . . . . . . . . . . . . . . Y,N  Y
```

```
12.0            SNA LINE MEMBER ATTRIBUTES                    LX25005     W1
1. Data link protocol . . . . . . . . . . . . . . . . . . . . . . 3
  1-Primary        2-Secondary        3-Negotiated
2. Line type  . . . . . . . . . . . . . . . . . . . . . . . . . . 1
  1-Nonswitched     2-Switched
4. X.25 configuration member name . . . . . . . . . . . . . . . . CX25005
6. Local system's station XID in hexadecimal  . . . . . . . . . . 00024
```

Note: The contents of the X.25 configuration member, CX25005, is shown in "System/36 X.25 Configuration" on page 8-19.

```
 12.5                      REMOTE SYSTEM SELECTION              LX25005     W1
1. Select from the following options:
                                                        5-Review
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . .
2. Remote system name . . . . . . . . . . . . . . . . . . . . .
--------------------------------------------------------------------------------
OPTION  REMOTE SYSTEM     OPTION  REMOTE SYSTEM      OPTION  REMOTE SYSTEM
  5       RCHSX499
```

Notice in the following System/36 display, when the values supplied by the system administrator for options 3 (056) and 4 (00499) are combined, they match that value (05600499) supplied for the EXCHID parameter in the line description created on AS/400 system 499. This particular EXCHID parameter is shown on page 8-22.

```
13.0               REMOTE SYSTEM ATTRIBUTES                    LX25005     W1
                     Remote system RCHSX499
1. Remote system type . . . . . . . . . . . . . . . . . . . . . . 2
  1-Host             2-Peer
3. Remote system's block ID in hexadecimal  . . . . . . . . . . . 056
4. Remote system's station XID in hexadecimal . . . . . . . . . . 00499
```

System/36 Subsystem Member Configuration

The following sequence of System/36 displays shows the contents of the subsystem member configuration named SX25APPN. The CNFIGICF procedure command is used on the System/36 to display this information.

```
 1.0          SSP-ICF CONFIGURATION MEMBER DEFINITION                  W1
1. Configuration member name . . . . . . . . . . . . . . . . . SX25APPN
2. Library name . . . . . . . . . . . . . . . . . . . . . . . . CMNCFG
3. Select one of the following:
      1. Create new member
      2. Edit existing member
      3. Create new member from existing member
      4. Remove a member
      5. Review a member
   Option . . . . . . . . . . . . . . . . . . . . . . . . 1-5  5
```

```
 2.0              SSP-ICF CONFIGURATION MEMBER TYPE          SX25APPN    W1
Select one of the following options:
      1. Intra
      2. BSC
      3. SNA
      4. Async
      5. PC Support/36
   Option: 3
```

```
 4.0                SNA CONFIGURATION MEMBER TYPE             SX25APPN    W1
1. SNA member type . . . . . . . . . . . . . . . . . . . . . . 1-4  1
      1. SNA subsystem member
      2. SNA/SDLC line member
      3. SNA/X.25 line member
      4. SNA/IBM Token-Ring Network line member
```

```
21.0             SNA SUBSYSTEM MEMBER SELECTION                SX25APPN    W1
1. Select subsystem type from the following options:
      1. Peer
      2. SNA Upline
      3. SNA 3270
      4. Finance
      5. SNA MSRJE
      6. APPC
      7. APPN
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . 1-7  7
```

```
22.0              SUBSYSTEM MEMBER DEFINITION                  SX25APPN    W1
1. Local location name . . . . . . . . . . . . . . . . . . . . RCH36024
5. Network ID . . . . . . . . . . . . . . . . . . . . . . . . . RPC
```

```
28.0            APPN SUBSYSTEM MEMBER DEFINITION              SX25APPN    W1
                                                               Optional-*
1. Select one of the following options:
      1. Define locations in non-networking nodes
      2. Define locations in networking nodes
      3. Define locations in nonadjacent single-session nodes
      5. Define session groups for multiple-session locations
      6. Define session groups for single-session locations
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
2. Line member name . . . . . . . . . . . . . . . . . . . . . . LX25005   *
```

Note: Remember that AS/400 system 499 is an APPN networking node.

```
 29.0                    REMOTE LOCATION SELECTION              SX25APPN    W1
1. Select from the following options:
                                                        5-Review
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . . .
2. Remote location name . . . . . . . . . . . . . . . . . . . . .
3. Remote system name . . . . . . . . . . . . . . . . . . . . . .
--------------------------------------------------------------------------------
OPTION   LOCATION     REMOTE SYSTEM                                 Page  1  of  1
  5      RCHSX499       RCHSX499
```

```
41.0           APPC AND APPN LOCATION DEFINITION              SX25APPN    W1
      Remote system RCHSX499              Remote location RCHSX499
2. Stay operational?  . . . . . . . . . . . . . . . . . . . . Y,N  Y
```

System/36 X.25 Configuration

The following sequence of System/36 displays and printed data shows the X.25 configuration information created on the System/36 for communications with the AS/400 system 499 through the X.25 network. The displays and printed data are obtained by using the CNFIGX25 procedure command on the System/36.

X.25 Network and Logical Channel Configuration

The following information was obtained by the system administrator for the network subscription purchased for System/36 024. Remember that this information describes the interface between the System/36 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00000024.
- Logical channel configuration:

  001-004 Currently unassigned PVCs
  005-008 SVCs handling incoming calls from the network
  009-00C SVCs handling both incoming and outgoing calls
  00D-010 SVCs handling outgoing calls from System/36 024

- Network address of the remote DTE:

  00000499 AS/400 system 499

- Physical interface supplied is CCITT Recommendation X.21 bis V.24.

- HDLC link level modulus is 8.
- Packet level modulus is 8.
- Maximum packet size supported is 256.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 7.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

Using the above network subscription information, the X.25 network and logical channel configuration information is defined on the System/36 using the CNFIGX25 procedure command. The following displays show the steps needed to print the contents of the configuration.

```
 1.0                  X.25 CONFIGURATION UTILITY MENU                    W1
 1. Select one of the following:
       1. X.25 network and logical channel configuration
       2. X.25 virtual circuit configuration
    Option . . . . . . . . . . . . . . . . . . . . . . . . . 1
```

```
 1.5                X.25 NETWORK CONFIGURATION MENU                      W1
 1. Select one of the following:
       1. Create new member
       2. Edit member
       3. Remove member
       4. Print member
    Option . . . . . . . . . . . . . . . . . . . . . . . . . 4
 2. Network configuration member name . . . . . . . . . . . . CX25005
```

The following is the result of the values specified on the two previous displays:

```
    X.25 NETWORK AND LOGICAL CHANNEL CONFIGURATION                                PAGE 001
    NETWORK CONFIGURATION                          CX25005
NETWORK TYPE . . . . . . . . . . . . . . . . . . . . . . A
NETWORK DEFAULT PACKET SIZE  . . . . . . . . . . . . . . 256
NETWORK DEFAULT PACKET WINDOW  . . . . . . . . . . . . . 07
LINK LEVEL TIME-OUT IN SECONDS . . . . . . . . . . . . . 3.0
LOCAL NETWORK ADDRESS  . . . . . . . . . . . . . . . . . 00000024
NUMBER OF LOGICAL CHANNELS . . . . . . . . . . . . . . . 16
NETWORK MAXIMUM PACKET SIZE  . . . . . . . . . . . . . . 256
     LOGICAL CHANNEL CONFIGURATION
REFERENCE NUMBER           01  02  03  04  05  06  07  08  09  10  11  12  13  14  15  16
1. TYPE . . . . . . . . .   P   P   P   P   S   S   S   S   S   S   S   S   S   S   S   S
2. GROUP NUMBER . . . . .   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0   0
3. CHANNEL NUMBER . . . .  01  02  03  04  05  06  07  08  09  0A  0B  0C  0D  0E  0F  10
4. CALL DIRECTION . . . .                  I   I   I   I   B   B   B   B   0   0   0   0
```

Figure 8-4. Printout of System/36 X.25 Network and Channel Configuration

X.25 Virtual Circuit Configuration

The X.25 virtual circuit configuration characteristics of the switched virtual circuit to the remote AS/400 system 499 are defined on the System/36 using the CNFIGX25 procedure command. The following displays show the steps needed to print the contents of the configuration.

```
 1.0                X.25 CONFIGURATION UTILITY MENU                    W1
1. Select one of the following:
      1. X.25 network and logical channel configuration
      2. X.25 virtual circuit configuration
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . . . 2
```

```
 4.0                  X.25 VIRTUAL CIRCUIT MENU                        W1
1. Select one of the following:
      1. Create new member
      2. Edit member
      3. Create new member from existing member
      4. Remove member
      5. Print member
   Option . . . . . . . . . . . . . . . . . . . . . . . . . . . . 5
```

```
 5.0              X.25 VIRTUAL CIRCUIT MEMBER SELECT                   W1
1. Member name . . . . . . . . . . . . . . . . . . . . . . . . CX25005
3. Library name . . . . . . . . . . . . . . . . . . . . . . . CMNCFG
```

The following is the result of the values specified on the three previous displays:

```
    X.25 VIRTUAL CONFIGURATION MEMBER                                  PAGE 001
MEMBER NAME  . . . . . . CX25005        LIBRARY NAME . . . . . CMNCFG
NETWORK CONFIGURATION NAME  . . . . . . . CX25005                          SS
REMOTE STATION:          RCHSX499       STATION ADDRESS:       01
PACKET SIZE  . . . . . . . . . . . . . . . . . . . . 256
PACKET WINDOW  . . . . . . . . . . . . . . . . . . . 07
PROTOCOL . . . . . . . . . . . . . . . . . . . . . . Q
VIRTUAL CIRCUIT TYPE . . . . . . . . . . . . . . . . SVC
TARIFF TOTALS ACCUMULATION . . . . . . . . . . . . . N
REMOTE NETWORK ADDRESS . . . . . . . . . . . . . . . 00000499
CALL DIRECTION . . . . . . . . . . . . . . . . . . . I
REVERSE CHARGE . . . . . . . . . . . . . . . . . . . N
CLOSED USER GROUP ID . . . . . . . . . . . . . . .
UNIQUE NETWORK FACILITIES  . . . . . . . . . . . .
================================================================================
```

Figure 8-5. Printout of System/36 X.25 Virtual Circuit Configuration

Configurations on System/38 258

The following configurations are created on System/38 258 to allow it to communicate with the AS/400 system 499 through the X.25 network.

First, the network attributes are changed as follows:

```
CHGNETA    ALRSTS(*ON)  ALRCTLU(CACFS338)  SYSNAM(RCH38258)
           ALRFOCPNT(*YES)  MSGQ(QSYSOPR.QSYS)  OUTQ(QPRINT.QGPL)
           JOBACN(*FILE)  MAXHOP(16)  DDMACC(*OBJAUT)
```

The following information was obtained by the system administrator for the network subscription purchased for System/38 258. Remember that this information describes the interface between the System/38 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00000258.
- Logical channel configuration:

  001-004 Currently unassigned PVCs
  005-008 SVCs handling incoming calls from the network
  009-00C SVCs handling both incoming and outgoing calls
  00D-010 SVCs handling outgoing calls from System/38 258

- Network address of the remote DTE:

  00000499 AS/400 system 499

- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 8.
- Maximum packet size supported is 512.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 7.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

Using the above network subscription information, the line description for System/38 258 is created on that system using the following command:

```
CRTLIND    LIND(LX2505E)  LINNBR(5E)  TYPE(*X25)  CNN(*PP)  RATE(009600)
           WIRE(4) DCEGRP(*A)  IDLETIME(0015)  RETRY(0002)
           EXCHID(02200258)  X25NETTYPE(0111)  LCLNETADR(00000258)
           DFTPKTSIZE(512)  DFTWDWSIZE(7)  NETMAXPIU(521)
           LGLCHLE((0 01 *PVC)  (0 02 *PVC)  (0 03 *PVC)  (0 04 *PVC)
           (0 05 *SVCIN)  (0 06 *SVCIN)  (0 07 *SVCIN)  (0 08 *SVCIN)
           (0 09 *SVCBOTH)  (0 0A *SVCBOTH)  (0 0B *SVCBOTH)
           (0 0C *SVCBOTH)  (0 0D *SVCOUT)  (0 0E *SVCOUT)
           (0 0F *SVCOUT)  (0 10 *SVCOUT))
```

The controller and device descriptions representing the remote AS/400 system 499 are created on the System/38 using the following commands:

```
CRTCUD  CUD(CX25S499S)  TYPE(*PEER)  MODEL(0)  CTLADR(0000)
        SWITCHED(*YES)  TELNBR(00000499)  INLCNN(*CALL)
        EXCHID(05600499)  LINLST(LX2505E)  MAXLENPIU(521)
        LINKTYPE(*X25LLS)  CODE(*EBCDIC)  X25ADR(000000)

CRTDEVD   DEVD(DX25S499S)  DEVADR(000000)  DEVTYPE(*PEER)  MODEL(0)
          CTLU(CX25S499S)  LCLLU(RCH38258)  RMTLU(RCHSX499)
          NETDEVADR(02000000)

ADDDEVMODE  DEVD(DX25S499S)  MODE(*BLANK)  MAXSSN(50)  PREBNDSSN(0)
            MAXSRCSSN(25)  MAXCNV(50)  INPACING(3)  OUTPACING(3)
```

Note: The mode *BLANK is associated with the device so that communications between the System/38 and the remote AS/400 system 499 can occur using the default mode of BLANK on the AS/400 system. (The mode name of *BLANK on the System/38 is changed to BLANK on the AS/400 system.)

Configurations for 5394 Controller and 5251 Display Station

The remote 5394 controller is configured by the system administrator in the following manner to allow it to communicate with the AS/400 system 499 through the X.25 network.

The following information was obtained by the system administrator for the network subscription purchased for the 5394 controller. Remember that this information describes the interface between the 5394 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00005394.
- Logical channel configuration:

  001 Currently unassigned PVC
  002 SVC handling both incoming and outgoing calls

- Network address of the remote DTE:

  00000499 AS/400 system 499

- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 8.
- Maximum packet size supported is 256.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 7.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

The following display shows, on an attached 5251 display station, the configuration of the 5394 that allows it to communicate with AS/400 system 499. This display is shown as a result of turning on the 5394 controller with its Normal/Test mode switch set to Test mode and then pressing the Cmd and Backspace keys on the 5251 display.

```
        0       1       2       3       4       5       6
      ------------------------------------------------------
   0/ D       .       P       .       .       .       .

   1/ .       .       .       .       .       .       .

   2/ .       .       .       .       .       .       .

   3/ .       .       .       .       .       .       .









AA-> 1    BB-> 0
1-> 00        2-> 01    4-> 0 7 7    5-> 1 0 0 1 0         6-> 0 0 1 0 0 0 0 0
7-> 0A 03
                                                                P-> _ _
```

In this display, the following fields are significant to X.25 communications. The D indicates a display station is located at address 0 (top row). This display station is associated with port 0 (side column). The P indicates a printer is located at address 2, port 0.

Additional fields at the bottom of the display pertain to X.25 communications as follows:

- Field 1 indicates the country of origin for the keyboard used — 00 = United States and Canada.
- Field 2 indicates the X.25 station address of the controller.
- Field 4 indicates the modulus, packet window size, and link window size.
- Fields 5 and 6 indicate communications configuration information including whether you are using SVCs or PVCs, LLC selection, and reverse charging.

After the 5394 controller is configured as shown in the previous display, the controller must be turned off, its Normal/Test mode switch set to Normal, and then turned back on. Then, on the 5251 display station, the Shift and Sys Req keys must be pressed. After that, if the data shown in the following display is entered on the 5251, a call (with reverse charging requested) will be placed to the AS/400 system 499.

```
c,n00000499-00005394,1002,r
```

This display requires the user to indicate several pieces of information. The c indicates a call is being placed. The n00000499 indicates the host system (in this case, the AS/400 system) network address. The -00005394 causes the 5394 to insert this address into the local network address field of the call request packet. The 1002 indicates the hexadecimal value of the logical channel, and the r indicates reverse charging is requested.

Configurations for 3274 Controller and 3279 Display Station

The remote 3274 controller is configured by the system administrator in the following manner to allow it to communicate with AS/400 system 499 through the X.25 network.

The following information was obtained by the system administrator for the network subscription purchased for the 3274 controller. Remember that this information describes the interface between the 3274 DTE and the network DCE to which it is directly attached:

- DCE clocking rate (line speed) is 9600 bps.
- DTE local network address is 00003274.
- Logical channel configuration:

  001 Currently unassigned PVCs
  002 SVC handling both incoming and outgoing calls

- Network address of the remote DTE:

  00000499 AS/400 system 499

- Physical interface supplied is CCITT Recommendation X.21 bis V.24.
- HDLC link level modulus is 8.
- Packet level modulus is 8.
- Maximum packet size supported is 256.
- HDLC link level maximum send and receive window size is 7.
- Packet level maximum send and receive window size is 7.
- Maximum DCE processing overhead is 0.5 second (0 increase delay is assumed).
- Good quality lines to the network are used.
- The network allows the DTE to insert its network address into call request and accept packets.

For more information on 3274 configuration customizing, see the *IBM 3270 Information Display System: 3274 Control Unit Customization Guide.*

The following figures show the 3274 configuration displays that result in the desired configuration, particularly the last display in the sequence, which shows the X.25-related configuration characteristics.

Insert the X.25 PVC or SVC system diskette for the 3274 model 51C and press the IML key. The following displays are shown:

```
001
1234567890ABCDEF 34
```

```
011
0
```

```
021
0
```

```
031
0
```

These displays require the user to supply the necessary values. Display 001 requires keyboard validation, the first string of characters, and the validation number, which in this case is 34. Displays 011 through 031 require information on printer and diskette specifications in the field where the 0 is located. (You can press the Enter key to move to the next display if you do not have the printer and diskette specifications.)

```
999

    111 - 00    112 - 08    113 - DC    114 - 0     115 - 0    116 - 0
    121 - 01    125 - 00100000          127 - 0 0
    136 - 0 0 0             137 - 0 0 0 0           138 - 0    139 - 0
    141 - A                 151 - 51C
    160 - 1     161 - 1     165 - 0     166 - B
    170 - 0     173 - 00000000          175 - 000000
                213 - 0     215 - 000C1             220 - 0
                302 - C1
                311 - 0
    331 - 2                 343 - 00


                                                            900 - 0
```

The previous display shows the following fields which contain information needed to communicate with the AS/400 system:

- Field 215 is the physical unit identification (PUID). This is a 5-character code that identifies the 3274 Control Unit to the AS/400 system in response to an SDLC XID command. Each controller on the network must have a unique PUID.
- Field 302 is the X.25 secondary address. This is a 2-digit hexadecimal number of the 3274 Control Unit as identified at the logical link control level.
- After making the necessary changes, change the `900 - 0` to `900 - 1`.

```
332                                                          C1/51C/X25

    400 - 00    401 - 4     402 - 0002  403 - 1
    410 - 00000499      /               411 - 00003274      /
    420 - 00000100                      421 - 00000100
    430 - 2     431 - 0     432 - 02    433 - 2
    434 - 2                 435 - 02
    440 - A     441 - NN    442 - NNNN  443 - 10100000
    450 - 0120              451 - 02    452 - 3274   /


                                                        908 - 0
```

Note: The slashes (/) shown in the display above indicate the end of the input areas for the fields shown to the left of them.

Display 332 is the X.25 Customization Panel. Several fields on this panel have information that must be matched to the AS/400 system. These fields include the following:

- Field 400 indicates the type of network. For this example, 00 (CCITT-recommended network) was selected.
- Field 401 indicates the type of circuit the 3274 is operating on. Options include PVC, SVC incoming, SVC outgoing, or SVC two way.
- Field 402 indicates the logical channel identifier.
- Field 410 indicates the host DTE address.
- Field 411 indicates the 3274 DTE address.
- Field 420 indicates the incoming call options.
- Field 421 indicates the outgoing call options.
- Field 452 indicates the connection identifier password.

With the 3274 controller configured as shown in the displays above, a call can be placed to the AS/400 system 499 by the 3274 dial-out procedures. On the 3274 keyboard, the sequence is:

```
<Alt>
<Eof>
<1>
<Enter>
```

For more information, see the *IBM 3270 Information Display System: X.25 Operation* manual.

Example 2: AS/400 System-to-AS/400 System X.25 Non-PSDN Configuration

In this example, the system administrator connects the AS/400 system 499 (9406 System Unit), acting as a DCE, through a V.35 modem eliminator to another AS/400 system 386 (9404 System Unit) acting as a DTE. The modem eliminator is operating at 56 000 bps. The administrator needs two virtual circuits defined between the systems for various APPC applications. One of the virtual circuits is an SVC to be used for testing purposes.

Since no network-imposed restrictions exist on the maximum packet and window sizes, the best performance is achieved by using a packet level modulus of 128 and by using the largest window and packet sizes of 15 and 1024, respectively.

Note: If SVC circuits are not expressly required when communicating using a modem eliminator, it is recommended that PVC circuits be defined instead, since SVCs have more overhead than PVCs for establishing the connection.

Figure 8-6 shows the connection of the AS/400 system 499 DCE through a V.35 modem eliminator to the AS/400 system 386 DTE.

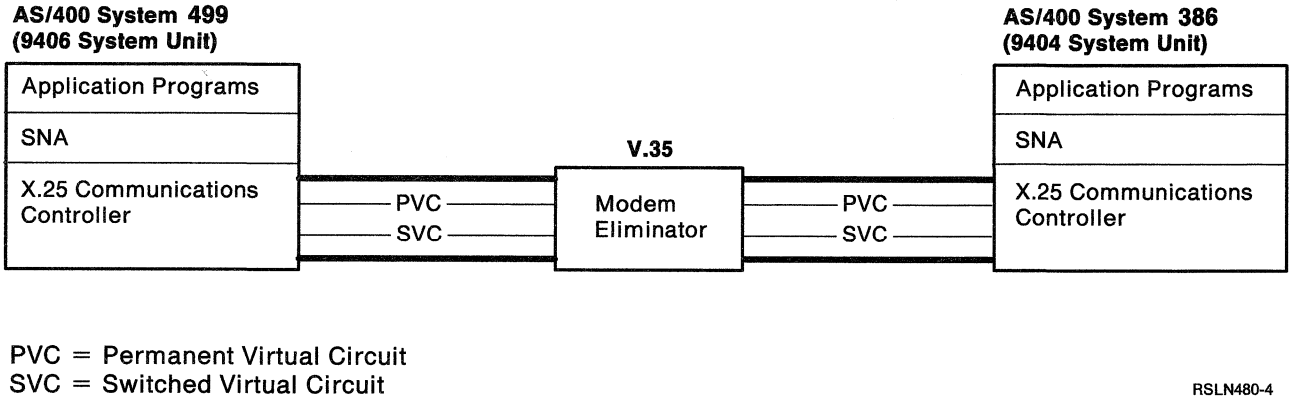

Figure 8-6. Example 2: Two AS/400 Systems Connected Using X.25 without a PSDN Network

Configurations on AS/400 System 499

The following configurations are created by the system administrator on system 499 to allow communications with system 386 through a modem eliminator.

First, the network attributes are changed as follows:

```
CHGNETA  SYSNAME(RCHSX499)  LCLNETID(RPC)  LCLCPNAME(RCHSX499)
         LCLLOCNAME(RCHSX499)  NODETYPE(*NETNODE)
```

The following command was used to create the line description on system 499. Notice that the DCE support is selected by means of the X25DCE parameter. Selection of *LOCAL for the CNNINIT parameter in the DCE line description causes system 499 to continuously attempt to establish an HDLC link to system 386.

```
CRTLINX25  LIND(LX25021)  RSRCNAME(LIN021)  LGLCHLE((001 *PVC)
           (002 *SVCBOTH))  NETADR(00000499)  CNNINIT(*LOCAL)
           INTERFACE(*X21BISV35)  LINESPEED(56000)  EXCHID(05600499)
           DFTPKTSIZE(1024)  MODULUS(128)  DFTWDWSIZE(15)  X25DCE(*YES)
```

The PVC controller description and device description representing system 386 are created on system 499 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S386P)  LINKTYPE(*X25)  APPN(*NO)  LINE(LX25021)
            EXCHID(05600499)  NETLVL(1984)  LGLCHLID(001)

CRTDEVAPPC  DEVD(DX25S386P)  RMTLOCNAME(X25S386P)
            LCLLOCNAME(X25S499P)  CTL(CX25S386P) APPN(*NO)
```

The SVC controller description and device description representing system 386 are created on system 499 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S386S)  LINKTYPE(*X25)  SWITCHED(*YES)
            APPN(*NO)  SWTLINLST(LX25021)  EXCHID(05600499)
            CNNNBR(00000386)  NETLVL(1984)

CRTDEVAPPC  DEVD(DX25S386S)  RMTLOCNAME(X25S386S)  LCLLOCNAME(X25S499S)
            CTL(CX25S386S)  APPN(*NO)
```

For an example of creating line, controller, and device descriptions using displays, see "Configurations on Local AS/400 System 499" on page 8-4.

Configurations on AS/400 System 386

The following configurations are created on system 386 to allow communications with system 499.

First, the network attributes are changed as follows:

```
CHGNETA  SYSNAME(RCHSX386)  LCLNETID(RPC)  LCLCPNAME(RCHSX386)
         LCLLOCNAME(RCHSX386)  NODETYPE(*ENDNODE)
         NETSERVER((RPC RCHSX119))
```

The following command is used to create the line description on system 386. Selection of *WAIT for the CNNINIT parameter in the DTE line description causes system 386 to wait indefinitely for system 499 to establish an HDLC link connection.

```
CRTLINX25  LIND(LX25071)  RSRCNAME(LIN071)  LGLCHLE((001 *PVC)
           (002 *SVCBOTH))  NETADR(00000386)  CNNINIT(*WAIT)
           INTERFACE(*X21BISV35)  LINESPEED(56000)  EXCHID(05600386)
           DFTPKTSIZE(1024)  MODULUS(128)  DFTWDWSIZE(15)
```

The PVC controller description and device description representing system 499 are created on system 386 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S499P)  LINKTYPE(*X25)  APPN(*NO) LINE(LX25071)
            EXCHID(05600499)  NETLVL(1984)  LGLCHLID(001)

CRTDEVAPPC DEVD(DX25S499P) RMTLOCNAME(X25S499P) LCLLOCNAME(X25S386P)
           CTL(CX25S499P) APPN(*NO)
```

The SVC controller description and device description representing system 499 are created on system 386 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S499S)  LINKTYPE(*X25)  SWITCHED(*YES)  APPN(*NO)
            SWTLINLST(LX25071)  EXCHID(05600499)  INLCNN(*ANS)
            CNNNBR(00000499)  NETLVL(1984)

CRTDEVAPPC  DEVD(DX25S499S) RMTLOCNAME(X25S499S)  LCLLOCNAME(X25S386S)
            CTL(CX25S499S)  APPN(*NO)
```

Note: The SVC controller has the initial connection (INLCNN) parameter set to *ANS as recommended in "Connecting Systems without a Network (DCE-to-DTE)" on page 2-7.

For an example of creating line, controller, and device descriptions using displays, see "Configurations on Local AS/400 System 499" on page 8-4.

Example 3: AS/400 System-to-System/38 X.25 Non-PSDN Configuration

In this example, the system administrator connects the AS/400 system 320 (9406 System Unit), acting as the DCE, through a V.24 modem eliminator to a System/38 262 acting as the DTE. The modem eliminator is operating at 19 200 bps. The administrator needs two virtual circuits defined between the systems for various APPC applications. One of the virtual circuits is an SVC to be used for testing purposes.

Note: If SVC circuits are not expressly required when communicating using a modem eliminator, it is recommended that PVC circuits be defined instead, because SVCs have more overhead than PVCs for establishing the connection.

Figure 8-7 shows the connection of the AS/400 system 320 DCE through a V.24 modem eliminator to the System/38 262 DTE.

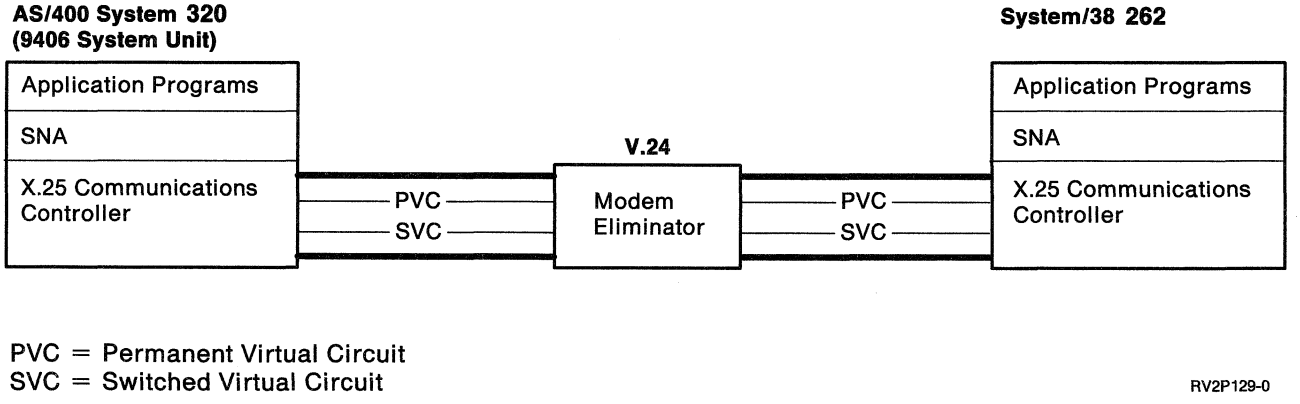

Figure 8-7. Example 3: An AS/400 System Connected to a System/38 Using X.25 without a PSDN Network

Configurations on the AS/400 System 320

The following configurations are created by the system administrator on system 320 to allow communications with system 262 through a modem eliminator.

The following command was used to create the line description on system 320. Notice that the DCE support is selected with the X25DCE parameter. Selection of *LOCAL for the CNNINIT parameter in the DCE line description causes system 320 to continuously attempt to establish an HDLC link to system 262.

```
CRTLINX25  LIND(LX25041)  RSRCNAME(LIN041)  LGLCHLE((001 *PVC)
           (002 *SVCBOTH))   NETADR(00000320)  CNNINIT(*LOCAL)
            LINESPEED(19200)  EXCHID(05600320)  DFTPKTSIZE(512)
           MODULUS(8)  DFTWDWSIZE(7)  X25DCE(*YES) LINKSPEED(19200)
```

The PVC controller description and device description representing system 262 are created on system 320 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S262P)  LINKTYPE(*X25)  APPN(*NO)  LINE(LX25041)
            ROLE(*SEC)  NETLVL(1980)  LGLCHLID(001)

CRTDEVAPPC  DEVD(DX25S262P)  RMTLOCNAME(RCH38262)
            LCLLOCNAME(RCHAS320)  CTL(CX25S262P) APPN(*NO)
```

The SVC controller description and device description representing system 262 are created on system 320 using the following commands:

```
CRTCTLAPPC  CTLD(CX25S262S)  LINKTYPE(*X25)  SWITCHED(*YES)
            APPN(*NO)  SWTLINLST(LX25041)  EXCHID(02200262)
            CNNNBR(00000262)  ROLE(*SEC)  NETLVL(1980)

CRTDEVAPPC  DEVD(DX25S262S)  RMTLOCNAME(RCH38262)  LCLLOCNAME(RCHAS320)
            CTL(CX25S262S)  APPN(*NO)
```

For an example of creating line, controller, and device descriptions using displays, see "Configurations on Local AS/400 System 499" on page 8-4.

Configurations on System/38 262

The following configurations are created on system 262 to allow communications with system 320.

The following command is used to create the line description on system 262. Selection of 0121 for the X25NETTYPE parameter in the DTE line description causes system 262 to wait indefinitely for system 320 to establish an HDLC link connection.

```
CRTLIND     LIND(LX2505E)  LINNBR(5E)  TYPE(*X25)  CNN(*PP)
            RATE(19200)  WIRE(4)  DCEGRP(*A)
            IDLETIME(0015)  RETRY(0002)  EXCHID(02200262)
            X25NETTYPE(0121)  LCLNETADR(00000262)
            DFTPKTSIZE(512)  DFTWDWSIZE(7) LGLCHLE((0 01 *PVC)
            (0 02 *SVCBOTH))
```

The PVC controller description, device description, and mode description representing system 320 are created on system 262 using the following commands:

```
CRTCUD  CUD(CX25S320P)  TYPE(*PEER)  MODEL(0)  CTLADR(0000)
        LINE(LX2505E)  EXCHID(05600320)  LINKTYPE(*X25LLP)
        CODE(*EBCDIC)  X25ADR(00015E)

CRTDEVD  DEVD(DX25S320P)  DEVADR(000000)  DEVTYPE(*PEER)  MODEL(0)
         CTLU(CX25S320P)  LCLLU(RCH38262)  RMTLU(RCHAS320)
         NETDEVADR(0000015E)

ADDDEVMODE  DEVD(DX25S320P)  MODE(*BLANK)  MAXSSN(8)
            PREBNDSSN(0)  MAXSRCSSN(4)  MAXCNV(8)
            INPACING(3)  OUTPACING(3)
```

The SVC controller description, device description, and mode description representing system 320 are created on system 262 using the following commands:

```
CRTCUD     CUD(CX25S320S)  TYPE(*PEER)  MODEL(0)
           CTLADR(0000)  SWITCHED(*YES)
           TELNBR(00000320)  INLCNN(*ANS)
           EXCHID(05600320)  LINLST(LX2505E)
           LNKTYPE(*X25LLP)  CODE(*EBCDIC)   X25ADR(000000)

CRTDEVD    DEVD(DX25S320S)  DVEADR(000000)  DEVTYPE(*PEER)
           MODEL(0)  CTLD(CX25S320S)  LCLLU(RCH38262)
           RMTLU(RCHAS320)


ADDDEVMODE   DEVD(DX25S320S)  MODE(*BLANK)  MAXSSN(8)
             PREBNDSSN(0)  MAXSRCSSN(4)  MAXCNV(8)
             INPACING(3)  OUTPACING(3)
```

Note: The SVC controller has the initial connection (INLCNN) parameter set to *ANS as recommended in the topic "Connecting Systems without a Network (DCE-to-DTE)" on page 2-7.

Example 4: AS/400 System-to-AS/400 System X.25 PSDN Switched Line Configuration

In this example, a system administrator at the local AS/400 system wishes to connect to two other remote AS/400 systems through an X.25 packet-switching data network (PSDN). The local AS/400 system, identified as system 340, has both a nonswitched and a switched line connection to the PSDN. SVCs will be used for all communications.

The PSDN in this example does not support dialing to the DTE. Therefore, a DTE with only a switched line connection is not able to receive calls. That DTE must dial to a DTE with a nonswitched line connection to establish X.25 communications. If the PSDN supports dialing to the DTE, a DTE can call a remote DTE or answer any calls on a switched line connection.

In this example, both APPC and asynchronous controllers are used for X.25 communications. The following example shows the configurations for only system 015 and system 340. This example does not show the nonswitched configuration.

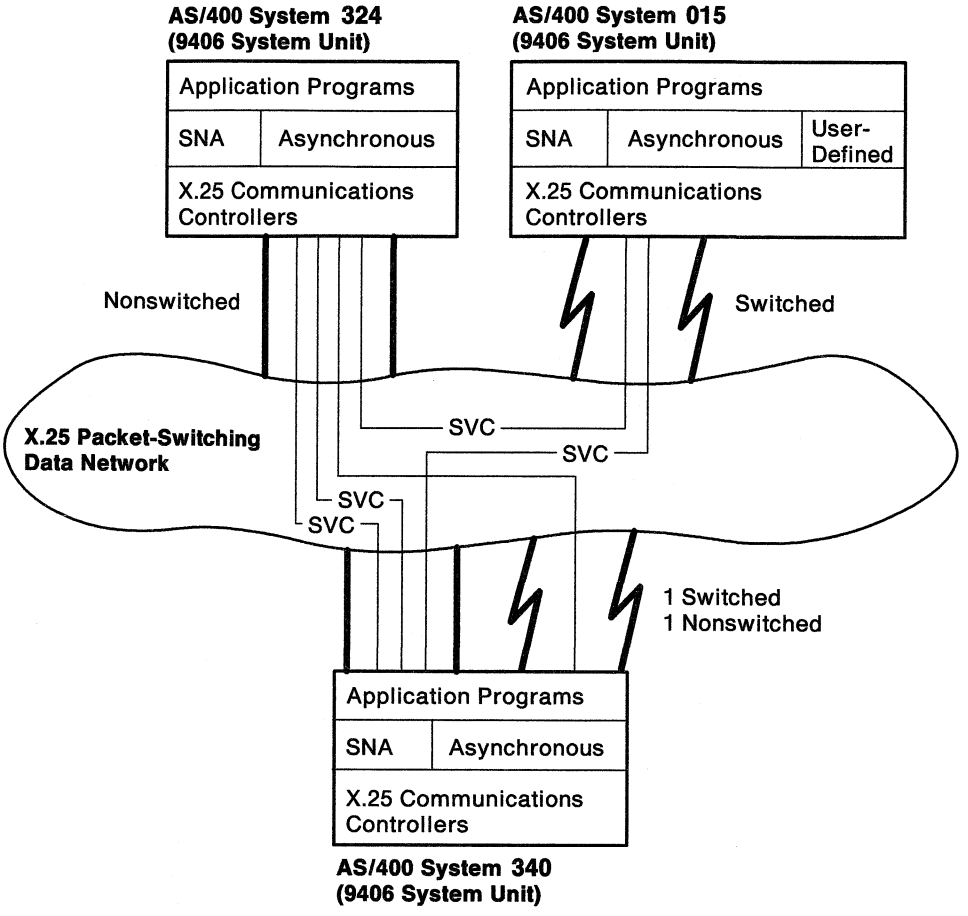

Figure 8-8. X.25 PSDN Switched and Nonswitched Line Configuration

Configuring System 340

System 340 is set up with both a switched line connection and a nonswitched connection. Each connection has a different network address. The following displays show the configuration of the switched line description.

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Line description . . . . . > LX25041      Name
Resource name  . . . . . > LIN041      Name
Logical channel entries:
  Logical channel identifier . . > 001        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .     _____      Name

  Logical channel identifier . . > 002        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .     _____      Name

  Logical channel identifier . . > 003        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .     _____      Name
            + for more values
Local network address  . . . . . > 61200086

                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Connection initiation  . . . . . > *WAIT   1   *LOCAL, *REMOTE, *WAIT
Online at IPL  . . . . . .       *YES        *YES, *NO
Physical interface . . . . . > *RS232V24     *X21BISV24, *X21BISV35...
Connection type  . . . . . > *SWTPP   2      *NONSWTPP, *SWTPP
Vary on wait . . . . . .         *NOWAIT     *NOWAIT, 15-180 (1 second)
Line speed . . . . . .           9600        600, 1200, 2400, 4800...
Exchange identifier  . . . . .   05600340    05600000-056FFFFF, *SYSGEN
Extended network addressing  . .  *NO        *YES, *NO
Default packet size:
  Transmit value . . . . . .     128         64, 128, 256, 512, 1024
  Receive value  . . . . . > 128             *TRANSMIT, 64, 128, 256...
Maximum packet size:
  Transmit value . . . . . .     *DFTPKTSIZE *DFTPKTSIZE, 64, 128, 256...
  Receive value  . . . . . .     *DFTPKTSIZE *DFTPKTSIZE, *TRANSMIT, 64...
Modulus  . . . . . .             8           8, 128

                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Default window size:
  Transmit value . . . . . .  2____          1-15
  Receive value  . . . . . .> 2____          1-15, *TRANSMIT
Insert net address in packets .> *NO 3       *YES, *NO
Network user ID  . . . . . .> C4000753454849424D32066039344B574300 4

Connection number  . . . . . .> 914142710113 5
Calling number . . . . . .  *NONE
Switched connection type . . . .  *BOTH      *BOTH, *ANS, *DIAL
Autoanswer . . . . . .  *YES      *YES, *NO
Autodial . . . . . .> *YES      *NO, *YES
Dial command type  . . . . . .  *V25BIS 6   *NONE, *V25BIS
Call immediate . . . . . .  *NO      *NO, *YES
Autocall unit  . . . . . .  *NO      *NO, *YES
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Predial delay  . . . . . .  6____          0-254 (0.5 seconds)
Redial delay . . . . . .  120___          0-254 (0.5 seconds)
Dial retry . . . . . .  2____          0-254
Switched disconnect  . . . . . .  *YES      *YES, *NO
Disconnect timers:
  Minimum connect timer  . . . .  170_____  0-65535 seconds
  Disconnection delay timer  . .  0_____    0-65535 seconds
Data Set Ready drop timer  . . .  6____     3-60 (seconds)
Autoanswer type  . . . . . .  *DTR___     *DTR, *CDSTL
Remote answer timer  . . . . . .  60____     30, 35, 40, 45 (seconds)...
Text 'description' . . . . . .> 'Switched X.25 line on AS/400 system 340'
_____

                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Considerations for specifying the CRTLINX25 command:

1 The connection initiation value specifies how an X.25 data link connection is initiated. *WAIT indicates the local system waits for a disconnect mode response or disconnect command from the DCE before sending a set asynchronous balanced mode command.

2 The connection type (CNN parameter) specifies whether this is a switched or nonswitched X.25 line.

3 In this example, the local (or calling) network address is not inserted in call request packets. Contact your network subscriber to determine if the network address should be inserted, or if the PSDN inserts the address.

4 The network user identifier informs the PSDN of the identity of the calling DTE. This parameter is required if your network subscription includes identified service through the network user identification (NUI selection) facility.

5 This parameter defines the telephone number of the DCE.

6 This parameter defines the dialing protocol used to establish a switched connection. V.25 bis dialing procedures allows one physical interface for both call establishment and data transmission.

The following displays demonstrate the configuration of an APPC controller using a switched line to communicate with system 015.

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

Controller description . . . . . > RCHAS015      Name
Link type . . . . . > *X25        *IDLC, *LAN, *LOCAL, *SDLC...
Online at IPL . . . . . *YES      *YES, *NO
Switched connection . . . . . > *YES 1      *NO, *YES
APPN-capable . . . . . *YES       *YES, *NO
Switched line list . . . . . > LX25042  2   Name
          + for more values
Maximum frame size . . . . . *LINKTYPE      265-16393, 265, 521, 1033...
Remote network identifier . . . *NETATR     Name, *NETATR, *NONE
Remote control point . . . . . > RCHAS015   Name
Exchange identifier . . . . . > 05600015    00100000-FFFFFFFF
Initial connection . . . . . > *ANS  3      *DIAL, *ANS
Connection number . . . . . > *ANY  4
Data link role . . . . . *NEG     *NEG, *PRI, *SEC
X.25 network level . . . . . > 1984         1980, 1984, 1988
X.25 link level protocol . . . . *QLLC      *QLLC, *ELLC
                                                                More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display       F24=More keys
```

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

X.25 connection password . . . . > PASSWRD1     Character value
APPN CP session support . . . . *YES            *YES, *NO
APPN node type . . . . . *ENDNODE               *ENDNODE, *LENNODE...
APPN transmission group number  1               1-20, *CALC
APPN minimum switched status . . *VRYONPND      *VRYONPND, *VRYON
Text 'description' . . . . . > 'APPC controller communicating with 015'
_____

                                                                Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display       F24=More keys
```

Considerations for specifying the CRTCTLAPPC command:

1 This is an SVC controller.

2 Line LX25042, a nonswitched line, is connected to this controller for X.25 communications. Multiple lines can be defined in the switched line list. The line used is selected when a job starts using this controller. In this example, system 015 is making calls to the system 340 nonswitched line.

3 By specifying *ANS, this controller is restricted to only answer SVC calls.

4 This parameter can be a specific remote network address or *ANY. If *ANY is specified, this controller accepts calls from any network address, providing the password in the controller description matches the password sent by the remote DTE. If *ANY is used, the initial connection (INLCNN parameter) must be *ANS.

Additional displays can be shown for additional parameter values. One of the additional parameters is X.25 switched line selection. If the default (*FIRST) is selected, the first line in the switched line list (SWTLINLST parameter) is selected. If *CALC is selected, the system selects the line description representing the minimum cost.

The following displays describe the asynchronous controller that is located on system 015.

```
                    Create Ctl Desc (Async) (CRTCTLASC)

 Type choices, press Enter.

 Controller description . . . . . > S015ASC      Name
 Link type  . . . . . . . . . . . > *X25         *ASYNC, *X25
 Online at IPL  . . . . . . . . .   *YES         *YES, *NO
 Switched connection  . . . . . . > *YES         *NO, *YES
 Switched line list . . . . . . . > LX25041   1    Name
              + for more values    _________
 Initial connection . . . . . . .   *DIAL        *DIAL, *ANS
 Connection number  . . . . . . . > 61200120
 Text 'description' . . . . . . . > 'Asynchronous controller to communicate with
015'

                          Additional Parameters

 Attached devices . . . . . . . .   _________    Name
 Predial delay  . . . . . . . . .   6            0-254 (0.5 seconds)
 Redial delay . . . . . . . . . .   120          0-254 (0.5 seconds)
                                                                    More...
 F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
 F13=How to use this display        F24=More keys
```

```
                    Create Ctl Desc (Async) (CRTCTLASC)

Type choices, press Enter.

Dial retry . . . . . .  2           0-254
Switched disconnect . . . . . .  *YES 2      *NO, *YES
File transfer ack timer . . . .  16          16-65535 seconds
File transfer retry . . . . . .  7           1-255
Remote verify . . . . . .  *NO               *NO, *YES
Local location . . . . . .  _____            Name
Local identifier . . . . . .  _____          Name
PAD Emulation . . . . . .  *NO               *NO, *YES
X.25 switched line selection . .  *FIRST     *FIRST, *CALC
X.25 default packet size:
  Transmit value . . . . . .  *LIND          *LIND, 64, 128, 256, 512...
  Receive value . . . . . .  *LIND           *LIND, *TRANSMIT, 64, 128...
X.25 default window size:
  Transmit value . . . . . .  *LIND          1-15, *LIND
  Receive value . . . . . .  *LIND           1-15, *LIND, *TRANSMIT
X.25 user group identifier . . .  __         00-99
                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Considerations for specifying the CRTCTLASC command:

1 If this controller is required to answer calls, you must use the CHGLINX25 command to put the name of the controller in the switched controller list (SWTCTLLST parameter) of all lines with which the controller can answer calls.

2 This parameter causes the controller to disconnect from the remote system when all jobs using the controller have ended. It is recommended that the switched disconnect (SWTDSC) parameter be specified as *YES if switched line disconnection is needed.

Create Controller Description (Network) (CRTCTLNET) Command

The Create Controller Description (Network) (CRTCTLNET) command is optional because the existing support will configure the network controller automatically.

The following displays show the creation of an APPC device description. This device description must be created manually if APPN is not specified.

```
                    Create Device Desc (APPC) (CRTDEVAPPC)

Type choices, press Enter.

Device description . . . . . > RCHAS015      Name
Remote location  . . . . . > S015         Name
Online at IPL  . . . . . *YES          *YES, *NO
Local location . . . . . > S340         Name, *NETATR
Remote network identifier  . . .  *NETATR      Name, *NETATR, *NONE
Attached controller  . . . . . _____        Name
Mode . . . . . *NETATR      Name, *NETATR
              + for more values _____
Message queue  . . . . . QSYSOPR      Name, QSYSOPR
  Library  . . . . . *LIBL       Name, *LIBL, *CURLIB
APPN-capable . . . . . > *NO          *YES, *NO
Single session:
  Single session capable . . . .  *NO          *NO, *YES
  Number of conversations  . . .  _____        1-512
Location password  . . . . . *NONE
Secure location  . . . . . *NO          *NO, *YES
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display       F24=More keys
```

```
                    Create Device Desc (APPC) (CRTDEVAPPC)

Type choices, press Enter.

Text 'description' . . . . . > 'APPC device attached to RCHAS015'
_____

                          Additional Parameters

Local location address . . . . . > 00           00-FF
Authority  . . . . . *LIBCRTAUT    Name, *LIBCRTAUT, *CHANGE...









                                                                    Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

The following display shows the configuration for the asynchronous device description attached to system 015.

```
                    Create Device Desc (Async) (CRTDEVASC)

Type choices, press Enter.

Device description . . . . . > S015ASC      Name
Remote location name . . . . . > S015ASC      Name, *NONE
Online at IPL  . . . . . *YES          *YES, *NO
Attached controller  . . . . . > S015ASC      Name
Text 'description' . . . . . > 'Asynchronous device attached to S015ASC'
_____
```

Create Device Description (Network) (CRTDEVNET) Command

The Create Device Description (Network) (CRTDEVNET) command is optional because the existing support will configure the network controller automatically.

Configuring System 015

The following displays show the configuration of remote system 015.

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Line description . . . . . > LX25052      Name
Resource name  . . . . . > LIN052      Name
Logical channel entries:                _
  Logical channel identifier . . > 001        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .      _________   Name
                                  _
  Logical channel identifier . . > 002        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .      _________   Name
                                  _
  Logical channel identifier . . > 003        001-FFF, *PROMPT
  Logical channel type . . . . . > *SVCBOTH   *PVC, *SVCIN, *SVCBOTH...
  PVC controller . . . . . .      _________   Name
              + for more values   _
Local network address  . . . . . > 61200120
                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Connection initiation  . . . . . > *WAIT      *LOCAL, *REMOTE, *WAIT
Online at IPL  . . . . . .        *YES       *YES, *NO
Physical interface . . . . . > *RS232V24  *X21BISV24, *X21BISV35...
Connection type  . . . . . > *SWTPP     *NONSWTPP, *SWTPP
Vary on wait . . . . . .          *NOWAIT    *NOWAIT, 15-180 (1 second)
Line speed . . . . . .            9600       600, 1200, 2400, 4800...
Exchange identifier  . . . . . > 05600015  05600000-056FFFFF, *SYSGEN
Extended network addressing  . .  *NO        *YES, *NO
Default packet size:
  Transmit value . . . . . > 128        64, 128, 256, 512, 1024
  Receive value  . . . . . > 128        *TRANSMIT, 64, 128, 256...
Maximum packet size:
  Transmit value . . . . . .      *DFTPKTSIZE  *DFTPKTSIZE, 64, 128, 256...
  Receive value  . . . . . .      *TRANSMIT    *DFTPKTSIZE, *TRANSMIT, 64...
Modulus  . . . . . .              8          8, 128

                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Default window size:
  Transmit value . . . . . .   2          1-15
  Receive value  . . . . . . > 2          1-15, *TRANSMIT
Insert net address in packets  > *NO      *YES, *NO
Network user ID  . . . . . . > *NONE 1
```

```
Connection number  . . . . . > 'SS;9-1-612-268-3313' 2
Calling number . . . . . . . > '507-555-0101' 3
Switched connection type . . .   *BOTH      *BOTH, *ANS, *DIAL
Autoanswer . . . . . . . . . .   *YES       *YES, *NO
Autodial . . . . . . . . . . > *YES       *NO, *YES
Dial command type  . . . . . > *V25BIS    *NONE, *V25BIS
Call immediate . . . . . . .   *NO        *NO, *YES
Autocall unit  . . . . . . .   *NO        *NO, *YES
                                                                More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Predial delay  . . . . . . .   6          0-254 (0.5 seconds)
Redial delay . . . . . . . .   120        0-254 (0.5 seconds)
Dial retry . . . . . . . . .   2          0-254
Switched disconnect  . . . .   *YES       *YES, *NO
Disconnect timers:
  Minimum connect timer  . .   170        0-65535 seconds
  Disconnection delay timer    0          0-65535 seconds
Data Set Ready drop timer  .   6          3-60 (seconds)
Autoanswer type  . . . . . .   *DTR       *DTR, *CDSTL
Remote answer timer  . . . .   60         30, 35, 40, 45 (seconds)...
Text 'description' . . . . . > 'Switched X.25 line on AS/400 system 015'
```

```
                        Additional Parameters

X.25 DCE support . . . . . .   *NO        *NO, *YES
                                                                More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

Network controller . . . . . _________   Name
Switched controller list . . . . *NONE     Name, *NONE
            + for more values  _________
Idle timer . . . . . 40        3-99 in 0.1 second intervals
Frame retry . . . . . 7        0-64
Error threshold level . . . . . *OFF       *OFF, *MIN, *MED, *MAX
Modem type supported . . . . . *NORMAL     *NORMAL, *V54, *IBMWRAP
Modem data rate select . . . . . *FULL     *FULL, *HALF
Clear To Send timer . . . . . 25           10-60 (seconds)
Link speed . . . . . *INTERFACE            *INTERFACE, *MIN, 1200...
Cost/connect time . . . . . 128            0-255
Cost/byte . . . . . 128                    0-255
Security for line . . . . . *PKTSWTNET     *NONSECURE, *PKTSWTNET...
Propagation delay . . . . . *PKTSWTNET     *MIN, *LAN, *TELEPHONE...
User-defined 1 . . . . . 128               0-255
User-defined 2 . . . . . 128               0-255
                                                                  More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                    Create Line Desc (X.25) (CRTLINX25)

Type choices, press Enter.

User-defined 3 . . . . . 128           0-255
Recovery limits:
  Count limit . . . . . 2              0-99, *SYSVAL
  Time interval . . . . . 5            0-120 (minutes)
Authority . . . . . *LIBCRTAUT         Name, *LIBCRTAUT, *CHANGE...









                                                                  Bottom
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Considerations for specifying the CRTLINX25 command:

1 A network user identifier will not be included in the facility field of outgoing call request packets.

2 The characters 'SS' are sent to the local modem, followed by the connection number. The ';' is used as a separator character.

3 If the CALLNBR is specified, a separator character is added to the connection number, followed by the calling number. In this example, SS;9-1-612-268-3313;507-555-0101 is transmitted to the modem. Some modems accept special digits as dial commands. These digits can be specified in the connection number field. The following displays demonstrate the configuration of the APPC controller description to communicate with system 340.

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

Controller description . . . . . > RCHAS340      Name
Link type . . . . . > *X25        *IDLC, *LAN, *LOCAL, *SDLC...
Online at IPL . . . . . *YES      *YES, *NO
Switched connection . . . . . > *YES      *NO, *YES
APPN-capable . . . . . > *NO      *YES, *NO
Switched line list . . . . . > LX25052    Name
             + for more values
Maximum frame size . . . . . *LINKTYPE    265-16393, 265, 521, 1033...
Remote network identifier . . . *NETATR   Name, *NETATR, *NONE
Remote control point . . . . . > RCHAS340 Name
Exchange identifier . . . . . > 05600340  00100000-FFFFFFFF
Initial connection . . . . . *DIAL        *DIAL, *ANS
Connection number . . . . . 311061200002
Data link role . . . . . *NEG             *NEG, *PRI, *SEC
X.25 network level . . . . . 1984         1980, 1984, 1988
X.25 link level protocol . . . . *QLLC    *QLLC, *ELLC
                                                              More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                    Create Ctl Desc (APPC) (CRTCTLAPPC)

Type choices, press Enter.

X.25 connection password . . . .  PASSWRD1      Character value
Text 'description' . . . . . > 'APPC controller to communicate with 340'
```

The following displays show the creation of an APPC device description. This device description must be created manually if APPN is not specified.

```
                    Create Device Desc (APPC) (CRTDEVAPPC)

Type choices, press Enter.

Device description . . . . . > RCHAS340     Name
Remote location . . . . . > S340            Name
Online at IPL . . . . . *YES                *YES, *NO
Local location . . . . . > S015             Name, *NETATR
Remote network identifier . . . *NETATR     Name, *NETATR, *NONE
Attached controller . . . . . *             Name
Mode . . . . . *NETATR                      Name, *NETATR
             + for more values
Message queue . . . . . QSYSOPR             Name, QSYSOPR
  Library . . . . . *LIBL                   Name, *LIBL, *CURLIB
APPN-capable . . . . . *NO                  *YES, *NO
Single session:
  Single session capable . . . . *NO        *NO, *YES
  Number of conversations . . .             1-512
Text 'description' . . . . . > 'APPC device attached to RCHAS340'

                                                              Bottom
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

The following displays demonstrate the configuration of an asynchronous controller to communicate with system 340.

```
                    Create Ctl Desc (Async) (CRTCTLASC)

Type choices, press Enter.

Controller description . . . . . > S340ASC      Name
Link type  . . . . . . . . . . . > *X25         *ASYNC, *X25
Online at IPL  . . . . . . . . .   *YES         *YES, *NO
Switched connection  . . . . . . > *YES         *NO, *YES
Switched line list . . . . . . . > LX25052   1  Name
              + for more values
Initial connection . . . . . . .   *DIAL        *DIAL, *ANS
Connection number  . . . . . . . > 311061200086
Text 'description' . . . . . . . > 'Asynchronous controller to communicate with
340'

                          Additional Parameters

Attached devices . . . . . . . .                Name
Predial delay  . . . . . . . . .  6             0-254 (0.5 seconds)
Redial delay . . . . . . . . . .  120           0-254 (0.5 seconds)
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

```
                    Create Ctl Desc (Async) (CRTCTLASC)

Type choices, press Enter.

Dial retry . . . . . . . . . . .  2             0-254
Switched disconnect  . . . . . . > *YES  2       *NO, *YES
File transfer ack timer  . . . .  16            16-65535 seconds
File transfer retry  . . . . . .  7             1-255
Remote verify  . . . . . . . . .  *NO           *NO, *YES
Local location . . . . . . . . .                Name
Local identifier . . . . . . . .                Name
PAD Emulation  . . . . . . . . .  *NO           *NO, *YES
X.25 switched line selection . .  *FIRST        *FIRST, *CALC
X.25 default packet size:
  Transmit value . . . . . . . .  *LIND         *LIND, 64, 128, 256, 512...
  Receive value  . . . . . . . .  *LIND         *LIND, *TRANSMIT, 64, 128...
X.25 default window size:
  Transmit value . . . . . . . .  *LIND         1-15, *LIND
  Receive value  . . . . . . . .  *LIND         1-15, *LIND, *TRANSMIT
X.25 user group identifier . . .  _             00-99
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Considerations for specifying the CRTCTLASC command:

1 If this controller is required to answer calls, you must use the CHGLINX25 command to put the name of the controller in the switched controller list (SWTCTLLST parameter) of all lines with which the controller can answer calls.

2 This parameter causes the controller to disconnect from the remote system when all jobs using the controller have ended. It is recommended that the switched disconnect (SWTDSC) parameter be specified as *YES if switched line disconnection is needed.

The following display demonstrates the configuration of an asynchronous device attached to S340ASC.

```
                    Create Device Desc (Async) (CRTDEVASC)

Type choices, press Enter.

Device description . . . . . > S340ASC      Name
Remote location name . . . . . > S340ASC    Name, *NONE
Online at IPL  . . . . . *YES               *YES, *NO
Attached controller  . . . . . > S340ASC    Name
Text 'description' . . . . . > 'Asynchronous device attached to S340ASC'
```

Bibliography

The following manuals referred to in this guide can be used for more information on the subject matter. These manuals are listed with their full title and base order number. When these manuals are referred to in this guide, a shortened version of the title is used. The shortened title version follows each manual description in this bibliography. Except where otherwise indicated, each is an AS/400 system manual.

AS/400 Publications

- *Communications: Advanced Peer-to-Peer Networking Guide*, SC41-8188, provides the application programmer with information about the advanced peer-to-peer networking (APPN) support provided by the AS/400 system. This guide provides information for configuring an APPN network and presents considerations to apply when using APPN.

  Short Title: *APPN Guide*

- *Communications: Asynchronous Communications Programmer's Guide*, SC41-9592, provides information on developing asynchronous communications applications programs that use the OS/400 intersystem communications function (OS/400-ICF).

  Short Title: *Asynchronous Communications Programmer's Guide*

- *Communications: Management Guide*, SC41-0024, provides the system operator with communications work management information, error handling information, communications status information, and communications performance information.

  Short Title: *Communications Management Guide*

- *Communications: Operating System/400* Communications Configuration Reference*, SC41-0001, provides the application programmer with information on configuring line, controller, and device descriptions to communicate within a network. Additional configuration considerations are discussed.

  Short Title: *OS/400* Communications Configuration Reference*

- *OSI Communications Subsystem/400 Configuration and Administration Guide*, SL23-0187, provides the system administrator and application programmer with information about using OSI Communications when configuring the AS/400 system for use over an X.25 network.

  Short Title: *OSI Communications Subsystem/400 Configuration and Administration Guide*

- *Programming: Control Language Reference*, SC41-0030, provides the application programmer with a description of the AS/400 control language (CL) and its commands.

  Short Title: *CL Reference*

- *Publications Guide*, GC41-9678, provides the AS/400 system user with a general guide to the AS/400 system publications, a glossary of all terms used in AS/400 system publications, and a list of topics and the manuals in which each topic can be found.

  Short Title: *Publications Guide*

- *System Programmer's Communications Interface Guide*, SC41-0027, provides the application programmer with information needed to define and configure systems for customizing to individual networks.

  Short Title: *System Programmer's Communications Interface Guide*

- *Transmission Control Protocol/Internet Protocol Guide*, SC41-9875, provides the application programmer and end user with information about how the AS/400 system carries out Transmission Control Protocol/Internet Protocol (TCP/IP). This guide describes how to use and configure TCP/IP and its relationship to other AS/400 communications protocols.

  Short Title: *TCP/IP Guide*

Non-AS/400 Publications

- *IBM 3270 Information Display System: X.25 Operation*, GA23-0204
- *IBM 3270 Information Display System: 3274 Control Unit Customization Guide*, GA23-0065
- *IBM 3270 Information Display System: 3274 Control Unit Description and Programmer's Guide*, GA23-0061
- *System/38 Data Communications Programmer's Guide*, SC21-7825
- *Using S/36 Communications Guide*, SC21-9082

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Application System/400
Communications:
X.25 Network Guide
Version 2

Publication No. SC41-0005-00

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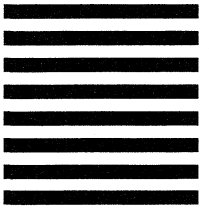

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