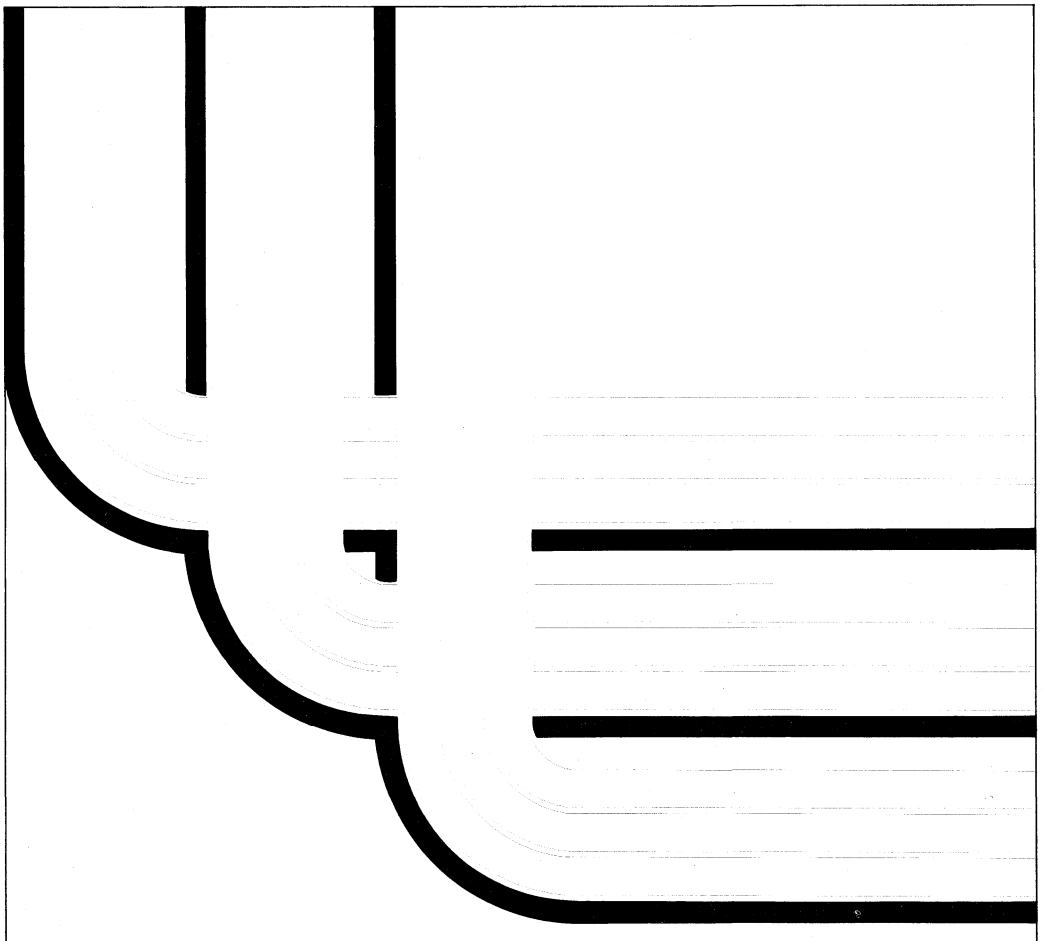
Application System/400

SC41-0004-02

Communications: Local Area Network Guide

Version 2



System and Application Support

Application System/400

SC41-0004-02

Communications: Local Area Network Guide

Version 2

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Third Edition (November 1993)

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About This Guide

This guide provides information needed to use AS/400 support for the following network types:

- IBM Token-Ring networks.
- Ethernet networks, including IEEE 802.3 and Ethernet Version 2 networks.
- Distributed data interface (DDI) networks. Throughout this guide, the terms *distributed data interface* and *DDI* are used to refer to the AS/400 support for both fiber distributed data interface (FDDI) and shielded twisted pair distributed data interface (SDDI) networks.
- Frame relay networks, including the use of these networks for local area network interconnection and for wide area networking.

The terms *local area network* and *LAN* are used to refer generally to token-ring, DDI, Ethernet, and frame relay networks.

This guide includes discussions of the various network standards, the AS/400 implementation of those standards, configuration examples, and information about link test and communications trace support for local area networks.

This guide should be used in conjunction with the *Communications: Operating System/400* Communications Configuration Reference* to configure your local area network. After configuration is completed, this guide can be used to improve network performance.

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 related publications, see the "Bibliography."

Who Should Use This Guide

This guide is intended for the programmer who must understand the AS/400 implementation of local area networks. This guide can also be used by the system administrator to improve local area network configuration and performance.

You should be familiar with general communications concepts and communications configuration on the AS/400 system. For more information on general communications concepts, refer to Discover/Education* Introduction to Data Communications course. This course is separately orderable.

For more information on AS/400 communications configuration, refer to the *Communications: Operating System/400* Communications Configuration Reference*.

Summary of Changes

Distributed Data Interface (DDI) Network Support

Support has been added for distributed data interface (DDI) networks, including networks using fiber-optic cabling (FDDI) and shielded twisted pair cabling (SDDI). DDI configuration is very similar to that used for token-ring networks. The line description used for DDI networks is configured using the Create Line Description (DDI) (CRTLINDDI) command.

Information about the AS/400 implementation of DDI networks can be found in Part 1 of this guide. See Part 3 for detailed information.

Frame Relay Network Support

Support has been added for communications using frame relay networks. Two types of frame relay configurations are supported:

- *Direct configurations* allow the exchange of Systems Network Architecture (SNA) data between systems directly attached to the frame relay network. The Create Network Interface Description (Frame Relay) (CRTNWIFR) and Create Line Description (Frame Relay) (CRTLINFR) commands are used to create these configurations.
- *Bridged configurations* allow an AS/400 system attached to a frame relay network to communicate with systems on a local area network (token-ring, Ethernet, or DDI) that are connected to the frame relay network using a bridge or router. Bridged configurations are created by associating a local area network line description with a frame relay network interface description.

Information about the AS/400 implementation of frame relay networking can be found in Part 1 of this guide. See Part 5 for detailed information.

Link Test Enhancements

The link test function for local area network lines no longer requires a controller description to test the connection between the AS/400 system and the remote station. Link tests can be run using the remote station MAC address and SAP values as input. See Appendix A for more information.

Communications Trace Enhancements for DDI and Frame Relay Networks

The AS/400 communications trace function has added support for DDI and frame relay network communications. This support includes options to limit the amount of trace data collected for these high speed communications types. See Appendix B for more information.

Miscellaneous Changes

This manual has been restructured to accommodate the material described above better. The manual is divided into six parts to provide some separation for discussions of the various types of networks. Part 1 and Part 6 provide information applicable to all of the network types described in this manual; Part 2 through Part 5 contain information about a specific network type (token-ring, DDI, Ethernet, or frame relay).

Part 1. Introduction

Chapter 1. Introduction to Local Area Networks

A **local area network** (LAN) is a communications system allowing interconnection and sharing of resources between independent devices within a moderately sized geographic area.

This chapter introduces the several types of local area networks supported by the AS/400* system and discusses the architectures and standards on which they are based. Frame relay wide area networks, which can be used to connect several local area networks, are also discussed.

The communications standards discussed in this chapter are defined by several standards organizations The names of the standards, and of the organizations, are abbreviated as follows:

ANSI American National Standards Institute
CCITT International Telegraph and Telephone Consultative Committee
IEEE Institute of Electrical and Electronics Engineers
ISO International Organization for Standardization

Local Area Network Standards

The AS/400 system supports communications using Systems Network Architecture (SNA), open systems interconnection (OSI), and Transmission Control Protocol/Internet Protocol (TCP/IP). These communications architectures are often represented as hierarchical models as shown in Figure 1-1. The architectures represented by these models define the functions performed at each layer.

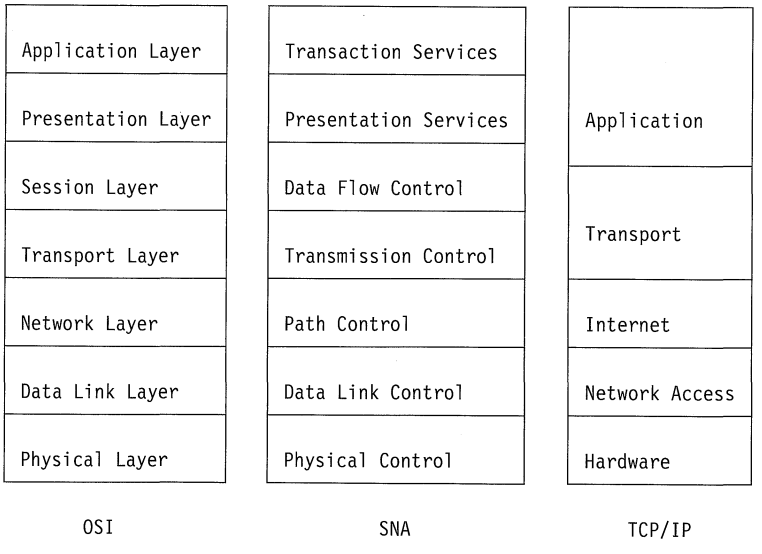


Figure 1-1. OSI, SNA, and TCP/IP Architecture Models

Each model describes system functions starting from the electromechanical interface used by the system (physical layer) to the interface used for communication between application programs (application layer).

Local area network standards deal principally with the data link layer (layer 2) of the OSI model or the equivalent layer described by the SNA and TCP/IP models.

Figure 1-2 shows the local area network standards supported by the AS/400 system at the data link layer of the OSI model.

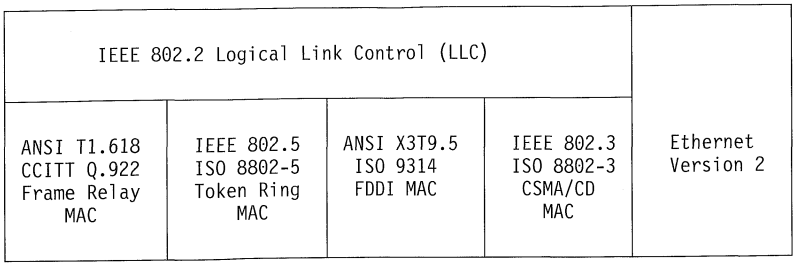


Figure 1-2. AS/400 Support of Local Area Networks (Data Link Layer View)

Except for Ethernet Version 2, the supported LAN types divide the data link layer into two sublayers:

Logical Link Control (LLC)
Provides connection and disconnection of logical links, data flow control, flow-related error detection and recovery.

Medium Access Control (MAC)
Provides the interface between the LLC sublayer and the physical layer. The MAC sublayer is responsible for frame transmission and reception, adapter address and frame format recognition, and frame validity-related error detection.

The following topics provide overviews of the local area network and frame relay support provided by the AS/400 system. For more information about local area network standards and related IBM products, see the *Token-Ring Network Architecture Reference*, *Local Area Network Concepts and Products*, and *FDDI Concepts and Products*.

Token-Ring Networks

A **token-ring network** is a LAN using the IEEE 802.5 standard for a token-passing ring MAC protocol and its physical attachments. Stations in a token-ring network are physically connected, usually in a star-wired ring topology, to a wiring concentrator such as the IBM 8228 Multistation Access Unit. The concentrator serves as a logical ring around which data is transmitted at 4 or 16 Mbps. Each station is connected to the concentrator, typically by shielded twisted pair (STP) cabling.

Token Ring Operation

The **token** controls access to the ring. A single bit, called the token bit, is used to indicate whether the token is free or in use (see Figure 1-3).

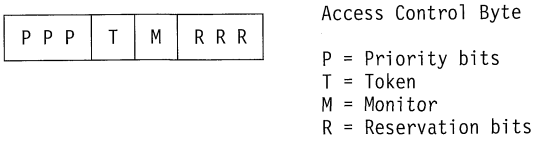


Figure 1-3. Token Format (Access Control Byte)

As the token circulates on the ring, each station examines the frame. If a station has no data to transmit when it receives a free token, it simply passes it on to the next station on the ring. When a station with data to transmit receives a free token,

it sets the token bit to 1 (indicating that the token is in use), appends its data, and sends the frame onto the ring.

Each downstream station examines the transmitted frame to determine whether it is the station intended to receive the frame. When a station recognizes its address in an incoming frame, it sets the *address recognized* bit in the frame status field and copies the frame. If the frame is successfully copied, the receiving station also sets the *frame copied* bit (see Figure 1-4).

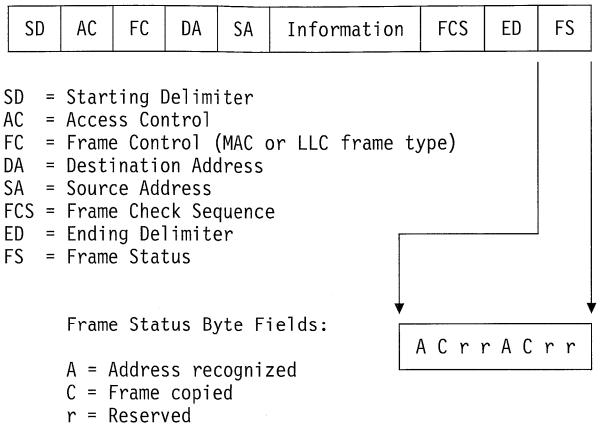


Figure 1-4. Token-Ring Frame Format and Frame Status Byte Fields

The receiving station also transmits the frame. The frame circulates until it returns to the station that originally sent it. The original sending station removes the token, verifies that the frame was copied by the receiving station, and sends out a new free token.

See Chapter 3 for more information about token-ring networks. See Chapter 5 for examples of token-ring network configurations.

Distributed Data Interface Networks

A **distributed data interface (DDI) network** is a LAN based on the ANSI X3T9.5 standard. Stations, concentrators, and bridges in a DDI network are physically connected to one or both of a pair of counter-rotating rings operating at 100 Mbps.

Note: The term *DDI* is used to represent all LAN types based on the fiber distributed data interface (FDDI) specifications, regardless of the medium (optical fiber, copper, or shielded twisted pair).

Figure 1-5 on page 1-4 shows the standards used to define DDI networks at the physical and data link layers of the OSI model.

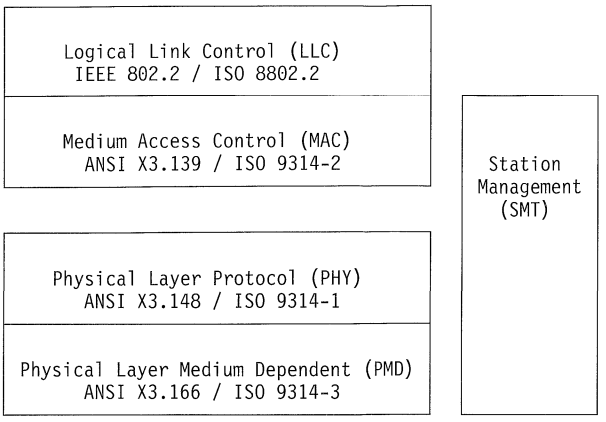


Figure 1-5. FDDI Standards, Including Station Management

DDI networks allow devices to be attached to one or both of the rings. Normally, only the primary ring in a DDI network is active. The secondary ring is used to maintain the network when a dual access station or a concentrator becomes inactive.

Figure 1-6 shows the frame format used for DDI networks.

PA	SD	FC	DA	SA	Information	FCS	ED	FS

PA = Preamble (8 or more bytes)
SD = Starting Delimiter
FC = Frame Control
DA = Destination Address
SA = Source Address
FCS = Frame Check Sequence
ED = Ending Delimiter
FS = Frame Status

Figure 1-6. DDI Frame Format

See Chapter 6 for more information about DDI networks. See Chapter 7 for examples of DDI configurations.

Ethernet Networks

An **Ethernet network** is a LAN using a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol to provide media access to competing stations. Two types of Ethernet networks are supported by the AS/400 system: Ethernet Version 2, a standard defined by Digital Equipment Corporation, Intel Corporation, and the Xerox Corporation (DIX); and the IEEE 802.3 standard.

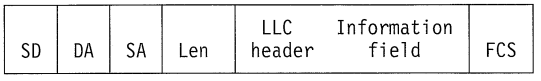
When a station has data to send, it checks the transmission medium to determine if the medium is available (no other stations are transmitting). When the medium is available, the station begins to transmit. The station continues to check during the transmission to determine if a collision occurs. A collision occurs when two or more stations begin transmitting at about the same time. If a collision does occur, the transmitting station stops transmission and waits a random length of time before transmitting again.

The following topics describe the frame formats used in the various Ethernet environments.

Ethernet Frame Formats

Ethernet IEEE 802.3 Support: IEEE 802.3 Ethernet frames contain a logical link control (LLC) header that can be used by the IEEE 802.3 layer to support acknowledged (connection-oriented) service over an Ethernet network. Acknowledged service provides a link-level connection between communicating systems and includes frame sequencing, flow control, and error recovery capabilities. IEEE 802.3 frames can also be used for LLC unacknowledged (connectionless) services for protocol stacks such as TCP/IP.

Figure 1-7 shows the frame format used for IEEE 802.3 Ethernet networks.

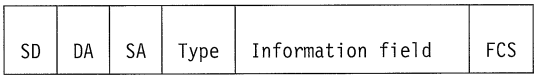



```
SD  = Starting Delimiter             1 byte
DA  = Destination Address            6 bytes
SA  = Source Address                 6 bytes
Len = Length                         2 bytes
      LLC header, information field  46-1500 bytes
FCS = Frame Check Sequence           4 bytes
```

Figure 1-7. IEEE 802.3 Frame Format

Ethernet Version 2 Support: The AS/400 system supports unacknowledged service using Ethernet Version 2 at the data link control level. Unacknowledged service supports the sending and receiving of frames only; no support is provided for flow control, sequencing, or error recovery. If these functions are needed, a higher-level protocol must provide them.

Figure 1-8 shows the frame format used for Ethernet Version 2 networks.

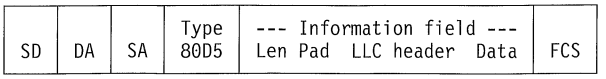



```
SD   = Starting Delimiter    1 byte
DA   = Destination Address   6 bytes
SA   = Source Address        6 bytes
Type = Type                  2 bytes
       Information field     46-1500 bytes
FCS  = Frame Check Sequence  4 bytes
```

Figure 1-8. Ethernet Version 2 Frame Format

SNA support is provided over Ethernet Version 2 by placing the IEEE 802.2 logical link control (LLC) header and data into the Ethernet Version 2 frame. A special Ethernet type field (hex 80D5) is used to indicate that the Version 2 frame contains the LLC header. Although the AS/400 system does support SNA over Ethernet Version 2, IEEE 802.3 is recommended for SNA communications.

Figure 1-9 on page 1-6 shows the frame format used for SNA data transmitted over Ethernet Version 2 networks.




```
SD  = Starting Delimiter            1 byte
DA  = Destination Address           6 bytes
SA  = Source Address                6 bytes
Len = Length                        2 bytes
Pad = Pad                           1 byte
      LLC header, information field 46-1493 bytes
FCS = Frame Check Sequence          4 bytes
```

Figure 1-9. Ethernet Version 2 Frame Format with Encapsulated SNA Data

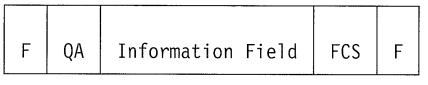
See Chapter 8 for more information about Ethernet networks. See Chapter 9 for examples of Ethernet configurations.

Frame Relay Networks

Frame relay is a protocol that defines how frames are routed through a fast-packet network based on the address field in the frame. Frame relay takes advantage of the reliability of data communications networks to minimize the error checking done by the network nodes. This provides a packet-switching protocol similar to, but much faster than, X.25.

The high speed that can be obtained through frame relay networks makes it well suited for wide area network (WAN) connectivity. Frame relay is commonly used to connect two or more LAN bridges over large distances.

Figure 1-10 shows the frame format used by frame relay networks. Detailed information about frame relay frame formats and protocol headers is given in Chapter 10.




```
F   = HDLC or Q.922 flag
QA  = HDLC or Q.922 address field (2 bytes)
FCS = HDLC or Q.922 frame check sequence (2 bytes)
```

Figure 1-10. Frame Relay Frame Format

Frame relay network architecture is based on the integrated systems digital network (ISDN) packet-mode bearer services. Figure 1-11 shows the standards, either pending or approved, that are used to define the services and the user-to-network interface of frame relay networks.

Figure 1-11. ANSI and CCITT Standards for Frame Relay Networks

ANSI Standard	Equivalent CCITT Standard
T1.606, Frame Relay Bearer Services (FRBS) Architectural Framework	I.233, ISDN Frame Mode Bearer Service
T1.618, FRBS Core Aspects	Q.922, ISDN Extended Data Link (LAP-E)
T1.617, FRBS Signaling	Q.933, Frame Mode Bearer Services (FMBS) Signaling
T1.606 Addendum 1, FRBS Congestion Management	I.370, ISDN FMBS Congestion Management

The AS/400 implementation of frame relay network support uses protocol headers as defined in the *TCP/IP Request for Comment 1294 (RFC-1294)*. See "Frame Relay Protocol Headers and Frame Formats" on page 10-6 for more information.

Frame relay networks achieve their greater efficiency by minimizing the error checking done by nodes within the network. AS/400 frame relay support uses IEEE 802.2 logical link control to provide flow control and error recovery functions (see Figure 1-12).

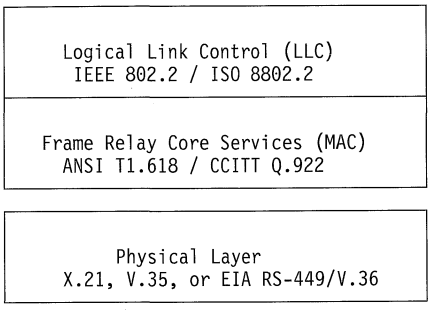


Figure 1-12. AS/400 Implementation of Frame Relay Networking

As indicated in Figure 1-12, the connection between the AS/400 system and the frame relay network can be made using X.21, V.35, or EIA RS-449/V.36 physical interfaces.

Direct and Bridged Frame Relay Network Configurations

The AS/400 system provides support for the following types of frame relay network connection:

Frame Relay Direct: Allows AS/400-to-AS/400 communications for SNA data over a frame relay network at speeds of up to 2.048 Mbps. This support allows an APPC/APPN* network of AS/400 systems to communicate using the frame relay network as a backbone, without the need for multiple leased T1 lines. TCP/IP data is not supported on frame relay direct connections.

Bridged Frame Relay Network: Allows the AS/400 system to communicate over a frame relay network through a remote bridge, such as the IBM 6611 Network Processor or RouteXpander/2, that is attached to a token-ring, Ethernet, or DDI network. Bridged frame relay connections allow the AS/400 system to communicate with stations on the remote LAN as if they were attached locally to the LAN medium.

Figure 1-13 on page 1-8 shows an example of a bridged frame relay connection. In this example, AS/400 System A communicates through the frame relay network and the bridge to AS/400 System B. Bridged frame relay connections support both SNA and TCP/IP data communications.

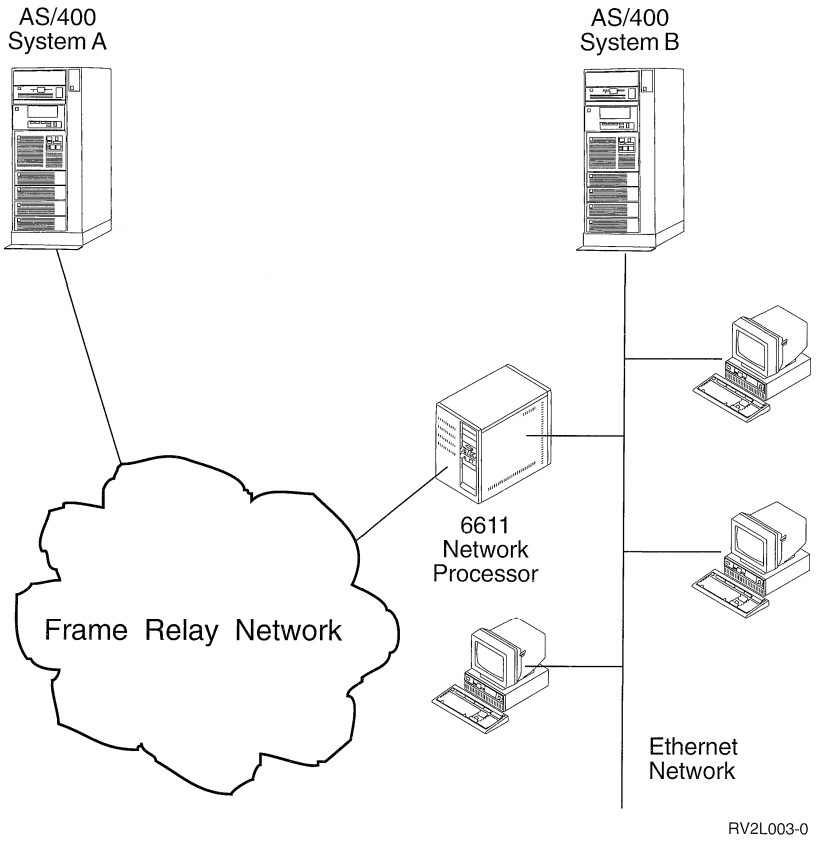


Figure 1-13. Example of a Bridged Frame Relay Network Connection

See Chapter 10 for more information about frame relay networks. See Chapter 11 for examples of bridged and direct frame relay configurations.

Chapter 2. AS/400 Implementation of Local Area Networks

This chapter discusses general considerations for AS/400 local area network support, including local area network lines configured for bridged frame relay networks. See Chapter 10 for more information about both bridged and direct frame relay considerations.

For more information about token-ring, Ethernet, and DDI networks, see the discussions of these network types in Part 2, Part 3, and Part 4 of this manual.

The following topics are discussed in this chapter:

- Acknowledged and unacknowledged services
- Physical and logical addresses (adapter addresses and SAP values)
- Establishing connections
- Exchange identifiers (XIDs)
- LAN performance tuning parameters

Local Area Network Concepts

The following discussion is intended to provide an understanding of some basic local area network concepts, how these concepts affect the configuration of your local area network line description and associated controller descriptions, and how they affect performance of the logical links to remote stations.

The AS/400 system allows you to attach to token-ring, Ethernet, and DDI networks using the appropriate LAN adapter. Connections to these networks can also be established using a frame relay network connection to a bridge on a remote local area network. The AS/400 system can communicate using either Systems Network Architecture (SNA) or non-SNA protocols with other systems, controllers, and personal computers attached to that network. These systems, controllers, and personal computers are commonly referred to as **stations**.

In addition to the stations that support SNA protocols (**acknowledged service**[1]), you can communicate with additional systems, personal computers, and controllers using non-SNA protocols (**unacknowledged service**[2]). Acknowledged service is discussed in "Acknowledged Service" and unacknowledged service is discussed in "Unacknowledged Service" on page 2-2.

Acknowledged Service

SNA requires the use of a logical link control (LLC) layer for acknowledged services as provided by the IEEE 802.2 standard. The LLC layer governs the assembling of transmission frames and their exchange between stations. For token-ring, IEEE 802.3 Ethernet, and DDI networks, the use of the LLC layer is standard. Ethernet Version 2 does not define an LLC layer and requires special processing to run SNA over Ethernet Version 2. For information on LLC over Ethernet Version 2, see Chapter 8.

---

1 Acknowledged service provides functions such as sequencing, flow control, and error recovery.

2 Unacknowledged service is a service that provides data transfer without the establishment of a data link connection.

SNA connections between your AS/400 system and other systems, personal computers, or controllers use LLC acknowledged service. LLC acknowledged service maintains, at the data link control layer of the system, a logical link between two nodes on the local area network. This service also provides ensured, end-to-end delivery of data by use of sequence numbers and acknowledgements. It supports flow control between two nodes, and, through the use of timers and retries, provides an efficient way of transferring data between those nodes.

These connections are logically switched, similar to the switched virtual circuit support for X.25 packet-switching networks available on the AS/400 system. This means, for example, that a personal computer can connect to an AS/400 system, disconnect from that AS/400 system, and then make a connection to another system. Similarly, you can configure more than one local area network line description with which these controller descriptions are associated. This allows you to make connections with a station over more than one adapter at different times.

Figure 2-1 shows the maximum number of adapters and active SNA connections (ring station sessions) supported for each AS/400 model.

Figure 2-1. Maximum Number of LAN Adapters and Active SNA Connections

AS/400 Model	Number of LAN Adapters	Number of SNA Connections per Adapter	Total Number of SNA Connections
9406 System Unit	4-6	256	1536
9404 System Unit	1-2	256	256
9402 System Unit	1	64	64

Unacknowledged Service

LLC unacknowledged service does not guarantee delivery of data frames from one data link control layer to another data link control layer. The receiving layer does not reply with an acknowledgement that the data has been received, and unacknowledged services do not require a connection at the data link layer. The User Datagram Protocol (UDP) layer of TCP/IP and user-defined communications support are examples of LLC unacknowledged services.

TCP/IP and user-defined communications can be configured using token-ring or Ethernet lines (Ethernet Version 2, IEEE 802.3, or both). Line descriptions used for unacknowledged services must specify appropriate service access points in the SSAP list (SSAP parameter). SSAP values used for LLC unacknowledged services must be in the range 02 through FE and be divisible by 2. For TCP/IP, specify AA.

For unacknowledged services, a network controller and device are configured for use with the Ethernet or token-ring line. These objects can be created using the Create Controller Description (Network) (CRTCTLNET) and Create Device Description (Network) (CRTDEVNET) commands. Normally, the network controller and device are automatically created. Each line used to provide an unacknowledged service (such as TCP/IP) can have only one network controller active at a time.

See the *TCP/IP Guide* for information on how to configure your system for TCP/IP. The *System Programmer's Interface Reference* contains information on how to configure your system for user-defined communications.

Assigning a Physical Address

Every system, controller, or personal computer is attached to a local area network by an adapter. Each adapter is identified in the network by its 6-byte **medium access control (MAC)**[3] address (12 hexadecimal characters), simply referred to as an **adapter address**. No two adapters may have the same address in the same network. Each adapter is assigned a unique address when it is manufactured. This address is referred to as the **preset address**, burned-in address, or universally administered address. You can use the preset address or assign an address yourself when you configure the local area network line description, which contains information describing a particular communications line that is attached to the system.

To minimize configuration problems in the future, you should consider assigning your own address. If you assign your own address, and the adapter on your system needs to be replaced, you can replace that adapter and assign it the same adapter address. This avoids configuring other units again that currently communicate with your system over that adapter. If you use the preset address and the adapter needs to be replaced, the new adapter has its own unique preset address. Restrictions prevent you from assigning an address that can also be imprinted during manufacturing. You cannot assign the preset address of the replaced adapter to the new adapter.

The frame relay adapter is not assigned a preset address. If the token-ring, DDI, or Ethernet line descriptions are created for use in a bridged frame relay environment, you must assign an adapter address to each line description that you create. This address is used by the bridge to recognize the AS/400 system in the network.

Finding a Physical Address: In general, all systems, controllers, and personal computers in a network must know the address of the adapter to communicate with it. If you are using a local area network, you need to know the address of your adapter so that you can configure the remote units with which you wish to establish connections.

To find the preset address (if you specified the preset address, ADPTADR(*ADPT), on the CRTLINTRN, CRTLINDDI, or CRTLINETH command) or the address you assigned when you configured the line, enter the Display Line Description (DSPLIND) command after your line description has been successfully varied on.

Note for Mixed Environments: If your system is used in a mixed environment where **bridges**[4] exist between Ethernet and token-ring or DDI networks, you must pay special attention to how physical-level addresses are assigned. Ethernet addresses are represented differently than addresses used for token-ring and DDI networks. See Appendix C for information about address conversions for bridged connections between networks using different address types. See "Token-Ring

3 Medium access control is a method of determining which device has access to the transmission medium at any time.

4 A bridge is used to connect two or more networks, and to store and forward information between them.

Physical Address Format" on page 3-3 and "Ethernet Physical Address Format" on page 8-2 for descriptions of these address formats.

Assigning a Logical Address

Associated with each adapter address is a set of logical addresses known as **service access points** (SAPs). SAPs are used to route data with the same adapter address to the correct station or application program, thus allowing multiple communications paths between independent application programs on these systems. The SAP addresses are 1-byte hexadecimal values, several of which are defined for particular functions. The architecture specifies hex 04 for the default SNA value, and it is the one most widely used. Other valid values of SNA service access points range from hex 04 to hex 9C and must be divisible by 4 (that is, end with 0, 4, 8, C). TCP/IP Utilities uses hex AA as a service access point. User-defined communications protocols can use any SAP from 02-FE, divisible by 2.

Data is sent from a source service access point (SSAP) to a destination service access point (DSAP). You can specify up to 24 SSAPs for your token-ring or Ethernet adapter when you configure the local area network line description. Another alternative is to let the system create SSAPs with the default hex 04, 06, and AA.

Service Access Points

When you configure the controller descriptions that represent the remote system, controller, or personal computer that you will be communicating with, you are asked to specify the **source service access points** (SSAP) from which the data will be sent and the **destination service access point** (DSAP) for which the data was intended. The SSAP in the controller description must be one of the SSAPs specified in the local area network line description with which this controller description is associated. That is, the local area network line description must contain the complete list of SSAPs used by the controllers that include that local area network line description in their switched line list (SWTLINLST) parameter.

To configure the remote station, remember that the SSAP in the controller description, which represents that station, must match that unit's configured DSAP and vice versa. For example, if your controller description uses an SSAP of 04 and the description on the remote unit uses an SSAP of 08, you must configure your controller description with a DSAP of 08 and the remote unit with a DSAP of 04. Figure 2-2 shows the relationship between the source service access point and the destination service access point.

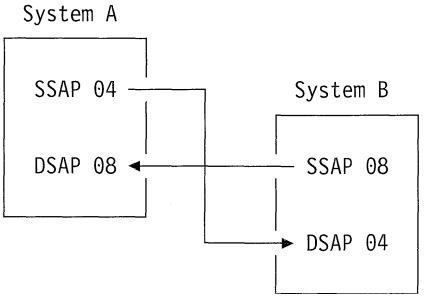


Figure 2-2. Relationship Between Service Access Points

Up to 24 unique SSAPs can be specified. If the default (*SYSGEN) is used when creating a token-ring line description, three SSAPs are automatically created: 04 for SNA, AA for TCP/IP applications, and 06. If the default is specified when creating an Ethernet line description, the SSAP values created depend on the Ethernet standard (ETHSTD parameter) selected. If ETHSTD(*ALL) or ETHSTD(*IEEE8023) is specified, three SSAPs are automatically created: 04 for SNA, AA for TCP/IP applications, and 06. If ETHSTD(*ETHV2) is specified, SSAP 04 is used.

For SNA, the default of hex 04 is often sufficient. This is the default on all of the create controller description commands, and is the most commonly configured on remote units. Some cases where alternative service access points should be used are:

- The remote system is configured such that its SSAP or DSAP is not hex 04. In this case, configure your controller description's SSAP with the remote system's DSAP and your controller description's DSAP with the remote system's SSAP. Ensure that the SSAP configured in your controller description is included in the list of SSAPs you configured in each of the local area network line descriptions this controller has listed in its switched line list (SWTLINLST) parameter.
- You want parallel station-to-station connections between adapters. This may be desirable if you want to link two application programs that require different controller descriptions.
- If you wish to use both an APPC and multinode APPN connection to the same host system, parallel connections, which require multiple SAPs, are also required. An example of this type of network is a AS/400 system as an intermediate APPN node to the host system, but you have existing application programs that use System/38 communications files and must use a host controller description with APPN(*NO).
- You want station-to-station connections to the same adapters. For example, you may want to configure multiple SAPs to test an application program on a single system.

See "Configuring Different Service Access Points" on page 5-6 for an example of using different service access points to establish two parallel station-to-station connections between two adapters.

As previously mentioned, all adapter addresses in the network must be unique. Furthermore, because the DSAP, SSAP, and remote adapter address uniquely describe a connection to another station on the ring, all combinations of these three pieces of information must be unique for any controller that is varied on. These three pieces uniquely identify a connection to another station on the ring. The system enforces this uniqueness by not allowing two controller descriptions with the same remote adapter address, DSAP, and SSAP to be varied on at the same time.

Establishing the Connection

The AS/400 local area network support is logically switched; that is, the attachment to the network is permanent, such as a nonswitched synchronous data link control (SDLC) line, but a station-to-station connection may be configured as either dial or answer. Because the support is logically switched, you can configure as many controller descriptions as you wish. All descriptions are available for connection, but the number of varied-on or active controller descriptions allowed is based on the value specified for the MAXCTL parameter on the LAN line description. In the con-

troller descriptions, you can specify more than one local area network line description in the SWTLINLST parameter. This allows you to dial stations using a different adapter address, if you like, or answer an incoming call from a remote system over two different adapters. This support provides more flexibility in connecting to your AS/400 system.

Most units (with the exception of the personal computer using PC Support/400) use what is known as *last-one-up-on-the-network-calls-out* logic. This means that the systems attempt polling for a specified period of time before falling back into answer mode. This is the same approach taken by the AS/400 system for controller descriptions configured as *DIAL on their initial connection (INLCNN) parameter.

Dial Mode

If you choose *DIAL for the initial connection (INLCNN) parameter on the controller description, this system attempts to poll the remote station to determine if any remote device on the line is ready to transmit, when the controller description is varied on. The frequency and persistence of this polling is configured on the controller description; the LAN connection retry (LANCNNRTY) value defines how many times the remote station is polled and the LAN connection timer (LANCNNTMR) value defines the amount of time between each poll. If the remote station answers the poll within LANCNNRTY-times-LANCNNTMR tenths of seconds, establishing a connection proceeds. If not, an inquiry message, CPA58E0 or CPA57EF, is sent to the system operator message queue indicating that a connection attempt failed, and the system automatically puts the controller description in answer mode.

If you choose:

- The retry option, the system again attempts to contact the remote station.
- The cancel reply, the controller description remains in a vary on pending state waiting to answer a polling attempt by the remote station.

Answer Mode

Similarly, other systems and controllers may attempt to establish a connection as soon as they are turned on, varied on, or the system has been loaded. Examples of this include the System/36 and the 3174 Subsystem Control Unit. If this system does not respond, the units listed previously go into answer mode. The 3725 Communication Controller also can be configured to either attempt establishing a connection, or simply wait for this system to try to contact it. Controller descriptions describing these systems should be configured as *DIAL on the INLCNN parameter. If the remote system is ready, the AS/400 system answers the poll. If not, the AS/400 system goes into answer mode, and the remote station contacts the polling system when it is varied on or turned on. Having both sides attempting to dial or poll simultaneously does not prevent the connection from being established. Call contention is resolved by architected retry sequences.

Dial Initiation

If *DIAL was specified for INLCNN, the dial initiation parameter is allowed. This parameter allows you to determine when the call is made to the other system.

If you specify *IMMED, the call occurs immediately after the controller is varied on. *DELAY delays the dial to allow you to control when the call is made. *LINKTYPE is the default value and it determines when the dial connection is made by the type of link.

Note: For LAN connections *LINKTYPE is treated as *IMMED.

Unsuccessful Connections

When using a controller description configured as INLCNN(*DIAL) and if no connection is established, a CPA58E0 `Controller not replying` or CPA57EF `Contact not successful` message can occur; this is not unusual. It may mean that the remote system or controller is not varied on or turned on. If the remote unit is in a state where it should be answering a poll from this system and successful contact is not being established, check the configuration on both sides to ensure that the adapter addresses, DSAP parameter, and SSAP parameter are correctly specified. You may also want to check and make sure that both the adapter for this system and the remote station are wired into the network correctly.

When using a controller description configured as INLCNN(*ANS), it is possible to receive the message CPI591A, `Controller on line varied off or not recognized by local system`. This message results when polling by a remote station does not satisfy the following conditions:

- The adapter address, DSAP, and SSAP match those configured for a varied on controller description.
- The local area network line description this poll used is contained in the switched line list.

If you have such a controller description, ensure that its addressing parameters are correct and that the local area network line description on which this polling occurred is listed in the SWTLINLST parameter. Also, make sure the controller is varied on and not in the recovery pending or recovery cancel state by using the Work with Configuration Status (WRKCFGSTS) command.

If the connection is of the answer type (*ANS for the INLCNN parameter), the system waits for the remote unit to poll. When the remote unit begins polling, an attempt to establish a connection is made.

PC Support/400: Controller descriptions for personal computers or Personal System/2* workstations running PC Support/400 and using DOS should specify *ANS for the INLCNN parameter. These systems will not answer a connection attempt started by an AS/400 system. Systems running PC Support/400 and using the OS/2* Communications Manager will answer calls from the AS/400 system.

Check the error log to see if an error was logged for a line description with a system reference code of AF06 if the following occurred:

- The remote station is polling the AS/400 system
- The message, indicating the system is being polled, does not appear in the system operator message queue
- The connection is not established

You can check the error log by using the Start SST (STRSST) command. This may mean the remote station was sending to a DSAP that was not configured in the SSAP list on your local area network line description. If the AF06 reference code is absent, the error still may have occurred. Check the adapter addresses, SSAPs, and DSAPs to verify the connection.

Exchange Identifier (XID)

To establish a connection, exchange identifiers (XIDs) are exchanged between the system and the remote unit.

For APPC and host controllers, a Format 3 exchange identifier (XID) is used to allow the remote station to properly identify the AS/400 system. Typically, the AS/400 system and other IBM systems conduct an initial poll with NULL XIDs to determine if the remote station is active on the network. If the station does not respond to the poll within the specified time period, another XID can be sent to the station. Typically, XID exchanges continue and a link is established.

Local Exchange Identifier (LCLEXCHID) Parameter

The local exchange identifier (LCLEXCHID) parameter is used to identify the AS/400 system to the host system. This parameter is specified on the host controller description.

If *LIND is specified for the LCLEXCHID parameter, then the LCLEXCHID value is retrieved from the EXCHID value specified on the line description. If another value is specified, it overrides what was specified for EXCHID on the line description. For example, if parallel connections are required between an AS/400 system and an SNA host system, then you need to override the EXCHID value. See "Example of Configuring Parallel Connections to the Host System" on page 5-19 for an example of parallel connections to the host.

Exchange Identifier (EXCHID) Parameter

The exchange identifier (EXCHID) parameter on the controller description specifies the block number and node identifier of the remote system. This parameter can be used to allow the local AS/400 system to identify the remote station.

If the EXCHID value is configured on the AS/400 controller description, the BLOCK identifier and the node identifier from the remote station are compared to the configured value before a connection is established. If no EXCHID is specified, no check is made. This check is optional because the remote unit has already been identified by its adapter address, SSAP, and DSAP.

Refer to the topic "LANCNNTMR and LANCNNRTY Parameters" on page 2-10 for information on polling the remote system or controller.

Data Link Role

Local area network controller descriptions are always created with a data link role (ROLE parameter) of negotiable (*NEG). This means that any time a connection attempt is made to a remote unit, the systems determine their role to be primary or secondary by using an algorithm specified in the *SNA Format and Protocol Refer-*

ence manual. Because the local area network uses a balanced and **duplex**[5] protocol, this role is simply a matter of which system is chosen to send the Set Asynchronous Balanced Mode-Extended (SABME) command to the other station.

Automatic Creation of APPC Controllers on LANs

When local area network lines are configured with the option to create APPC controllers automatically (AUTOCRTCTL(*YES) is specified), the connection establishment and exchange identifier processing is handled differently on incoming calls. If a controller description with a matching adapter address, SSAP, and DSAP is varied on when an incoming call is received, the system processes the incoming call request as was described in "Establishing the Connection" on page 2-5.

If the system does not have a controller description that is varied on and the line is configured as AUTOCRTCTL(*YES), the system will accept the call. After the remote system sends an exchange identifier, the system then causes a controller description to be created and varied on. The system dynamically determines the adapter address, SSAP, DSAP, RMTNETID, and RMTCPNAME used for the automatically created controller description based on the incoming call and the exchange identifier sent by the adjacent system. If a model controller is varied on for this line, the parameters, such as timers and retry limits, are copied from the model controller and used for the automatically created controller.

Automatic creation of controller descriptions is supported for locally attached LANs and bridged frame relay configurations; it is not supported for SNA direct frame relay configurations.

For more information on automatically creating controllers on LANs, see the *APPN Guide*.

Performance Tuning Parameters

When the controller descriptions are created, any type of local area network line can be specified in the switched line list (SWTLINLST parameter). At run time (dial or answer), the system can attach this LAN controller to any type of LAN line description. The first line description in the list that has the correct status is selected.

Because the AS/400 system does not know the type of line description that the controller will be attached to, you can specify values for parameters that do not apply to the environment you are using. Only at run time does the AS/400 system recognize that certain parameters are not needed for a particular environment. The AS/400 system ignores these parameters. For example, if you specify a value for the LANACCPTY parameter and you use Ethernet, the AS/400 system simply ignores that value.

SNA controller descriptions (APPC, SNA host, remote work station, finance, and retail) all have parameters that describe the behavior for the station. These parameters are the LANxxxxxx parameters, and are used for all local area network types.

[5] The duplex protocol allows either station to send at any time at the link level. Polling is not necessary to transfer information.

The following controller description parameters are discussed:

Figure 2-3. Summary of LAN Controller Description Performance Parameters

Parameter	Function	Page
LANCNNTMR	Sets wait time for polling remote station during connection establishment.	2-10
LANCNNRTY	Sets number of poll retries sent to remote station during connection establishment.	2-10
LANRSPTMR	Sets wait time for frame retransmission.	2-11
LANFRMRTY	Sets number of frame retransmission attempts.	2-11
LANACKTMR	Sets wait time for acknowledgement to remote station.	2-11
LANACKFRQ	Sets number of frames received before sending acknowledgement.	2-11
LANINACTMR	Sets wait time for requesting response from remote station.	2-12
LANMAXOUT	Sets number of outstanding frames allowed before requesting acknowledgement from remote station.	2-12
LANWDWSTP	Provides an alternative value equivalent to the LANMAXOUT parameter for use during periods of network congestion. The system provides an algorithm for returning the effective maximum outstanding frames value to that specified by the LANMAXOUT parameter as congestion subsides.	2-13
LANACCPTY	Sets priority of the station. Stations with higher priority have greater access to the token. (Used for token-ring only.)	2-13

Note: The defaults for the parameters listed in the following topics are the recommended values. In general, these values provide the best performance for a logical link and should only be adjusted if performance is unsatisfactory.

LANCNNTMR and LANCNNRTY Parameters

The LAN connection timer (LANCNNTMR) and the LAN connection retry (LANCNNRTY) parameters work together on the AS/400 system to define the frequency and persistence of polling the remote system or controller for the purpose of establishing a connection. The LANCNNTMR specifies, in tenths of seconds, how long to wait before sending an exchange identifier (XID) or the Set Asynchronous Balanced Mode-Extended (SABME) command again. The LANCNNRTY specifies how often this polling occurs when the LANCNNTMR has ended. When the value specified for the LANCNNRTY parameter is reached and no response is received from the remote station, the following occurs:

- The user is notified that contact with the station was unsuccessful.
- The system places the controller description in answer mode.
- If retry is the answer to the inquiry, the AS/400 system attempts to establish connection again.

The defaults for these parameters are intended for use on a single local area network. If a bridge is being used to communicate with a remote station on a remote network, you may want to consider increasing the values of the LANCNNTMR and LANCNNRTY parameters because a bridge may slow down line

traffic enough for the timer to expire before the station is able to respond. **Line traffic** is the number of transmissions and the amount of data sent.

LANRSPTMR and LANFRMRTY Parameters

The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters work together to determine how soon and how often a frame of data is transmitted again. Frames of data need to be transmitted again when one of the following occurs:

- A previous frame of data was lost or damaged.
- The remote station is so busy that it cannot copy or respond to the frame.
- The remote station is waiting to acknowledge the frame with an information frame of its own.

Refer to the topic "LANACKTMR and LANACKFRQ Parameters" for information about the LAN acknowledgement timer (LANACKTMR) parameter.

The LANRSPTMR parameter defines the time interval, in tenths of seconds, that the system waits before transmitting a frame to the remote station again. The LANFRMRTY value specifies how many times the frame is transmitted again before the system notifies the user that an error occurred and the logical link to the remote station is disconnected.

The defaults for these parameters are intended for use on a single local area network. If a bridge is being used to communicate with a remote station on a different local area network, you may want to consider increasing the values on both the local and remote systems, because a bridge may slow down traffic enough for the timer to end before the station is able to respond.

If the values chosen are too small, performance may be slower. Either too many frames are transmitted when acknowledgements are received after the LANRSPTMR ends or the logical link to the remote station may be disconnected. If the values are too large, the notification that a logical link failed may not be immediate.

LANACKTMR and LANACKFRQ Parameters

The LAN acknowledgement timer (LANACKTMR) and the LAN acknowledgement frequency (LANACKFRQ) parameters work together to determine how often an acknowledgement is sent to the remote station. The LANACKTMR parameter specifies how long the system waits before sending an acknowledgement to a received frame. This allows the system, if it has any data to send to the remote controller, to use that frame to acknowledge the received frame. Similarly, the LANACKFRQ parameter specifies the maximum number of frames the system can receive before acknowledgement is sent to the remote station, independent of timers or having data to send. The system has a greater chance of sending a frame of data that includes an acknowledgement of the received frame if the LANACKFRQ value is large.

The values specified for the LANACKFRQ and LANACKTMR parameters must either both be zero or both be nonzero.

Large values may be desirable because unnecessary acknowledgements send additional frames and can contribute to heavier traffic on the LAN. If you are on a

network where frame traffic is a problem, you may wish to increase either or both of these values.

However, in most cases where frame traffic is not a problem, and data tends to flow only one way on the logical link (file transfer), large values for these parameters introduce unnecessary delay in sending acknowledgements and slow response times.

The LAN acknowledgement values should be chosen with careful consideration for the response timer and maximum outstanding frame count of the remote station. For example, if LANACKTMR is set longer than the response timer of the remote station, and the local system does not regularly have data to send to the remote station, the remote response timer ends and transmits the frame again.

Similarly, if LANACKFRQ is set larger than the remote station's maximum outstanding frame count (LANMAXOUT), the remote station continuously waits for acknowledgement of the frames it has outstanding, while the local system waits for more frames of data. This can lead to poor performance for this logical link because more frames are being transmitted than actually necessary, and the remote station may wait longer than necessary before transmitting data again.

The LANACKFRQ parameter should be set less than or equal to the LANMAXOUT value for the remote station. If the local station LANACKFRQ parameter is smaller, the remote station LANMAXOUT value should be evenly divisible by the LANACKFRQ value.

LANINACTMR Parameter

The LAN inactivity timer (LANINACTMR) parameter is used to determine how long the system should wait before requesting a response from the remote station. This request is made to determine if the remote station is still on the ring or if the logical link is disconnected. If the value is set too small, unnecessary traffic is created, which may lead to a performance throughput problem. If it is set too large, the system may not determine that the logical link is inoperable as quick as when the value is smaller. This timer is sensitive to whether the remote station is on the same local area network or not. If it is across a bridge, this value may need to be increased. If the value is set to 0 (no time-out), you may not be informed if the logical link is inoperable until a data transfer attempt occurs.

LANMAXOUT Parameter

The LAN maximum outstanding data frames (LANMAXOUT) parameter specifies how many unacknowledged frames the system can have outstanding to the remote station without waiting for an acknowledgement. This parameter is highly sensitive to the ability of the remote station to copy and acknowledge frames, based on buffering capabilities and processing resource.

For optimal performance, it is essential to specify appropriate values for the LANMAXOUT and LAN acknowledgement frequency (LANACKFRQ) parameters on both the sending and receiving stations.

Some of the variables affecting which LANMAXOUT and LANACKFRQ values provide the best performance are:

- The characteristics of the application
- The amount of data being sent

- The rate that the application can present and accept data
- The data blocking characteristics
- The LAN adapter type
- The processing unit model
- The utilization of the line, the adapter, and the processing unit
- The internal buffering capabilities

In most environments, *CALC (LANACKFRQ=1 and LANMAXOUT=2) offers the best performance. However, for some environments, changing these values may provide a significant performance improvement.

You can change the LANMAXOUT and LANACKFRQ values to determine if performance improves. The following guidelines can be used as starting values which you can then change to determine the best values:

- For a large transfer environment when the frame size is:
  - 1994 bytes or less, use LANACKFRQ=4 and LANMAXOUT=8.
  - Between 1994 and 8156 bytes, use LANACKFRQ=2 and LANMAXOUT=4.
- For a mixed environment with both interactive and large transfer activity, follow the guidelines for a large transfer environment but keep LANACKFRQ=*CALC.
- When communicating with a PS/2* system Model 50 or above, follow the guidelines for a large transfer environment but keep LANACKFRQ=*CALC.
- If you decide to change the values from *CALC for LANACKFRQ and LANMAXOUT, here are some guidelines for determining new values:
  - LANACKFRQ should be about half the size of LANMAXOUT.
  - LANACKFRQ should be the same on sending and receiving systems.
  - LANMAXOUT should be the same on sending and receiving systems.

Note: If the LANACKFRQ and LANMAXOUT values are changed without a noticeable performance improvement, change the values back to *CALC.

LANWDWSTP Parameter

The LAN window step (LANWDWSTP) parameter is used to determine whether the number of outstanding frames (those sent without receiving an acknowledgement from the remote system) should be reduced during periods of network congestion. If the value set is too small (or *NONE), congestion takes longer to subside. For more information on network congestion, see the discussion of the dynamic window algorithm in the *Token-Ring Network Architecture Reference*.

LANACCPTY Parameter

The LAN access priority (LANACCPTY) parameter is set in each frame before being sent on the ring. This priority determines which tokens can be captured and used to send the frame. The greater the access priority value, the more tokens the station can capture and the greater chance the frame will be sent. This is important if the ring that your system is attached to is heavily used (not many free tokens available) and your application program needs priority treatment.

The adapters on most systems send a priority of 0, which is the default for LANACCPTY on the create controller commands. If your station requires more priority (for example, a personal computer which requires access to the token ring), you should set the LANACCPTY parameter to a greater value. This parameter is used only for token-ring network connections.

LAN Bridge Frame Size Considerations

If a frame is being transmitted to a station that resides on a different LAN, the frame must be copied and transmitted again by a bridge. If the bridge is not configured to support a frame size as large as that configured on the line description, the frame will be discarded. The frame may also be discarded if the frame size configured on a line description used for a bridged frame relay configuration is not supported by the network.

For SNA in the token-ring environment, the system originating the connection is informed of the frame size supported by the bridge, and will automatically retry with that frame size. The CPF5908 message `Controller contacted` that is sent to the QSYSOPR message queue gives the effective maximum frame size for that connection.

If it is not possible to configure the bridge to support larger frame sizes, you may need to adjust one of the following to a value acceptable to the bridge:

- MAXFRAME parameter on the controller description
- SSAP MAXFRAME parameter on the line description
- MAXFRAME parameter on the line description (except Ethernet lines)

If an adjustment is made, it is recommended that the MAXFRAME value on the controller description be adjusted.

Relationship of LAN Parameters to Token-Ring Network Architecture

Figure 2-4 shows how the AS/400 LAN controller description parameters relate to the parameters described in the *IBM Token Ring Architecture Reference*.

Figure 2-4. AS/400 LAN Parameters. Relationship of LAN Controller Description Parameters to Parameters Used in the IBM Token-Ring Architecture Reference.

AS/400 Parameter	Short Term	Short Description
LANCNNTMR	CT1	Connection Timer T1 (for link establishment)
LANCNNRTY	CN2	Connection Retry Count N2 (for link establishment)
LANRSPTMR	T1	Response timer (waiting for remote acknowledgement)
LANFRMRTY	N2	Retry count (maximum number of resends on T1 expiration)
LANACKTMR	T2	Receiver acknowledgement timer
LANACKFRQ	N3	Acknowledgement frequency—must send acknowledgement after receiving N3 I-format frames (data frames)
LANINACTMR	Ti	Inactivity Timer (poll remote on expiration)
LANMAXOUT	TW (k)	Maximum number of outstanding I-Format LLC protocol data units (data frames)
LANWDWSTP	Nw	Dynamic Window Step
MAXFRAME on line and controller descriptions	N11	Maximum number of octets (bytes) in the information field.2

Notes:

TW may be referred to as MAXOUT because TW is perceived as the MAXimum OUTstanding frames transmitted to the other end. Similarly, N3 may be referred to as MAXIN because it is perceived as the MAXimum INbound frames received before sending an acknowledgement to the originator of the frames.

1. N1 is the maximum length of an LLC Protocol Data Unit. The effective MAXFRAME value is the length excluding the LLC header. The LLC header is 3 to 4 bytes long. The setting of N1 on the AS/400 LAN adapter is the effective MAXFRAME + 4.
2. For AS/400 Version 1 Release 3 and later, the effective MAXFRAME for the controller description is not necessarily the same as the MAXFRAME value on the controller description. Because LAN controller descriptions are logically switched, the effective MAXFRAME is the smallest of:
   - The controller description MAXFRAME value.
   - The line description MAXFRAME value.
   - The SSAP maximum frame size on the line description.

   The effective maximum frame size may be set to a smaller value if the AS/400 system must communicate with the remote station through a source-routing bridge that requires a smaller frame size. For more information about source-routing bridge frame sizes, see the *IBM Token-Ring Architecture Reference*.

Part 2. Token-Ring Networks

Chapter 3. Token-Ring Networks

This chapter discusses token-ring network configuration and considerations.

Token-Ring Physical Environment

Figure 3-1 shows the multistation access unit (MAU), which is the token-ring hardware needed to connect your device to a token ring. Each multistation access unit allows up to eight attached devices to have access to a ring. You can attach multiple multistation access units together for additional resources on the same token ring. All adapters on the token ring must run at the same speed, either 4 million bits per second or 16 million bits per second.

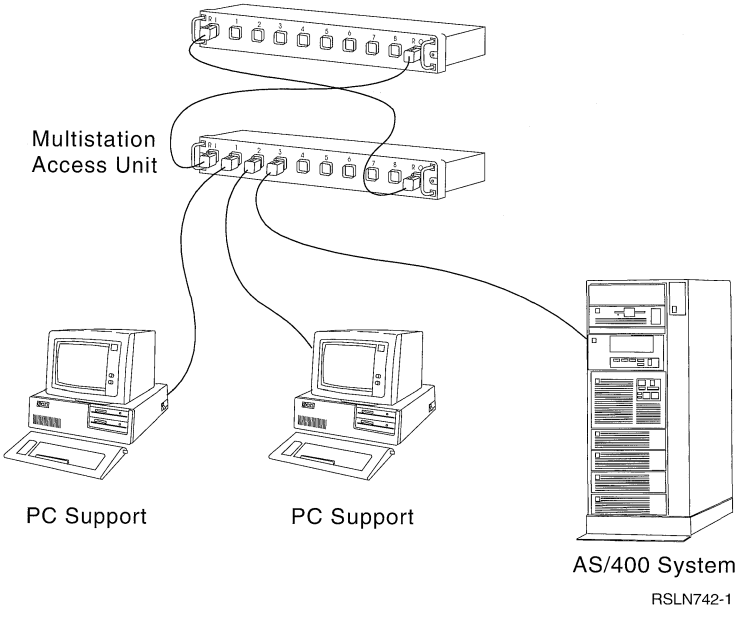


Figure 3-1. Multistation Access Unit

Figure 3-2 shows the necessary adapter cable to attach the IBM Token-Ring Network Adapter to the IBM Token-Ring Network. This adapter cable has a nine-pin D connector at the system end and a token-ring modular plug at the cabling end. You can purchase this IEEE 802.5-compliant cable from any vendor. IBM Token Ring uses baseband transmission at a rate of 4- or 16-million bps.

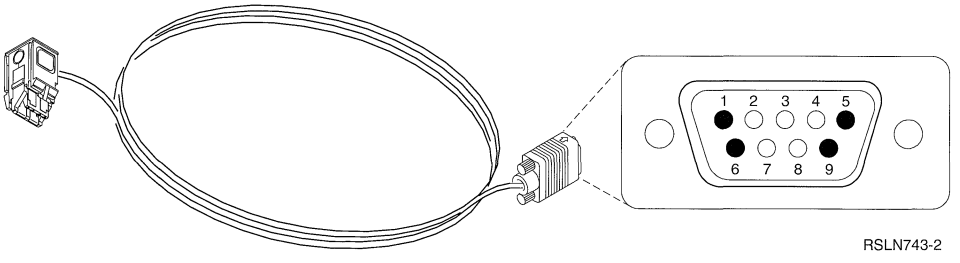


Figure 3-2. Token-Ring Adapter Cable

Ring Configuration

The actual wiring of your network may have some bearing on performance. Rings may be linked together by adapters, which are called bridges. When this system attempts to establish a connection to a station, a frame is sent first around the local ring, and if no response is received, it is then sent to all rings that are connected by bridges to this system. If a station on a connected ring answers the poll, the routing information that the response carries is used in all subsequent transmissions to the remote station. Thus, only one route is ever used (source routing) when communicating with a station on a remote ring. Because all acknowledgements and retries are end to end, these bridges may become congested. This congestion can cause problems for your logical links if the correct values are not chosen for the timer parameters of the controller descriptions.

Notes:

1. The number of bridges through which token-ring frames can be routed is limited by the size of the routing information (RI) field in the token-ring frame. The maximum of 18 bytes allowed for the RI field supports routing through up to seven bridges.
2. More than one multistation access unit can be used in a single-ring network. They are linked together by wiring relays, not by bridges, and thus still constitute a single ring.

Token-Ring Speed Differences

When using a token ring in a heavily used network, a 16 million bits per second token ring moves the token around the ring much faster than the 4 million bits per second token ring. This faster speed allows more free tokens to travel around the ring and, therefore, a shorter wait time for data to be sent. The differences in token rings can be determined by the input/output processor used.

Note: The first adapter on the ring determines the ring speed. This means that any other system coming onto the ring must have the same ring speed. A different ring speed disrupts the ring.

Early Token Release

The early token release (ELYTKNRLS parameter), available only with the 16-million-bps token-ring network, is used to reduce the time another adapter on the same ring has to wait for a free token. For early token release, the transmitting adapter releases a free token after sending its frame. The following figure demonstrates the concept of early token release.

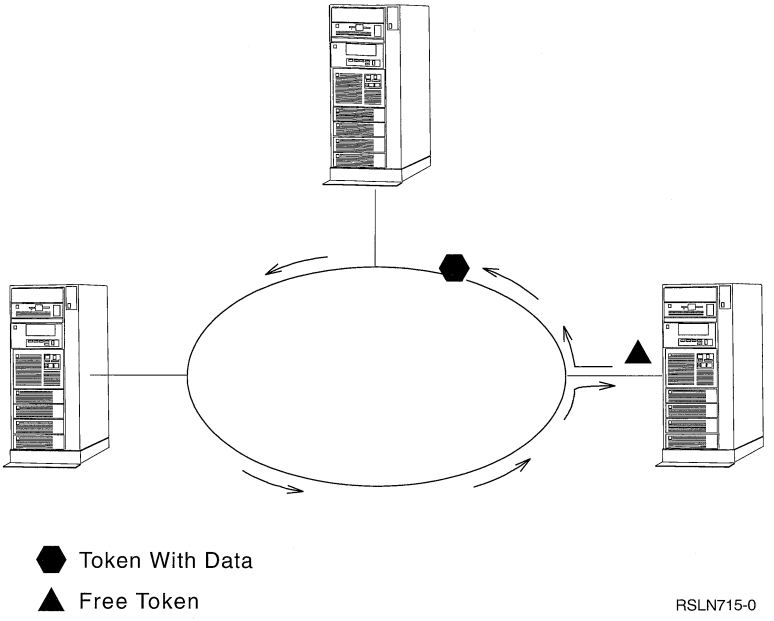


Figure 3-3. Early Token Release on the IBM Token-Ring Network

If early token release is not used and the frame is shorter than the ring length, a free token is not released until the transmitting adapter sees the header of its transmitted frame. If the frame is shorter than the ring length, the ring is idle for the difference in time of the lengths. Early token release removes this idle time.

Token-Ring Physical Address Format

Every system, controller, or personal computer that is attached to a local area network has a physical address for its attachment adapter. This physical level is called the medium access control (MAC), and the IEEE architecture has defined the 48-bit (or 6-byte) MAC address formats to be used for IEEE 802.5 token-ring LANs.

Figure 3-4 and Figure 3-5 on page 3-4 define how the MAC addresses are displayed on the AS/400 system for the token-ring LAN. The order of bit transmission on the medium starts with byte 0, bit 0 and ends with byte 5, bit 7. This order of transmission is called most significant bit because the most significant bit of each byte is transmitted first.

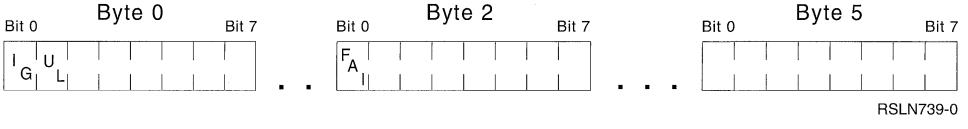


Figure 3-4. Token-Ring MAC Destination Address Format

- Bit 0 of byte 0 (called the I/G bit) indicates whether the destination address is an **individual address**, an address associated with a particular station on the network, (B'0'), or **group address**, a multidestination address associated with one or more stations on the network, (B'1').
- Bit 1 of byte 0 (called the U/L bit) indicates whether the address is universally administered (B'0') or locally administered (B'1').

- Bit 0 of byte 2 (called the functional address indicator (FAI)) indicates whether a locally administered group address is a functional address (B'0') or a group address (B'1').

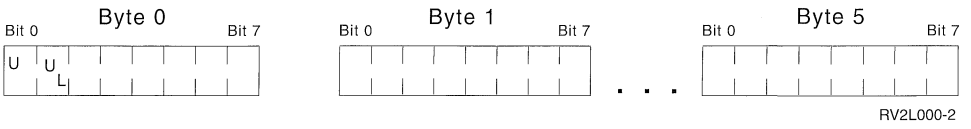


Figure 3-5. Token-Ring MAC Source Address Format

- Source addresses are always individual addresses. Bit 0 of byte 0 is set to 1 when a routing information field is present in the frame. It is set to 0 when no routing information field is present.
- Bit 1 of byte 0 is used to indicate whether the address is universally administered or locally administered as in the destination address.

The above indicators are an integral part of each station address and must be considered during address recognition.

Note the following:

- Byte 0, bit 0 = 0. This assignment controls the values of the local adapter address (ADPTADR parameter on the CRTLINTRN command) to the range of hex 7FFFFFFFFFFF and below. The remaining addresses (when byte 0, bit 0 = 1) are group addresses.
- Locally assigned addresses with byte 0, bit 1 = 1, are further restricted to values in the range hex 400000000000 to hex 7FFFFFFFFFFF. IEEE restrictions preclude the use of adapter preset addresses with values in the range of hex 000000000000 to hex 3FFFFFFFFFFF.

  Other remote systems may have further restrictions on specifying the adapter address. For example, if your AS/400 system is communicating with FBSS controller, the locally assigned address is restricted to the range of hex 400000000000 to hex 400099999999. Only characters 0 through 9 are permitted.

  Note: If you choose to assign your own address, ensure that the last 4 bytes (8 hexadecimal characters) are unique in the local area network. This is required by some adapters.

Bridged LAN Addressing Considerations

It is very important to note that MAC addresses are always displayed in the above format on all AS/400 token-ring configuration displays even if they represent stations on other LAN media, such as Ethernet stations reached through bridges. Refer to "Ethernet Physical Address Format" on page 8-2 for more information on bridged LAN considerations.

Functional Addresses

Functional addresses are bit-specific group addresses in a token-ring network. All functional addresses are locally administered. Functional addresses are assigned using the FCNADR parameter on the CRTLINTRN command.

For an address to be a functional address, the destination address must have both bit 0 and 1 of byte 0 set to 1, all the bits in byte 1 should be set to 0, and bit 0 of byte 2 set to 0. The remaining 7 bits of byte 2 and the 8 bits in byte 3, 4, and 5

are used to identify the specific functional address. This allows up to 31 functional addresses to be defined.

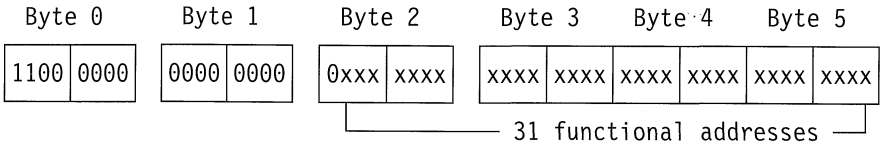


Figure 3-6. Token-Ring Functional Address Format

Note: Each x, when set to 1, represents a functional address.

For more information on functional addresses see *OS/400* Communications Configuration Reference* and the *Token-Ring Network Architecture Reference*.

For converting a token-ring functional address to an Ethernet group address, see "Token-Ring to Ethernet Address Conversion" on page C-2.

Frame Size Considerations for Token-Ring Networks

Data is transmitted to remote stations in frames, the basic unit of transmission for all data. Frame size indicates how large each transmission is.

A token-ring network provides an environment with few errors. Therefore, data transmission is more efficient if data is sent in as large a frame as possible. The largest frame size the AS/400 system sends (the MAXFRAME parameter on the CRTLINTRN command) can be set in any range from 265 through 16393.

Depending on the token-ring LAN adapter you are using, the maximum frame size will vary.

Figure 3-7. Token-Ring Adapter and Largest MAXFRAME Value

Resource Type	Largest MAXFRAME Value	
	Line Speed 16 million bps	**Line Speed 4 million bps**
2619, 2626	16 393	4060
6134, 2636	8156	4060
6034, 6160	N/A	1994 (default)

Note: Type `WRKHDWRSC *CMN` to view the LAN adapter (resource) types.

The maximum value may not always be possible. For example, the station to which you are transmitting may not be able to accept as large a frame that configured on the AS/400 system token-ring line description. Typically, the largest frame size supported by both the AS/400 system and the remote station is exchanged in XIDs while establishing the connection, and the smaller of the frame sizes is then used by both the AS/400 system and the remote station. If this negotiation is not done, a frame reject (FRMR) condition results, and the message CPA58E2 is sent to the QSYSOPR message queue. If this condition occurs, it is necessary to adjust the maximum frame size (MAXFRAME) parameter on the appropriate change controller command or change the maximum frame size in the remote station's configuration.

General Frame Size Considerations

On token-ring lines, the MAXFRAME parameter defines the maximum frame size to be used on that line. Maximum frame size can also be configured for each SAP associated with the line description. In addition, a controller description also has a MAXFRAME size. When the connection process begins, the frame size is the smaller of the three values: line MAXFRAME, SSAP MAXFRAME, or the controller MAXFRAME. However, the frame size may become even smaller because of the XID negotiations or bridge considerations.

LAN Bridge Frame Size Considerations

If a frame is being transmitted to a station that resides on a different LAN, the frame must be copied and transmitted again by a bridge. If the bridge is not configured to support a frame size as large as that configured on the token-ring or Ethernet line description, the frame will be discarded. For SNA in the token-ring environment, the system originating the connection is informed of the frame size supported by the bridge, and will automatically retry with that frame size. The CPF5908 message `Controller contacted` that is sent to the QSYSOPR message queue gives the effective maximum frame size for that connection.

If it is not possible to configure the bridge to support larger frame sizes, you may need to adjust one of the following to a value acceptable to the bridge:

- MAXFRAME parameter on the controller description
- SSAP MAXFRAME parameter on the line description
- MAXFRAME parameter on the line description

If an adjustment is made, it is recommended that the MAXFRAME value on the controller description be adjusted.

Chapter 4. AS/400 Token-Ring Network Manager Support

The token-ring network manager support allows you to manage an IBM Token-Ring Network by monitoring the status of the ring and of the attached stations, and by determining the source of problems on the ring. The token-ring network manager provides this support for one ring only, using the following methods:

- Analysis and reporting of error and **beaconing**[1] conditions through the ring error monitor, which observes, collects, and analyzes error reports sent by stations on the token-ring. The ring error monitor also assists in fault isolation and correction.
- Alerts the network **focal point**, an APPN network node that allows a customer to centrally manage a network, of errors causing performance degradation and beaconing conditions.
- Operational functions, such as:
  - Displaying ring configuration
  - Displaying token-ring network status
  - Displaying adapter profiles
  - Adapter name support
  - Setting the level of ring error monitor error reporting and logging
  - Specifying whether to log ring changes
  - Specifying whether a token-ring network manager is controlling or observing

The token-ring network manager is part of the OS/400 licensed program on the AS/400 system.

Token-Ring Network Manager Parameters

The Create Line Description (Token-Ring) (CRTLINTRN) command allows you to select the level of recoverable error logging on the ring to be used by the token-ring network manager for a token-ring line description. After creation of a line description and specifying the error logging level, the CHGLINTRN command can be used to change the level of error logging on the ring. The logging levels supported by the TRNLOGLVL parameter are *OFF, *MIN, *MED, and *MAX.

In addition to indicating error logging levels on the ring, you can configure your token-ring line description to be either a controlling network manager (TRNMGRMODE(*CONTROLLING)) or an observing manager (TRNMGRMODE(*OBSERVING)). A controlling network manager can remove adapters on a token-ring. Only one controlling manager should be active on a token ring.

The network manager can also keep track of configuration changes that occur on the token ring. Changes are tracked through the nearest active upstream neighbor (NAUN) reports on the ring. If LOGCFGCHG(*LOG) is specified on the line description, the network manager on this line logs all changes in QHST. If LOGCFGCHG(*NOLOG) is specified, no changes are tracked.

---

[1] Beaconing is a repeated message sent in a token-ring network to indicate an adapter is not receiving a normal signal because of a serious error, such as a line break or power failure.

Token-Ring Network Ring Errors

The token-ring network manager supplies information about the problems on the ring, about its own operating status, and about the operating status of the ring.

All ring error problems reported by the token-ring network manager are logged as messages to the history log (QHST), and many are also logged to the system operator message queue (QSYSOPR). Errors on the ring considered serious enough to affect performance and other errors that cause beaconing are logged to QHST as alertable messages. Alertable messages may cause an alert to be reported to a network operator at a problem management (alert) focal point.

The token-ring network manager can be configured to send beaconing information from the line to the QHST log. To send information to QHST, specify the token-ring inform of beacon (TRNINFBCN) parameter as *YES (the default). If you specify the TRNINFBCN parameter as *NO, the information is not logged.

Working with Configuration Status

You can work with your token-ring environment through the Work with Configuration Status (WRKCFGSTS) command. This command allows you to vary on a token-ring line description. After the line is varied on, specify the *Work with TRLAN adapter* option to display the active token-ring adapter configuration. From this display, you can obtain adapter profiles, remove an adapter, and display information on the token-ring network status. The Work with Configuration Status display can be accessed by either of the following methods:

- By typing `WRKCFGSTS` at any command line and pressing F4 (prompt).
- By selecting option 6 (Communications) on the main menu. The Communications menu will display several options; select option 1 (Communication status). This display will allow you to display the status of the token-ring lines and the associated controllers and devices.

From the Work with Configuration Status display you can do the following:

- Vary on and off lines, controllers, and devices
- Work with a job or an object description
- Display mode status and connection status
- Hold or release a device
- Resume or end recovery
- Work with token-ring adapters

For more information on this command, see the *Communications Management Guide*.

Work with Hardware Resources Display

You can work with your token-ring environment using the Work with Hardware Resources (WRKHDWRSC) command. You can add, change, remove, or show information about local communications resources on the system and the associated configuration objects. The Work with Communication Resources display shows all communication processors, adapters, and ports installed on the system. The following example display was generated by specifying WRKHDWRSC *CMN.

```
                    Work with Communication Resources
                                                              System:   RCHAS730
Type options, press Enter.
  2=Edit   4=Remove   5=Work with configuration description
  7=Add configuration description ...

                    Configuration
Opt  Resource        Description   Type  Description
     CMB01                        2615  MFIO Processor
     CC01                         2625  Comm Processor
       LIN01                      2625  LAN Adapter
         LIN011      TRNLINE      2625  Ethernet Port
     CC02                         2626  Comm Processor
       LIN02                      2626  LAN Adapter
         LIN021      TOKENRING1   2626  Token-Ring Port

                                                                        Bottom
F3=Exit      F5=Refresh   F6=Print   F11=Display resource addresses/statuses
F12=Cancel   F23=More options
```

Figure 4-1. Prompt Display for Work with Hardware Resources

Work with TRLAN Adapters Display

The WRKHDWRSC *TRA command allows you to perform functions with the token-ring adapter information file. Information on this display reflects the status of the adapters on the ring. You can perform various tasks relating to token-ring adapters from this display.

From the Work with TRLAN Adapters display, you can do the following:

- Change information
- Remove information
- Display adapter profile
- Add information
- Remove adapter
- Print ring lists
- Display token-ring network status
- Display adapter descriptions or adapter addresses
- Work with TRLAN adapter information

Working with TRLAN Adapters

To work with TRLAN adapters, select the *Work with TRLAN adapters* option from the Work with Configuration Status display or use the Work with TRLAN Adapter (WRKTRA) command and specify the name of the token-ring line description.

The following is the Work with TRLAN Adapters display. Adapter entries are presented in the order they are reported from the token-ring. When an adapter name is provided from the token-ring adapter file, the adapter name is displayed alongside the adapter address. This display provides an adapter description as well as the address.

```
                          Work with TRLAN Adapters
                                                              System:   RCHAS400
Position to  . . . . .  ___________   Address

Line description . . . . . . . . . :   TRNLINE

Type options, press Enter.
  4=Remove information   5=Display adapter profile   6=Add information


                  Adapter
Opt  Address      Name        Description
 _   400077012ACE   TRNTESTADP   Adapter for System 34
 _   400071032900   NEXTDOORAD   Next to System 110
 _   10005A0402D8
 _   10005A0068A9
 _   400071001500
 _   400071072300
                                                                        More...
Command
===> ____________________________________________________________________________
F3=Exit   F4=Prompt      F5=Refresh   F6=Print   F9=Retrieve
F10=Display TRN status   F12=Cancel   F13=Work with TRLAN adapter information
```

Figure 4-2. Prompt Display for Work with TRLAN Adapters

Work with TRLAN Adapter Information

The token-ring adapter file contains information that allows you to easily identify each adapter on the network. The adapter file associates names and descriptions that you specify with each adapter on the token-ring. Therefore, if a user on your token ring moves from one adapter to another (for example, an office move takes place), you can easily determine which adapter the user was associated with and which adapter the user will be associated with.

The F13 (Work with TRLAN adapter information) key can be selected from any Work with TRLAN Adapters display, or you can type:

```
WRKHDWRSC TYPE(*TRA)
```

and use the Work with Hardware Resources command to get the Work with TRLAN Adapter Information display. Working with token-ring adapter information allows you to change the adapter address or description in the adapter file or to remove the adapter information from the adapter file. Removing adapter information from the adapter file does not remove the adapter from the token ring.

The following is the Work with TRLAN Adapter Information display.

```
                    Work with TRLAN Adapter Information
                                                              System:   RCHAS400
Position to . . . . .  _________   Adapter name

Type options, press Enter.
  1=Add information   2=Change information   4=Remove information

     Adapter
Opt  Name        Address
 _   _________

 _   TRNTESTADP   400077012ACE
 _   NEXTDOORAD   400071032900

                                                                        Bottom
Command
===> ____________________________________________________________________________
F3=Exit   F4=Prompt        F5=Refresh   F6=Print   F9=Retrieve
F11=Display descriptions   F12=Cancel
```

Figure 4-3. Prompt Display for Work with TRLAN Adapter Information

Display Adapter Profile

You can display the adapter profile from the Work with TRLAN Adapters display by selecting option 5 (Display adapter profile) or by using the Display TRLAN Adapter Profile (DSPTRAPRF) command. This display obtains adapter profile information directly from the TRLAN adapter attached to the token ring. The following is the Display Adapter Profile display.

```
                         Display Adapter Profile
                                                              System:   RCHAS400
Product ID . . . . . . . . . . . . . :   000890EF00083F4800023F6F0002001E41EF
Licensed internal code . . . . . . . :   F0F0F0C1F6F4F1F1F740
Group address  . . . . . . . . . . . :   800000000001C
Adapter address  . . . . . . . . . . :   400077012ACE
Adapter name . . . . . . . . . . . . :   TRNTESTADP
Adapter description  . . . . . . . . :   Adapter for system 34

NAUN address . . . . . . . . . . . . :   400071001500
NAUN name  . . . . . . . . . . . . . :
NAUN description . . . . . . . . . . :



                                                          Functional
Function                                                   Address
Ring error monitor                                        C00000000008
Configuration report server                               C00000000010

Press Enter to continue.
                                                                        Bottom
F3=Exit   F5=Refresh   F6=Print   F12=Cancel
(C)
```

Figure 4-4. Prompt Display for Display Adapter Profile

From this display, you can display much of the hardware information associated with the specified adapter. You can display the level of code, adapter addresses, product information, and the adapter address next in line on the token ring.

Display Token-Ring Network Status

You can also display token-ring network status from the Work with TRLAN Adapters display by pressing F10 (Display TRN status). This display provides the present ring state. The **fault domain**, as discussed in the ring state list below, is the adapter or adapters where the problem resides. Possible ring states include:

NORMAL No irrecoverable error condition exists on the token ring.

TEMPORARY 1
Indicates a temporary beaconing condition was detected and the beaconing processing function was replaced by another beacon condition before it could complete its analysis.

TEMPORARY 2
Indicates a temporary beaconing condition was detected and this ring error monitor does not use the function to query the fault domain stations after temporary beaconing.

TEMPORARY 3
Indicates a temporary beaconing condition was detected. The ring error monitor queried the beacon fault domain stations and received responses from both stations, indicating that neither station left the ring as part of the automatic recovery process.

TEMPORARY 4
Indicates a temporary beaconing condition was detected. The ring error monitor queried the beacon fault domain stations and detected that one of the stations in the fault domain has left the ring as part of the automatic recovery process.

TEMPORARY 5
Indicates a temporary beaconing condition was detected. The ring error monitor queried the beacon fault domain stations and detected that both of the stations in the fault domain had left the ring as part of the automatic recovery process.

PERMANENT
The ring has been in a beaconing condition for longer than the permanent-error detection timer.

The following is an example of a Display Token-Ring Network Status display.

```
                    Display Token-Ring Network Status
                                                        System:   RCHAS400
Line description . . . . . . . . . . . :   TRNLINE
Ring status  . . . . . . . . . . . . . :   Normal
```

Figure 4-5. Prompt Display for Display Token-Ring Network Status

The terminology used in token-ring network manager messages has the technical descriptions changed to be more easily understood by an operator unfamiliar with the technical details of the IBM Token-Ring Network. The following correlation exists between the message and technical terminology:

Message Terminology	Technical Terminology
Recoverable error	Soft error
Irrecoverable error	Hard error
Location on ring where error is occurring	Fault domain
Type of error when location is known	Isolating error
Type of error when location is unknown	Nonisolating error

For a complete and detailed description of all the technical details of the IBM Token-Ring Network and problem diagnostic processes, refer to the *IBM Token-Ring Network Architecture Reference* manual and the *IBM Token-Ring Network Problem Determination Guide*.

Alert support on the AS/400 system allows a record to be sent to a focal point to identify a problem or an impending problem. Refer to the *Alerts and DSNX Guide* for more information about the alert support on the AS/400 system.

Token-Ring Network Manager Command Summary

The following figure summarizes the CL commands you can use to perform the same functions demonstrated with the token-ring adapter.

Figure 4-6. Token-Ring Network Manager Command Summary

Command	Description
CRTLINTRN	Create Line Description (Token-Ring)
CHGLINTRN	Change Line Description (Token-Ring)
WRKHDWRSC	Work with Hardware Resources
ADDTRAINF	Add Token-Ring Adapter Information
CHGTRAINF	Change Token-Ring Adapter Information by Address
DSPTRAPRF	Display Token-Ring Adapter Profile
DSPTRNSTS	Display Token-Ring Network Status
RMVTRA	Remove Adapter from Token-Ring
RMVTRAINF	Remove Adapter Information Entry
WRKTRA	Work with Adapters on Token-Ring

In addition to these commands, the following parameters on the CRTLINTRN and CHGLINTRN commands are significant for the token-ring network manager.

Figure 4-7. Token-Ring Network Manager Parameter Summary

Parameter	Values (Default Listed First)
TRNLOGLVL	*OFF, *MIN, *MED, *MAX
TRNINFBCN	*YES, *NO
LOGCFGCHG	*YES, *NO
TRNMGRMODE	*OBSERVING, *CONTROLLING

Token-Ring Network Messages

Messages contain detailed information about errors on the ring. This information can be used to find the cause of a problem on the ring or used by service personnel to resolve a problem. Messages logged to QHST and QSYSOPR have information about the probable cause of the error, a description of the error, and operator recovery actions.

Messages issued by the token-ring network manager can generally be categorized into the following types:

- Recoverable error, noticeable decrease in performance.
- Recoverable error, warning of increase in errors toward level where they noticeably decrease performance.
- Ring beaconing, automatic recovery procedures in process.
- Ring beaconing, automatic recovery procedures have failed and manual intervention is required to identify and correct the problem.
- Ring beaconing has stopped, recovery procedures (either automatic or manual) have corrected the problem.
- Informational messages: inform the operator that error logging on the ring has started, stopped, or changed and the level of error logging.

The following chart summarizes the error messages on the ring issued by the token-ring network manager. The chart contains the following information:

- Error message description.
- CPF message identification number. All messages are in the range of numbers CPF8B01 to CPF8B99.
- Minimum level required for logging of recoverable error messages (*MIN, *MED, *MAX).

  Note: N/A means logging level is not applicable to logging of message. Many of these messages are displayed interactively and are not logged.
- Logged in QHST. X means yes; blank means no.
- Logged in QSYSOPR. X means yes; blank means no.
- Message is alertable. X means yes; blank means no.

  Note: Alertable messages cause an alert notification message to be sent to a problem manager (alert) focal point.

Figure 4-8 (Page 1 of 2). Error Messages Issued by Token-Ring Network Manager

Error Message Description	Message Number	Log Level	QHST	QSYSOPR	Message Alert
Recoverable: no performance degradation	CPF8B01	*MIN	X	X	
Errors decreasing	CPF8B02	*MIN	X	X	
Recoverable: performance degradation	CPF8B03	*MIN	X	X	X
Frequency mismatch recoverable error	CPF8B05	*MED	X	X	
Frame copied recoverable error	CPF8B06	*MED	X	X	
Receive congestion recoverable error	CPF8B07	*MED	X	X	
Lost frame recoverable error	CPF8B08	*MED	X	X	
Token error recoverable error	CPF8B09	*MED	X	X	
Monitor error recoverable error	CPF8B10	*MAX	X		
Poll failure recoverable error	CPF8B11	*MAX	X		
Recoverable error report	CPF8B12	*MAX	X		
Recoverable: performance degradation	CPF8B13	*MIN	X	X	X
Recoverable: no performance degradation	CPF8B14	*MIN	X	X	
Errors decreasing	CPF8B15	*MIN	X	X	
No logging occurring	CPF8B16		X	X	
Logging stopped due to vary off	CPF8B17	N/A	X	X	
Logging started	CPF8B18	N/A	X	X	
Logging request failed: log level not changed	CPF8B19	N/A	X	X	
Logging stopped due to line failure	CPF8B20	N/A	X	X	
Data that is not valid received from ring error monitor	CPF8B21	*MIN	X	X	
Configuration report server data not valid	CPF8B22		X	X	
Receiver congestion table full	CPF8B25	*MIN	X	X	
Receiver congestion	CPF8B26	*MIN	X	X	X
Receiver congestion ended	CPF8B27	*MIN	X	X	X
Ring beaconing, automatic recovery in process	CPF8B28	N/A	X	X	X
Ring beaconing, automatic recovery in process	CPF8B29	N/A	X	X	X
Ring beaconing, automatic recovery in process	CPF8B30	N/A	X	X	X
Ring beaconing, automatic recovery failed	CPF8B31	N/A	X	X	X
Ring beaconing, automatic recovery failed	CPF8B32	N/A	X	X	X
Ring beaconing, automatic recovery failed	CPF8B33	N/A	X	X	X
Beaconing stopped, automatic recovery successful	CPF8B34	N/A	X	X	
Beaconing stopped, ring manually recovered	CPF8B35	N/A	X	X	X
Beaconing stopped, ring manually recovered	CPF8B36	N/A	X	X	X
Beaconing stopped, ring manually recovered	CPF8B37	N/A	X	X	
Adapter inserted or removed from token ring	CPF8B41	N/A	X	X	
Adapter removed from adapter file	CPF8B42	N/A	X		

Figure 4-8 (Page 2 of 2). Error Messages Issued by Token-Ring Network Manager

Error Message Description	Message Number	Log Level	QHST	QSYSOPR	Message Alert
Removal of adapter from file failed	CPF8B43	N/A			
Adapter address not valid	CPF8B45	N/A			
Adapter name not found in file	CPF8B46	N/A			
Not a controlling TRLAN manager, remove failed	CPF8B47	N/A			
Adapter name already exists	CPF8B48	N/A			
Request to remove adapter failed	CPF8B49	N/A			
Cannot remove own TRLAN manager adapter	CPF8B50	N/A			
Change failed, duplicate address in file	CPF8B51	N/A			
Change failed, adapter not in file	CPF8B52	N/A			
Adapter added to file	CPF8B53	N/A	X		
File change completed successfully	CPF8B54	N/A	X		
Remove failed, adapter not in file	CPF8B62	N/A			
Time-out in ring error monitor	CPF8B64	N/A			
Time-out in configuration report server	CPF8B65	N/A			
Error in configuration report server	CPF8B66	N/A			
Error in ring error monitor	CPF8B67	N/A			
Line description not found	CPF8B68	N/A			
Line description not a TRLAN line description	CPF8B69	N/A			
Line description not varied on	CPF8B70	N/A			
Adapter already exists in file	CPF8B71	N/A			
Change failed, adapter not in file	CPF8B72	N/A			
Change completed successfully	CPF8B73	N/A	X		
No active adapters on line	CPF8B74	N/A			
No adapter entries in adapter file	CPF8B75	N/A			
No functional addresses for adapter	CPF8B76	N/A			
Ring error monitor response not valid	CPF8B78	N/A			
Configuration report server response not valid	CPF8B79	N/A			
Configuration report server error frame reported	CPF8B80	N/A			
Ring error monitor error frame reported	CPF8B81	N/A			

IBM Personal Computer LAN Manager

The IBM LAN Manager provides network management functions for the personal computer that are similar to those of the AS/400 token-ring network manager. Figure 4-9 lists the terminology used by LAN Manager to describe soft (recoverable) error levels and the equivalent logging level values specified for the AS/400 TRNLOGLVL parameter.

Figure 4-9. Token-Ring Network Manager Terminology

LAN Manager Error Logging Level	**Equivalent AS/400 TRNLOGLVL Parameter Value**
Full	*MAX (maximum)
Limited	*MIN or *MED (minimum or medium)
None	*OFF
Reset	No similar parameter

Chapter 5. Token-Ring Network Configuration Examples

Figure 5-1 shows an example of an AS/400 system on a token-ring network communicating with a 3725, a 3174 (Model 1L) Subsystem Control Unit, a System/36 using APPC, a 3174 (Model 3R or 53R) Subsystem Control Unit, a personal computer using the PC Support/400, and the same system routed back to itself (wrapped). Token-ring network support is not limited to these systems. For example, the AS/400 system can also communicate with the RISC System/6000, System/390*, and Personal System/2 AIX*. The *TCP/IP Guide* has TCP/IP configuration examples. The *APPN Guide* has configuration examples that use APPN over the token-ring network. The *System Programmer's Interface Reference* has examples of user-defined communications over token-ring networks.

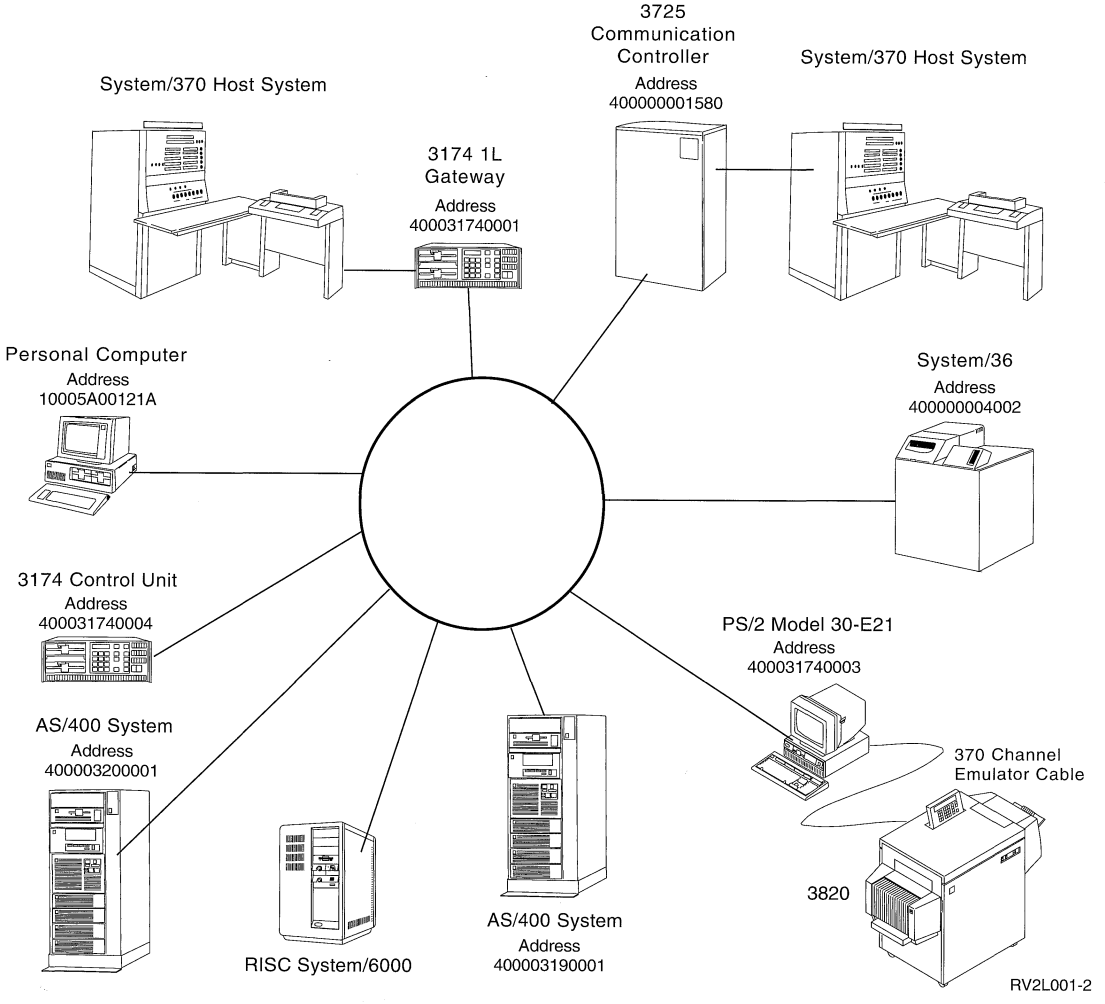


Figure 5-1. Token-Ring Network Configurations

Creating the Token-Ring Network Line Description

The token-ring network line description (TOKENRING1) created by the following displays has specified a user-assigned adapter address (400003190001), a maximum frame size of 16393 (allowed only for a 16M LAN adapter), and two SSAPs, hex 04 and hex 08. The maximum number of controllers (MAXCTL parameter) is set to 40; this means that no more than 40 controllers can be active on this line description at any one time.

```
                    Create Line Desc (Token-Ring) (CRTLINTRN)

Type choices, press Enter.

Line description . . . . . > TOKENRING1     Name
Resource name  . . . . . > LIN012          Name, *NWID
Online at IPL  . . . . . .  *YES           *YES, *NO
Vary on wait . . . . . .  *NOWAIT        *NOWAIT, 15-180 (1 second)
Maximum controllers  . . . . . .  40      1-256
Line speed . . . . . > 16M           4M, 16M, *NWI
Maximum frame size . . . . . > 16393         265-16393, 265, 521, 1033...
Local adapter address  . . . . . > 400003190001  400000000000-7FFFFFFFFFFF...
Exchange identifier  . . . . . > 05600000 1   05600000-056FFFFF, *SYSGEN

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

```
                    Create Line Desc (Token-Ring) (CRTLINTRN)

Type choices, press Enter.

SSAP list:  2
  Source service access point  . > 04            02-FE, *SYSGEN
  SSAP maximum frame . . . . . > *MAXFRAME     *MAXFRAME, 265-16393
  SSAP type  . . . . . > *CALC         *CALC, *NONSNA, *SNA

  Source service access point  . > 08            02-FE
  SSAP maximum frame . . . . . .  *MAXFRAME     *MAXFRAME, 265-16393
  SSAP type  . . . . . .  *CALC         *CALC, *NONSNA, *SNA
              + for more values
Text 'description' . . . . . > 'Token-ring line description'

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

Figure 5-2. Prompt Displays for TOKENRING1 Token-Ring Line Description

Considerations for specifying the CRTLINTRN command:

1 The exchange identifier (EXCHID) parameter is the block number and node identifier of the local AS/400 system.

2 The source service access point (SSAP) specifies the logical channel addresses used to route incoming data from the token ring to the correct user. The hex 08 SSAP is used in a controller description, so it must be included in the TOKENRING1 line description.

Example of AS/400-to-AS/400 Configuration

The APPC controller description, created using the following prompt display, describes another AS/400 system at adapter address 400003200001. The TOKENRING1 line description created in "Creating the Token-Ring Network Line Description" on page 5-2 is used for the SWTLINLST parameter. The SSAP of hex 08 is one of the SSAPs included in the SSAP list in the line description, TOKENRING1.

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

Type choices, press Enter.

Controller description . . . . . > TRLANS3X       Name
Link type  . . . . . . . . . . . > *LAN           *FAX, *FR, *IDLC, *LAN...
Online at IPL  . . . . . . . . .   *YES           *YES, *NO
APPN-capable . . . . . . . . . .   *YES           *YES, *NO
Switched line list . . . . . . . > TOKENRING1     Name
            + for more values
Maximum frame size . . . . . .     *LINKTYPE      265-16393, 256,
 265, 512...
Remote network identifier  . . .   *NETATR        Name, *NETATR, *NONE, *ANY
Remote control point . . . . . . > LANAPPN2 1     Name, *ANY
Exchange identifier  . . . . . .                  00000000-FFFFFFFF
Initial connection . . . . . . .   *DIAL          *DIAL, *ANS
Dial initiation  . . . . . . . .   *LINKTYPE      *LINKTYPE, *IMMED, *DELAY
LAN remote adapter address . . . > 400003200001 2 000000000001-FFFFFFFFFFFF
APPN CP session support  . . . .   *YES           *YES, *NO
APPN node type . . . . . . . . .   *ENDNODE       *ENDNODE, *LENNODE...
APPN transmission group number     1              1-20, *CALC
                                                                      More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 5-3 (Part 1 of 3). Prompt Displays for TRLANS3X Controller Description

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

Type choices, press Enter.

APPN minimum switched status . .   *VRYONPND      *VRYONPND, *VRYON
Autodelete device  . . . . . . .   1440           1-10000, *NO
User-defined 1 . . . . . . . . .   *LIND          0-255, *LIND
User-defined 2 . . . . . . . . .   *LIND          0-255, *LIND
User-defined 3 . . . . . . . . .   *LIND          0-255, *LIND
Model controller description . .   *NO            *NO, *YES
Text 'description' . . . . . . . > 'AS/400 at 400003200001'
```

Figure 5-3 (Part 2 of 3). Prompt Displays for TRLANS3X Controller Description

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

Type choices, press Enter.

LAN DSAP . . . . . .  04 3          04, 08, 0C, 10, 14, 18, 1C...
LAN SSAP . . . . . > 08 4           04, 08, 0C, 10, 14, 18, 1C...
```

Figure 5-3 (Part 3 of 3). Prompt Displays for TRLANS3X Controller Description

Considerations for specifying the CRTCTLAPPC command:

1 The remote control point name should match the local control point name of the remote AS/400 system. The local control point name can be determined by using the DSPNETA command.

2 The adapter address (ADPTADR parameter) of the CRTCTLAPPC command must match the ADPTADR parameter of the TOKENRING2 line description previously configured for the other system.

3 The destination service access point (DSAP parameter) of the CRTCTLAPPC command must match the source service access point (SSAP parameter) of the APPC controller description previously configured for the other system.

4 The SSAP parameter of the CRTCTLAPPC command must match the DSAP parameter of the APPC controller description previously configured for the other system.

The following command shows the device description created for communications with the SYS320 AS/400 system. The remote network identifier (RMTNETID parameter) should match the local network identifier of the remote AS/400 system. The local network identifier can be determined by using the DSPNETA command.

```
CRTDEVAPPC DEVD(TRLANS3XD) RMTLOCNAME(SYS320) LCLLOCNAME(SYS319) +
           RMTNETID(LANAPPN1) CTL(TRLANS3X) MODE(BLANK) +
           TEXT('APPC device for SYS320')
```

The following commands can be used to configure another AS/400 system communicate with this AS/400 system.

```
CRTLINTRN LIND(TOKENRING2) RSRCNAME(LIN011) LINESPEED(16M) +
          MAXFRAME(16393) ADPTADR(400003200001) EXCHID(05600000) +
          SSAP((04 *MAXFRAME *CALC) (08 *MAXFRAME *CALC)) +
          TEXT('Line description for 400003200001')
```

The adapter address (ADPTADR parameter) specified for the CRTLINTRN command must match the ADPTADR parameter of the APPC controller description previously configured for the other system.

The following command shows the creation of the APPC controller description.

```
CRTCTLAPPC CTLD(TRLANS3X2) LINKTYPE(*LAN) SWTLINLST(TOKENRING2) +
           RMTCPNAME(LANAPPN) 1 ADPTADR(400003190001) 2 +
           DSAP(08) 3 SSAP(04) 4 TEXT('AS/400 at 400003200001')
```

Considerations for specifying the CRTCTLAPPC command:

1 The remote control point name should match the local control point name of the remote AS/400 system. The local control point name can be determined by using the DSPNETA command.

2 The adapter address (ADPTADR parameter) of the CRTCTLAPPC command must match the ADPTADR parameter of the TOKENRING1 line description previously configured for the other system.

3 The destination service access point (DSAP parameter) of the CRTCTLAPPC command must match the source service access point (SSAP parameter) of the APPC controller description previously configured for the other system.

4 The SSAP parameter of the CRTCTLAPPC command must match the DSAP parameter of the APPC controller description previously configured for the other system.

The following command shows the device description created for communications with the SYS319 AS/400 system. The remote network identifier should match the local network identifier of the remote AS/400 system. The local network identifier can be determined by using the DSPNETA command.

```
CRTDEVAPPC DEVD(TRLANS3XD2) RMTLOCNAME(SYS319) LCLLOCNAME(SYS320) +
           RMTNETID(LANAPPN) CTL(TRLANS3X2) MODE(BLANK) +
           TEXT('APPC device for SYS319')
```

Example of a Token-Ring Network-to-Personal Computer Configuration

The APPC controller description created by the Create Controller Description (APPC) (CRTCTLAPPC) command describes a personal computer that uses PC Support/400. Notice its adapter address (a preset address assigned by the adapter manufacturer) and the fact that it is an APPN controller, because APPN(*YES) is the default.

Notice that no device is created along with the controller. The system creates a device description for your use the first time a connection is made to the personal computer. For more information on automatically creating controller descriptions, see the discussion of the AUTOCRTCTL line description parameter in the *OS/400* Communications Configuration Reference*. It is recommended that PC Support/400 automatically create a controller and device description for you.

```
CRTCTLAPPC CTLD(TRLANPC) LINKTYPE(*LAN) SWTLINLST(TOKENRING1) +
           RMTCPNAME(PC01) ADPTADR(10005A00121A) CPSSN(*NO) 1 +
           SWTDSC(*NO) 2 TEXT('Controller for PC on TOKENRING1')
```

Considerations for specifying the CRTCTLAPPC command:

1 By specifying the APPN CP session support (CPSSN parameter) as *NO, the automatic disconnect feature can be used.

2 The switched disconnect (SWTDSC) parameter is ignored unless CPSSN(*NO) is specified. These values indicate that the automatic disconnect feature is being used.

For more information on configuring the PC Support/400, refer to the *PC Support/400 DOS Installation and Administration Guide* and the *PC Support/400 OS/2 Installation and Administration Guide*.

When installing PC Support/400 on a personal computer, the location name for the personal computer must be set to the value specified as the remote control point name (RMTCPNAME) for the APPC controller description for this personal computer. This value must be unique for each personal computer in the token-ring network.

The system name is the local control point name (LCLCPNAME) specified in the Change Network Attributes (CHGNETA) command.

The system token-ring address must be set to the ADPTADR parameter of the TOKENRING1 line description.

The first part of the RTLN entry of the PC Support/400 configuration file, CONFIG.PCS, must match the RMTNETID parameter value on the AS/400 CRTCTLAPPC command. It is recommended that the value match what is specified as the current local network identifier in the network attributes. APPN is the default value. The *PC Support/400 DOS Installation and Administration Guide* and *PC Support/400 OS/2 Installation and Administration Guide* contain information for tailoring the configuration record of your personal computer to match the local network identifier on your system.

Note: To change the value for the RTLN entry in the CONFIG.PCS file, you must use an editor.

It is recommended that you begin the name of the APPC controllers, which describe the personal computers you attach to the ring, with the letters PC. This allows you to display the status of the personal computers using the Work with Configuration Status (WRKCFGSTS) command. See *Communications Management Guide* for more information on the WRKCFGSTS command.

Configuring Different Service Access Points

The following APPC controller and device descriptions allow you to connect from the AS/400 system back to the same AS/400 system. You may wish to do this to test an application within your system before testing it over the network to a different system. This example also shows how different service access points are configured in the controller descriptions. Notice that the SSAP for TRLANCTL1 and the DSAP for TRLANCTL2 correspond, as do the DSAP for TRLANCTL1 and the SSAP for TRLANCTL2. This example has one controller description as a *DIAL and the other as *ANS.

Notice that because both controllers are communicating through the same adapter, they both list the adapter address that was listed when creating TOKENRING1. Data actually goes out and around the ring for token-ring. However, when Ethernet is used, there is an internal wrap in the input/output processor. This is only the case in a wrapped situation.

You can configure the controller and device descriptions using a CL program or CL commands as demonstrated here, or you can configure these objects through configuration displays as shown previously in this chapter.

```
CRTCTLAPPC CTLD(TRLANCTL1) LINKTYPE(*LAN) APPN(*NO)
           SWTLINLST(TOKENRING1) ADPTADR(400003190001)
           DSAP(04) SSAP(08)
           TEXT('AS/400 at address 400003190001, DSAP 04')

CRTDEVAPPC DEVD(TRLANDEV1) RMTLOCNAME(SOURCE)
           LCLLOCNAME(TARGET) CTL(TRLANCTL1)
           MODE(BLANK) APPN(*NO)


CRTCTLAPPC CTLD(TRLANCTL2) LINKTYPE(*LAN) APPN(*NO)
           INLCNN(*ANS) SWTLINLST(TOKENRING1)
           ADPTADR(400003190001) DSAP(08) SSAP(04)
           TEXT('AS/400 at address 400003190001, DSAP 08')

CRTDEVAPPC DEVD(TRLANDEV2) RMTLOCNAME(TARGET)
           LCLLOCNAME(SOURCE) CTL(TRLANCTL2)
           MODE(BLANK) APPN(*NO)
```

Example of Token-Ring Network to System/36 Using APPC Configuration

The following APPC controller description describes a system that uses adapter address 400000004002. The TOKENRING1 line description created in "Creating the Token-Ring Network Line Description" on page 5-2 is used for the SWTLINLST parameter. The SSAP and DSAP parameters are not included because the defaults of DSAP(04) and SSAP(04) are used. Refer to the *APPN Guide* for configuration examples using APPN.

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

Type choices, press Enter.

Controller description . . . . . > TRLANS36      Name
Link type  . . . . . . . . . . . > *LAN          *FAX, *FR, *IDLC, *LAN...
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
APPN-capable . . . . . . . . . . > *NO           *YES, *NO
Controller type  . . . . . . . .   *BLANK        *BLANK, *FBSS, 3174, 3274...
Switched line list . . . . . . . > TOKENRING1    Name
              + for more values
Maximum frame size . . . . . . .   *LINKTYPE     265-16393, 256, 265, 512...
Remote network identifier  . . . > *NONE         Name, *NETATR, *NONE, *ANY
Remote control point . . . . . .                 Name, *ANY
Exchange identifier  . . . . . . > 03E00000      00000000-FFFFFFFF
Initial connection . . . . . . .   *DIAL         *DIAL, *ANS
Dial initiation  . . . . . . . .   *LINKTYPE     *LINKTYPE, *IMMED, *DELAY
LAN remote adapter address . . .   400000004002  0000000000001-FFFFFFFFFFFF
Text 'description' . . . . . . . > 'Token-ring controller for System/36'

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

Figure 5-4. Prompt Display for TRLANS36 Controller Description

The following device description can be used to configure the APPC device description.

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

Type choices, press Enter.

Device description . . . . . > TRLANS36D      Name
Remote location  . . . . . > SYSTEM36       Name
Online at IPL  . . . . . .   *YES           *YES, *NO
Local location . . . . . > AS400          Name, *NETATR
Remote network identifier  . . > *NONE          Name, *NETATR, *NONE
Attached controller  . . . . . > TRLANS36       Name
Mode . . . . . > BLANK          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   F12=Cancel   F13=How to use this display
F24=More keys
```

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

Type choices, press Enter.

Text 'description' . . . . . > 'APPC device for System/36'
```

Figure 5-5. Prompt Displays for TRLANS36D Device Description

System/36 Configuration CNFIGICF Displays

A System/36 user must fill in the following displays to configure an APPC subsystem member and token-ring line member to communicate with the AS/400 system previously configured. To get to the first display, use the CNFIGICF command.

```
 1.0           SSP-ICF CONFIGURATION MEMBER DEFINITION                    W2

1. Configuration member name  . . . . . . . . . . . . . . . . . .  TRNLINA

2. Library name . . . . . . . . . . . . . . . . . . . . . . . . .  CNFIGLIB

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  1
```

Figure 5-6. Prompt Display for SSP-ICF Configuration Member Definition

On display 2.0, specify the type of configuration member you want to define.

```
2.0              SSP-ICF CONFIGURATION MEMBER TYPE          TRNLINA  W2

Select one of the following options:
      1. INTRA
      2. BSC
      3. SNA
      4. Async
      5. PC Support/36

   Option: 3
```

Figure 5-7. Prompt Display for Configuration Member Type

Select one of the following options:
Select option 3 (SNA) to process an SNA member.

On display 4.0, specify the type of member you want to define.

```
4.0                SNA CONFIGURATION MEMBER TYPE              TRNLINA    W2

1. SNA member type . . . . . . . . . . . . . . . . . . . . . 1-4    4
      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
```

Figure 5-8. Prompt Display for Configuration Member Type

1. SNA member type
Specify option 4 (SNA/IBM Token-Ring Network line member).

2. Will APPC or APPN be used?
Specify a Y (Yes) to indicate that APPC or APPN is used on this line.

The prompts for display 12.0 are described below.

```
12.0             SNA LINE MEMBER ATTRIBUTES                 TRNLINA    W2




 6. Local system's station XID in hexadecimal. . . . . . . . . . 00000

 7. Source service access point (SSAP) value . . . . . . . . . . 04


Cmd5-Restart CNFIGICF            Cmd7-End
Cmd19-Cancel                                    COPR IBM Corp. 1986
```

Figure 5-9. Prompt Display for SNA Line Member Attributes

Note: Item 7 on display 12.0, SNA Line Member Attributes, describes the System/36 SSAP. This must be equal to the DSAP parameter on the APPC controller description on the AS/400 system.

On display 12.5, select the remote systems that this subsystem communicates with. If the protocol is primary or the line type is switched, up to 32 remote systems can be defined.

If no remote systems have been defined, only option 1 (Create) is shown.

```
 12.5                      REMOTE SYSTEM SELECTION              TRNLINA  W2

 1. Select from the following options:
      1-Create     3-Create From Existing            5-Review
      2-Edit       4-Remove
    Option . . . . . . . . . . . . . . . . . . . . . . . . . .
 2. Remote system name . . . . . . . . . . . . . . . . . . . .
 3. Existing remote system name  . . . . . . . . . . . . . . .

--------------------------------------------------------------------------------
 OPTION  REMOTE SYSTEM    OPTION  REMOTE SYSTEM     OPTION  REMOTE SYSTEM
           AS400
```

Figure 5-10. Prompt Display for Remote System Selection

1. Select from the following options:
Specify option 1 (Create).

2. Remote system name
Specify the name (up to 8 characters) by which the remote system is known in the line member. This value should match the AS/400 network attributes control point name, which you can display using the DSPNETA command.

On display 13.0, define the characteristics for the remote system selected on display 12.5.

```
 13.0                REMOTE SYSTEM ATTRIBUTES                    TRNLINA    W2
           Remote system AS/400
 1. Remote system type . . . . . . . . . . . . . . . . . . . .  2
                       2-Peer


 3. Remote system's block ID in hexadecimal. . . . . . . . . .  056

 4. Remote system's station XID in hexadecimal . . . . . . . .  00000
```

Figure 5-11. Prompt Display for Remote System Attributes

1. Remote system type
Specify option 2 (Peer) for the remote system type.

3. Remote system's block ID in hexadecimal
Specify the 3-hexadecimal character block identifier of the remote system. This value can be from 000 to FFF and must be the same as the value assigned to the remote system by SNA. This is the XID that System/36 expects from the

AS/400 system. This must equal the EXCHID parameter on the TOKENRING1 line description. Set this value to 056.

4. Remote system's station XID in hexadecimal
Specify the exchange identifier (XID) used to identify the remote system. This identifier is 5 hexadecimal characters from 00000 through FFFFF. This is the XID that System/36 expects from the AS/400 system. This must equal the EXCHID parameter on the TOKENRING1 line description. Set this value to 00000.

Display 13.5 is shown if you selected option 4 (IBM Token-Ring Network) for the SNA member type on display 4.0.

```
13.5              REMOTE SYSTEM ATTRIBUTES                    TRNLINA    W2
          Remote system AS/400

1. Remote adapter address . . . . . . . . . . . . . . . . . . 400003190001

2. Destination service access point (DSAP) value  . . . . . . . 04
```

Figure 5-12. Prompt Display for Remote System Attributes

Remote adapter address
Specify the hexadecimal adapter address for this remote system for an SNA/IBM Token-Ring Network line member. Valid addresses are hex 0000000000001 through hex 7FFFFFFFFFFF. This must equal the ADPTADR parameter on the TOKENRING1 line description on the AS/400 system. The remote adapter address is 400003190001.

Destination service access point DSAP value
Specify the hexadecimal logical channel address used for routing at the remote system for an SNA/IBM Token-Ring Network. This value must be nonzero, divisible by 4, and must match the remote system's source service access point (SSAP). Valid values are hex 04 through hex EC. This must equal the SSAP parameter on the APPC controller description on the AS/400 system. Set this value to 04.

```
1.0           SSP-ICF CONFIGURATION MEMBER DEFINITION                  W2


1. Configuration member name  . . . . . . . . . . . . . . . . . TRNSBSA

2. Library name . . . . . . . . . . . . . . . . . . . . . . . . CNFIGLIB

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  1
```

Figure 5-13. Prompt Display for SSP-ICF Configuration Member Definition

On display 2.0, specify the type of configuration member you want to define.

```
2.0              SSP-ICF CONFIGURATION MEMBER TYPE          TRNSBSA   W2

Select one of the following options:
      1. INTRA
      2. BSC
      3. SNA
      4. Async
      5. PC Support/36

   Option: 3
```

Figure 5-14. Prompt Display for Configuration Member Type

Select one of the following options:
Select option 3 (SNA) to process an SNA member.

On display 4.0, specify the type of member you want to define.

```
4.0                SNA CONFIGURATION MEMBER TYPE              TRNSBSA   W2

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
```

Figure 5-15. Prompt Display for SNA Configuration Member Type

1. SNA member type
Specify option 1 (SNA subsystem member).

On display 21.0, select the type of subsystem for which you want to create a subsystem member. Also, enter the name of the line member (previously defined) that you will use with this subsystem member.

```
21.0             SNA SUBSYSTEM MEMBER SELECTION              TRNSBSA   W2

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  6

2. Line member name . . . . . . . . . . . . . . . . . . . . .  TRNLINA
```

Figure 5-16. Prompt Display for SNA Subsystem Member Selection

1. Select subsystem type from the following options:
Specify option 6 (APPC) to indicate that the subsystem used is APPC.

2. Line member name
Specify the name of the *line member* with which this subsystem member is associated. The line member name is specified on display 1.0 during line member configuration (TRNLINA).

The prompt on display 22.0 is described as follows:

```
22.0              SUBSYSTEM MEMBER DEFINITION                  TRNSBSA    W2

1. Local location name . . . . . . . . . . . . . . . . . . . . SYSTEM36
```

Figure 5-17. Prompt Display for SNA Subsystem Member Definition

1. Local location name
Specify the local location name as SYSTEM36.

On display 29.0, select the remote locations that this subsystem communicates with.

```
 29.0                      REMOTE LOCATION SELECTION              TRNSBSA  W2

 1. Select from the following options:
      1-Create     3-Create From Existing              5-Review
      2-Edit       4-Remove
    Option . . . . . . . . . . . . . . . . . . . . . . . . . . . . 1
 2. Remote location name . . . . . . . . . . . . . . . . . . . . . AS400
 3. Remote system name . . . . . . . . . . . . . . . . . . . . . . AS400
 3. Existing location name . . . . . . . . . . . . . . . . . . .
-------------------------------------------------------------------------------
 OPTION  REMOTE SYSTEM    OPTION  REMOTE SYSTEM     OPTION  REMOTE SYSTEM
```

Figure 5-18. Prompt Display for Remote Location Selection

On display 30.0, enter whether or not you want to activate communications with the remote location at the time this subsystem is enabled.

```
30.0                  REMOTE LOCATION DEFINITION                 TRNSBSA  W2

      Remote system AS400                 Remote location AS400

1. Activate location at ENABLE? . . . . . . . . . . . . . . Y,N  Y

2. Send alerts to this location?  . . . . . . . . . . . . . Y,N  N
```

Figure 5-19. Prompt Display for Remote Location Definition

1. Activate location at ENABLE?
Specify whether or not you want the subsystem, as soon as it is enabled, to allow communications with this remote location. Specify a Y (Yes), which is the default, to indicate that communications can start without having to specify the name of the remote location on an ENABLE procedure command.

2. Send alerts to this location?
Specify whether or not you want alerts sent. Specify an N (No) if you do not want alerts sent to this location.

Note: A separate location needs to be defined to send alerts to the remote system named AS400.

Display 42.0 lists the session groups that are defined for this remote location. You can create a new session group, edit an existing session group, remove a session group, create a new session group from an existing session group, or review a session group. In addition, you can specify the name of the session group that is to be used as the default.

System/36 has a default session group of *BLANK, and the AS/400 system has a default mode of BLANK.

```
42.0                      SESSION GROUP SELECTION              TRNSBSA    W2

      Remote system AS400                 Remote location AS400

1. Select from the following options:
                                                    5-Review

   Option . . . . . .
2. Session group name . . . . . .

4. Default session group name . . . . . .  *BLANK
--------------------------------------------------------------------------------
OPTION   SESSION GROUP
            *BLANK
```

Figure 5-20. Prompt Display for Session Group Selection

1. Select from the following options:
Option 5 (Review) displays an existing session group. The configuration member cannot be changed.

2. Session group name
Each session group name must be unique within the remote location.

4. Default session group name
Specify that the default session group name is used by the APPC subsystem whenever a local application program does not specifically provide a session group name at the start of a session. The default session group name must be a session group name already configured for this remote location.

Display 43.0 is the first of a set of displays that you use to define the session groups. The remote system name, remote location name, and session group name are shown for reference.

```
43.0          APPC and APPN SESSION GROUP DEFINITION            TRNSBSA     W2

      Remote system AS400                Remote location AS400

                        Session group *BLANK

1. Session group type . . . . . . . . . . . . . . . . . . . . . . . 1
     1-Interactive              2-Batch

2. Maximum session limit  . . . . . . . . . . . . . . . .1 - 64  08

3. Number of locally controlled sessions  . . . . . . . . .0 - 08  04

4. Number of pre-established sessions . . . . . . . . . . .0 - 04  01
```

Figure 5-21. Prompt Display for Session Group Definition

1. Session group type
Specify whether or not the sessions are used for batch or interactive communications. This is used to select defaults at the local system for display 44.0. Type a 1 (Interactive) if the record exchange is in both directions, meaning that the systems alternate sending and receiving.

2. Maximum session limit
Specify the maximum number of sessions that are allowed for this session group. The maximum number of sessions for all session groups in a single remote location is 64. The default is 8.

3. Number of locally controlled sessions
Specify the number of locally controlled sessions that are requested for this session group. The range of available sessions is shown and the default is one-half of the maximum session limit. This value is actually negotiated with the remote system when the data link is established. Therefore, the number specified here is not a guaranteed value.

4. Number of pre-established sessions
Specify the number of sessions established and kept active while communications with the remote location is active. The default is 1 if the line type is non-switched or switched without automatic disconnect. The default is 0 if the line type is switched with automatic disconnect.

Note: All values specified in this session group are the default values.

On display 44.0, define additional options that can affect performance for this session group. The remote system name, remote location name, and session group name are shown for reference.

```
44.0          APPC AND APPN SESSION GROUP ADDITIONAL OPTIONS        TRNSBSA W2

       Remote system AS400                  Remote location AS400

                         Session group *BLANK

1. Receive pacing value . . . . . .1-63  07

2. Maximum receive RU size  . . . . . .8-16384 04096

3. Acquire remotely controlled sessions?  . . . . . Y,N  N
```

Figure 5-22. Prompt Display for APPC and APPN Session Group Additional Options

1. Receive pacing value
Specify that 7 request units (RUs) may be sent from the remote location without an intervening pacing response. The default is 7 if the type of session group is interactive.

2. Maximum receive RU size
Specify that the maximum RU size (in bytes) that can be received by the APPC subsystem is 1024. The default is 1024 if the type of session group is interactive.

3. Acquire remotely controlled sessions?
If there are no locally controlled sessions available, this prompt determines whether or not the subsystem attempts to acquire a session controlled by the remote system.

Note: All values specified in this session group are the default values.

Example of Token-Ring Network-to-3725 Host Configuration

The following host controller description is used to configure the connection to a 3725 controller at adapter address 400000001580. The SSAP and DSAP parameters are not included because the defaults of DSAP(04) and SSAP(04) are used.

```
CRTCTLHOST CTLD(TRLANHOST) LINKTYPE(*LAN) +
           SWTLINLST(TOKENRING1) 1 RMTCPNAME(LANAPPN) 2 +
           LCLEXCHID(*LIND) 3 ADPTADR(4000000001580) +
           NODETYPE(*LENNODE) TEXT('3725 controller')
```

Considerations for specifying the CRTCTLHOST command:

1 The TOKENRING1 line description created in "Creating the Token-Ring Network Line Description" on page 5-2 is used for the switched line list (SWTLINLST parameter).

2 The remote control point name (RMTCPNAME parameter) should match the local control point on the remote system. On the AS/400 system, you can verify this name by using the Display Network Attributes (DSPNETA) command.

On the host system, the local control point name is the SSCPNAME that is specified in the VTAM* Start Option list.

3 The local exchange identifier (LCLEXCHID) parameter is used to identify the AS/400 system to the host system.

The following device description commands are used to configure an emulation display and printer, and a distributed host command facility (DHCF) device.

```
CRTDEVHOST DEVD(TRLANEML) LOCADR(01) RMTLOCNAME(HOST) +
           CTL(TRLANHOST) APPTYPE(*EML) +
           TEXT('3270 emulation over TOKENRING1')

CRTDEVHOST DEVD(TRLANPRT) LOCADR(0C) RMTLOCNAME(HOST) +
           CTL(TRLANHOST) APPTYPE(*EML) EMLDEV(3287) +
           TEXT('3270 printer emulation over TOKENRING1')

CRTDEVDSP DEVD(TRLANDHCF) DEVCLS(*RMT) TYPE(3277) MODEL(*DHCF) +
          LOCADR(02) CTL(TRLANHOST) TEXT('DHCF over TOKENRING1')
```

The Physical Configuration for the Host System

This is the network control program generation (NCP GEN) for the GROUP and LINE macroinstructions created by the system administrator to provide for connectivity between the AS/400 system and the 3725 Communication Controller. This NCP GEN is valid on Network Control Program (NCP) Version 4.2 and Virtual Telecommunications Access Method (VTAM) Version 3.1.1. Different NCP or VTAM levels may require different parameters.

```
R1G006P  GROUP ECLTYPE=PHYSICAL
R1080P   LINE  ADDRESS=(080,FULL),LOCADD=(400000001580),PORTADD=01,ISTA*
               TUS=INACTIVE
R1080PA  PU    ADDR=01,ISTATUS=INACTIVE
R1080PA1 LU    LOCADDR=0,
               LUDR=NO
R1G006L  GROUP ECLTYPE=LOGICAL,
               PHYPORT=80
R108000  LINE
R108000A PU    MAXLU=32
R108001  LINE
R108001A PU    MAXLU=32
R108002  LINE
R108002A PU    MAXLU=32
R108003  LINE
R108003A PU    MAXLU=32
R108004  LINE
R108004A PU    MAXLU=32
R108005  LINE
R108005A PU    MAXLU=32
R108006  LINE
R108006A PU    MAXLU=32
R108007  LINE
R108007A PU    MAXLU=32
```

Note: The location address (LOCADD) parameter on the LINE statement defines the adapter address of the 3725 Communication Controller, in this case 400000001580. This value must match the value specified for the adapter address (ADPTADR) parameter on the Create Controller (SNA Host) (CRTCTLHOST) command on the AS/400 configuration.

The Logical Configuration for the Host System

This is the NCP GEN for the switched major node created by the system administrator to provide for connectivity between the AS/400 system and 3725 Communication Controller. This GEN is valid on Network Control Program (NCP) Version 4.2 and Virtual Telecommunications Access Method (VTAM) Version 3.1.1. Different NCP or VTAM levels may require different parameters.

```
SW3270C  VBUILD TYPE=SWNET,       REQUIRED PARAMETER                  X
                MAXNO=8,                                              *
                MAXGRP=5
S3270C   PU     ADDR=C1,          8 BIT STATION UNIQUE ADDRESS        X
                DISCNT=NO,        ACCEPT DISCONTACT FROM PU (DEFAULT) X
                IDBLK=056,        12 BIT BLOCK NUMBER FOR STATION     X
                IDNUM=00000,      20 BIT ID NUMBER FOR AS/400 SYSTEM  X
                MAXDATA=1994,
                MAXPATH=8,        MAX OF 8 STATIONS MAY BE CALLED     X
                NETID=AS400,      LOCAL NETWORK ID ON AS/400          X
                MAXOUT=7,         7 PIUS TO STATION BEFORE RESPONSE   X
                PACING=7,         NCP SENDS 7 TO LU AND MARKS FIRST   X
                PASSLIM=7,        7 CONTIGUOUS PIUS MAX AT ONE TIME   X
                PUTYPE=2,         TYPE OF STATION CALLING IN          X
                ISTATUS=ACTIVE,   ACTIVATE WITH MAJOR NODE            X
                MODETAB=LOGMOD38, I/S DEFINED TABLE                   *
                SSCPFM=USSSCS,    VTAM TO STRIP/ADD MEDIA CONTROL CHAR *
                VPACING=7         VTAM SENDS 7 TO NCP AND MARKS FIRST
S348L80    PATH GRPNM=R1G006L,DIALNO=0104400003190001,PID=1  319-R1080
SW327C01 LU     LOCADDR=1,        AS/400 LOCADDR VALUE X'01'          X
                ISTATUS=ACTIVE    ACTIVATE WITH MAJOR NODE
SW327C02 LU     LOCADDR=2,        AS/400 LOCADDR VALUE X'02'          X
                ISTATUS=ACTIVE    ACTIVATE WITH MAJOR NODE
SW327C12 LU     LOCADDR=12,       AS/400 LOCADDR VALUE X'0C'          X
                ISTATUS=ACTIVE    ACTIVATE WITH MAJOR NODE
```

Notes:

1. The XID block number (IDBLK) and the ID number (IDNUM) concatenated together supply the XID that the 3725 Communication Controller requires from the AS/400 system for the connection to be established. This is configured on the AS/400 system on the TOKENRING1 line description EXCHID parameter if *LIND is specified for the LCLEXCHID parameter on the host controller description. IDBLK and IDNUM must be set so their concatenation is equivalent to the EXCHID parameter on the TOKENRING1 line description.
2. If the 3725 Communication Controller is to start a connection to the AS/400 system, it must know the adapter address and SSAP of the AS/400 system. This is defined in the PATH statement under dial number (DIALNO). The form for DIALNO is:

   ```
   aabb4000cccccccc
   ```

Where:

aa Is the value from the PORTADD parameter specified in the NCP line definition for token-ring adapters.

bb Is the SAP address of the AS/400 system which is specified on the controller description (using the SSAP parameter).

4000cccccccc
Is the remote adapter address specified in the line description.

The 3725 Communication Controller uses this addressing information to resolve the route to the AS/400 system. In this example, the DSAP is set to 04, corresponding to the SSAP parameter for the CRTCTLHOST command on the AS/400 configuration. The remote adapter address is set to 400003190001, corresponding to the adapter address specified on the ADPTADR parameter of the TOKENRING1 line description on the AS/400 configuration.

Notes:

1. Because NCP SAP cannot be specified or changed, it is always 04. Therefore, on the AS/400 controller description, the DSAP is always 04.
2. For bb on the DIALNO operand, only values of two decimal digit numbers between 04-94 may be specified.

Example of Configuring Parallel Connections to the Host System

The following SNA host controller descriptions, SWTRNCTL1A and SWTRNA002, set up parallel connections between an AS/400 system and a host system. This example configures two link-to-link connections through a 3745 communications controller to a host system. Each link-to-link connection has a separate instance of logical link control and a separate band width. As a result, it is possible for one link to be varied on and active if the other link goes down. Parallel connections allow you to establish an additional 254 device description per controller description.

```
CRTCTLHOST CTLD(SWTRNCTL1A) LINKTYPE(*LAN) APPN(*NO) +
           SWTLINLST(TRNBGOUT) LCLEXCHID(056A001A) +
           ADPTADR(400000001592) DSAP(04) SSAP(08) +
           TEXT('Controller for XID 0056A001A')
```

The following panels establish the second controller description for the instance that runs in parallel to the controller description SWTRNCTL1A.

```
CRTCTLHOST CTLD(SWTRNA002A) LINKTYPE(*LAN) APPN(*NO) +
           SWTLINLST(TRNBGOUT) 1 LCLEXCHID(056A002A) 2 +
           ADPTADR(400000001592) DSAP(04) 3 SSAP(04) 4 +
           TEXT('Controller for XID 0056A002A')
```

Considerations for specifying the CRTCTLHOST for a parallel connection:

1 Both controller descriptions specify the same line description for switched line list (SWTLINLST) parameter.

2 Local exchange identifiers (LCLEXCHID) must be specified to establish a parallel connection to the host.

3 The DSAP (remote SAP) for the 3745 communication controller must be 04. (Note that the DSAPs are the same on SWTRNCTL1A and SWTRNA002A.)

4 The SSAP value 04 has to be on the line TRNBGOUT. (Note that the SSAPs are different on SWTRNCTL1A and SWTRNA002A.)

The following commands are used to create the device descriptions for controller descriptions SWTRNCTL1A and SWTRNA002A.

```
CRTDEVDSP DEVD(DSPA001A02) DEVCLS(*RMT) TYPE(3279) MODEL(0) +
          LOCADR(02) CTL(SWTRNCTL1A) APPTYPE(*NRF) +
          TEXT('NRF device for XID 056A001A, LOCADDR 02')

CRTDEVDSP DEVD(DSPA001A03) DEVCLS(*RMT) TYPE(3279) MODEL(0) +
          LOCADR(03) CTL(SWTRNCTL1A) APPTYPE(*NRF) +
          TEXT('NRF device for XID 056A001A, LOCADDR 03')

CRTDEVHOST DEVD(EMLA001A04) LOCADR(04) RMTLOCNAME(SWXIDA04) +
           CTL(SWTRNCTL1A) APPTYPE(*EML) +
           TEXT('Emulation display for XID 056A001A, LOCADDR 04')

CRTDEVPRT DEVD(PRTA001A05) DEVCLS(*RMT) TYPE(3287) MODEL(0) +
          LOCADR(05) CTL(SWTRNCTL1A) APPTYPE(*NRF) +
          LOGON('LOGON APPLID(NRF2A07) LOGMODE(SCSTRYR)') +
          TEXT('NRF printer for XID 056A001A, LOCADDR 05')

CRTDEVDSP DEVD(DSPA002A02) DEVCLS(*RMT) TYPE(3279) MODEL(0) +
          LOCADR(02) CTL(SWTRNA002A) APPTYPE(*NRF) +
          TEXT('NRF device for XID 056A002A, LOCADDR 02')

CRTDEVHOST DEVD(EMLA002A04) LOCADR(04) RMTLOCNAME(SWXIDB04) +
           CTL(SWTRNA002A) APPTYPE(*EML) +
           TEXT('Emulation display for XID 056A002A, LOCADDR 04')

CRTDEVPRT DEVD(PRTA002A05) DEVCLS(*RMT) TYPE(3287) MODEL(0) +
          LOCADR(05) CTL(SWTRNA002A) APPTYPE(*NRF) +
          LOGON('LOGON APPLID(NRF2A07) LOGMODE(SCSTRYR)') +
          TEXT('NRF printer for XID 056A002A, LOCADDR 05')
```

Configuring Physical and Logical Parallel Connections for the Host System

This is the NCP GEN created by the system administrator to provide for connectivity between the AS/400 system and 3745 Communication Controller. This GEN is valid on Network Control Program (NCP) Version 5.4 and Virtual Telecommunications Access Method (VTAM) Version 3.3. Different NCP or VTAM levels may require different parameters.

```
SWXID    VBUILD TYPE=SWNET,       THIS IS A SWITCHED MAJOR NODE        X
              MAXNO=64,           MAXIMUM DIALNO PARAMETERS            X
              MAXGRP=64           MAXIMUM NUMBER OF LINE GROUPS
*************************************************************************
*
*  DEFINE ONE PU FOR EACH XID AND CTLD DEFINED AT AS/400
*  XIDS ARE DEFINED INDIVIDUALLY AT THE AS/400, AND MUST MATCH BOTH
*  IDBLK AND IDNUM VALUES IN THE PU MACRO
*
*************************************************************************
SWXIDA   PU    ADDR=01,            NOT CHECKED IF TOKEN RING DEFINITION X
               DISCNT=NO,          ACCEPT DISCONTACT FROM AS/400        X
               IDBLK=056,  1       12 BIT BLOCK NUMBER FOR AS/400    X
               IDNUM=A001A,  2     20 BIT ID FOR THIS PU (AS/400 CTLD)  X
               MAXDATA=1994,       MAX FOR 4M TOKEN RING                X
               MAXPATH=1,          ONLY NEED ONE PATH STATEMENT         X
               MAXOUT=7,           7 PIUS TO DEVICE BEFORE RESPONSE     X
               NETID=APPN,         NETID OF AS/400 (IF DIFFERENT)       X
               PACING=0,           PACING CAN BE ANY ACCEPTABLE VALUE   X
               PASSLIM=7,          7 CONTIGUOUS PIUS MAX AT ONE TIME    X
               PUTYPE=2,           TYPE OF DEVICE CALLING IN            X
               ISTATUS=ACTIVE,     ACTIVATE WITH MAJOR NODE             X
               MODETAB=LOGMOD38,   ANY VALID LOGMODE TABLE              *
               SSCPFM=USSSCS,      VTAM TO STRIP/ADD MEDIA CONTROL CHAR *
               VPACING=0           VPACING CAN BE ANY ACCEPTABLE VALUE
*
*       ALL PUS USE THE SAME DIALNO
*  NOTE: MUST HAVE ENOUGH LOGICAL TOKEN RING LINES DEFINED TO ALLOW
```

```
*       ALL PUS TO BE DIALLED IN/OUT AT ONCE
*
PATHA    PATH  GRPNM=R3G092L,DIALNO=0508400071032004 3
*
*  SAME NUMBER OF LUS ON HOST AS DEVICES ON AS/400
*
SWXIDA01 LU    LOCADDR=1,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDA02 LU    LOCADDR=2,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDA03 LU    LOCADDR=3,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDA04 LU    LOCADDR=4,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDA05 LU    LOCADDR=5,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDA06 LU    LOCADDR=6,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE

*********************************************************************
*
*  DEFINE ONE PU FOR EACH XID AND CTLD DEFINED AT AS/400
*  XIDS ARE DEFINED INDIVIDUALLY AT THE AS/400, AND MUST MATCH BOTH
*  IDBLK AND IDNUM VALUES IN THE PU MACRO, AND MUST BE UNIQUE IN THE
*  NETWORK
*  ADDR VALUE MUST BE UNIQUE IN THE SWITCHED MAJOR NODE
*
*********************************************************************
SWXIDB   PU    ADDR=02,           NOT CHECKED IF TOKEN RING DEFINITION X
               DISCNT=NO,         ACCEPT DISCONTACT FROM AS/400        X
               IDBLK=056, 1       12 BIT BLOCK NUMBER FOR AS/400       X
               IDNUM=A002A, 2     20 BIT ID FOR THIS PU (AS/400 CTLD)  X
               MAXDATA=1994,      MAX FOR 4M TOKEN RING                X
               MAXPATH=1,         ONLY NEED ONE PATH STATEMENT         X
               MAXOUT=7,          7 PIUS TO DEVICE BEFORE RESPONSE     X
               NETID=APPN,        NETID OF AS/400 (IF DIFFERENT)       X
               PACING=0,          PACING CAN BE ANY ACCEPTABLE VALUE   X
               PASSLIM=7,         7 CONTIGUOUS PIUS MAX AT ONE TIME    X
               PUTYPE=2,          TYPE OF DEVICE CALLING IN            X
               ISTATUS=ACTIVE,    ACTIVATE WITH MAJOR NODE             X
               MODETAB=LOGMOD38,  ANY VALID LOGMODE TABLE              *
               SSCPFM=USSSCS,     VTAM TO STRIP/ADD MEDIA CONTROL CHAR *
               VPACING=0          VPACING CAN BE ANY ACCEPTABLE VALUE
*
*  NOTE: SHOULD HAVE ENOUGH LOGICAL TOKEN RING LINES DEFINED TO ALLOW
*        ALL PUS TO BE DIALLED IN/OUT AT ONCE
*        LABEL ON PATH MACRO MUST BE UNIQUE, IF SPECIFIED
*
PATHB  PATH  GRPNM=R3G092L,DIALNO=0504400071032004 3
*
*  SAME NUMBER OF LUS ON HOST AS DEVICES ON AS/400
*
SWXIDB01 LU    LOCADDR=1,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDB02 LU    LOCADDR=2,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDB03 LU    LOCADDR=3,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDB04 LU    LOCADDR=4,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDB05 LU    LOCADDR=5,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
SWXIDB06 LU    LOCADDR=6,         FIRST AVAILABLE LOCAL ADDRESS        X
               ISTATUS=ACTIVE     ACTIVATE WITH MAJOR NODE
*********************************************************************
*
*  REPEAT AS THE PREVIOUS DEFINITIONS AS NEEDED
*
*********************************************************************
```

Considerations for NCP GENs for parallel connections to a host system:

1 **2** The concatenation of IDBLK and IDNUM must match the value specified for the LCLEXCHID parameter in the AS/400 controller description.

3 In the DIALNO operand, the fist two digits specify the PORTADDR on the NCP line definition, the second two digits specify the SSAP on the controller description on the AS/400 system, and the remaining digits specify the adapter address on the AS/400 line description.

Example of Token-Ring Network-to-3174 Model 1L Gateway Configuration

The following host controller description describes a 3174 Model 1L Subsystem Control Unit. The 3174 Model 1L is used to attach a 370-type host system to the token ring. In this example, the 3174 Control Unit is used as a **gateway** to bridge two systems with different network architectures. This configuration does not require a 3725 Communications Controller.

The 3174 1L is configured to use an adapter address of 400031740001. The TOKENRING1 line description created in "Creating the Token-Ring Network Line Description" on page 5-2 is used for the SWTLINLST parameter. The SSAP and DSAP parameters are not included because the defaults of DSAP(04) and SSAP(04) are used.

```
CRTCTLHOST CTLD(TRLANHOST2) LINKTYPE(*LAN) APPN(*NO) +
           SWTLINLST(TOKENRING1) MAXFRAME(16393) RMTNETID(*NONE) +
           ADPTADR(400031740001) TEXT('3174 Gateway')
```

Although the following device description example is not specific to token-ring networks, you can use it to configure an emulation display.

```
CRTDEVHOST DEVD(TRLANEML2) LOCADR(01) RMTLOCNAME(HOST2) +
           CTL(TRLANHOST2) APPTYPE(*EML) +
           TEXT('3270 emulation for HOST2')
```

Example of the 3174 Model 1L Subsystem Control Unit Configuration

These displays must be filled in during customization of the 3174 Model 1L. The *3174 Subsystem Control Unit Customizing Guide* describes these fields in the chapter that discusses planning to configure.

Note: The *3174 Subsystem Control Unit Customizing Guide* uses the term panel rather than display. When looking up information in that guide, use the term panel.

Model/Attach Display

This display contains information about the attachment of the 3174 gateway to the host processor.

```
                        _______ Model/Attach _______

   99 - Identification

   100 - 01L

   101 - 5
```

Figure 5-23. Prompt Display for 3174 Gateway Attachment to Host Processor

Item 100 is the 3174 model designation, 01L.

Item 101 is the type of host attachment used. In this example, type 5 (Local SNA) is used because the 3174 gateway is locally attached to the host processor.

Local SNA Display

This display contains information about the attachment of the 3174 gateway to the host processor. Because item 101 on the Model/Attach display was set to local SNA, this display appears.

```
                    _______ Local SNA _______

104 - B0            105 - B1          108 - A013700      116 - 0

121 - 01            125 - 00000000      127 - 0 0

132 - 0 0 0 0       136 - 0 0 0 1       137 - 0 0 0 0    138 - 0

141 - A             165 - 0             166 - B

173 - 11111111      175 - 000000

213 - 1             215 - 00000         220 - 3

222 - 0             226 - 10            224 - 2          225 - 4
```

Figure 5-24. Prompt Display for Local SNA

Each 3174 gateway must be configured for every AS/400 system, personal computer, or 3174 Control Unit that it will communicate with. Each is assigned a particular address on a following display. Items 104 and 105 define the first and last addresses assigned.

Token-Ring Gateway Display

This display contains information about the 3174 gateway's attachment to the token-ring network.

```
                  _______ Token-Ring Gateway _______

900 - 400031740001     905 - 1             908 - IBMLAN
```

Figure 5-25. Prompt Display for Token-Ring Gateway

Item 900 is the local adapter address of the 3174 gateway being configured. This must equal the ADPTADR parameter of the host controller description on the AS/400 system.

Ring Address Assignment Display

This display contains information about the stations communicating with the 3174 gateway. Each system, controller, or personal computer that will communicate with the 3174 gateway must be configured here.

```
          _______ 940:  Ring Address Assignment _______

S@ Ring @       SAP@  T       S@ Ring @       SAP@  T
B0 400031740001  04
B1 400003190001  04   1       B2 N/A
B3 N/A                        B4 N/A
B5 N/A                        B6 N/A
B7 N/A                        B8 N/A
B9 N/A                        BA N/A
BB N/A                        BC N/A
BD N/A                        BE N/A
BF N/A                        C0 N/A
C1 N/A                        C2 N/A
C3 N/A                        C4 N/A
C5 N/A                        C6 N/A
C7 N/A                        C8 N/A
C9 N/A                        CA N/A
CB N/A                        CC N/A
```

Figure 5-26. Prompt Display for Ring Address Assignment

The ring address of the first controller is that of the 3174 gateway itself.

The second controller is the AS/400 system. The ring address must equal the ADPTADR parameter of the token-ring line description for the AS/400 system. The SAP@ must be configured in the SSAP list of the token-ring line description and must equal the SSAP parameter of the host controller description on the AS/400 system. The type is set to 1 for the 3174 Control Unit because the AS/400 system appears to the host system as a remote 3174.

The S@ (station address) value must match the CUADDR parameter of the PU macroinstruction of the NCP/VTAM configuration.

Ring Transmission Definition Display

This display contains details about the transmission characteristics for each station the 3174 will communicate with. The maximum frame size and maximum number of outstanding frames are defined on this display.

```
          _______ 941:  Ring Transmission Definition _______

S@ Ring @       SAP@  F  W    S@ Ring @       SAP@  F  W
B0 400031740001  04   2  4
B1 400003190001  04   2  4    B2 N/A
B3 N/A                        B4 N/A
B5 N/A                        B6 N/A
B7 N/A                        B8 N/A
B9 N/A                        BA N/A
BB N/A                        BC N/A
BD N/A                        BE N/A
BF N/A                        C0 N/A
C1 N/A                        C2 N/A
C3 N/A                        C4 N/A
C5 N/A                        C6 N/A
C7 N/A                        C8 N/A
C9 N/A                        CA N/A
CB N/A                        CC N/A
```

Figure 5-27. Prompt Display for Ring Transmission Definition

The values in column F are frame sizes. The value 2 corresponds to an information frame size of 1033. The MAXFRAME parameter on the host controller description on the AS/400 system should equal this.

The S@ (station address) value must match the CUADDR parameter of the PU macroinstruction of the NCP/VTAM configuration.

Example of the NCP/VTAM Configuration

This is the NCP GEN for the local controller created by the system administrator to provide for connectivity between the AS/400 system and the 3174 gateway. This GEN is valid on Network Control Program (NCP) Version 4.2 and Virtual Telecommunications Access Method (VTAM) Version 3.1.1. Different NCP or VTAM levels may require different parameters.

```
R13B1    VBUILD TYPE=LOCAL
R13B0A   PU     CUADDR=3B1,                                    X
                DISCNT=(NO,F),                                 X
                ISTATUS=ACTIVE,                                X
                PUTYPE=2,                                      X
                SPAN=(SYSPGMR),                                X
                SSCPFM=USSSCS,                                 X
                VPACING=7
R13B102  LU     DLOGMOD=P6ES2,                                 X
                ENCR=NONE,                                     X
                ISTATUS=ACTIVE,                                X
                LOCADDR=2,                                     X
                LOGAPPL=SAMON,                                 X
                MODETAB=LOGMOD38,                              X
                SPAN=(SYSPGMR),                                X
                SSCPFM=USSSCS,                                 X
                VPACING=7
```

The last two characters in the CUADDR parameter must match the Control Unit Address on the Ring Address Assignment and the Ring Transmission Definition displays of the 3174 1L configuration.

Example of Token-Ring Network-to-3174 Subsystem Control Unit Configuration

The remote work station controller description, created by the following displays, describes a 3174 (Model 3R or 53R) Subsystem Control Unit capable of attaching to a token-ring network. It uses adapter address 400031740004. The TOKENRING1 line description created in "Creating the Token-Ring Network Line Description" on page 5-2 is used for the SWTLINLST parameter.

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

Type choices, press Enter.

Controller description . . . . . > TRLAN3174      Name
Controller type  . . . . . . . . > 3174           3174, 3274, 5251, 5294...
Controller model . . . . . . . . > 0              0, 1, 0001, 2, 0002, 12, 0012
Link type  . . . . . . . . . . . > *LAN           *IDLC, *LAN, *NONE, *SDLC...
Online at IPL  . . . . . . . . .   *YES           *YES, *NO
Switched line list . . . . . . . > TOKENRING1     Name
               + for more values
Maximum frame size . . . . . .     *LINKTYPE      265-1994, 256, 261, 265...
Exchange identifier  . . . . .                    00100000-FFFFFFFF
Initial connection . . . . . .     *DIAL          *DIAL, *ANS
Dial initiation  . . . . . . .     *LINKTYPE      *LINKTYPE, *IMMED, *DELAY
LAN remote adapter address . . .   400031740004   000000000001-FFFFFFFFFFFF
Text 'description' . . . . . . . > 'Controller description for 3174'



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

Figure 5-28. Prompt Display for TRLAN3174 Controller Description

Note: When tailoring the 3174 Control Unit that this controller description represents, you must set the maximum frame parameter greater than or equal to the MAXFRAME parameter on the TOKENRING1 line description to which this controller is attached.

Although the following device description examples are not specific to a token-ring network, you can use them to configure a 3279 display and a 3287 printer capable of attaching to a 3174.

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

Type choices, press Enter.

Device description . . . . . > TRLAN3279      Name
Device class . . . . . . . . . > *RMT         *LCL, *RMT, *VRT, *SNPT
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  . . . . . > TRLAN3174    Name
Keyboard language type . . . .   *SYSVAL      *SYSVAL, AGB, AGI, BLI...
Drop line at signoff . . . . .   *YES         *YES, *NO
Application type . . . . . . .   *NONE        *NONE, *NRF, *CTLSSN...
Text 'description' . . . . . . > '3279 attached to 3174'
```

Figure 5-29. Prompt Display for TRLAN3279 Display Device Description

```
                    Create Device Desc (Printer) (CRTDEVPRT)

Type choices, press Enter.

Device description . . . . . > TRLAN3287     Name
Device class . . . . . > *RMT          *LCL, *RMT, *VRT, *SNPT
Device type  . . . . . > 3287          3287, 3812, 4019, 4201...
Device model . . . . . > 0             0, 1, 2, 3, 4, 10, 13, 301...
Local location address . . . . . > 03          00-FE
Online at IPL  . . . . . *YES          *YES, *NO
Attached controller  . . . . . > TRLAN3174     Name
Separator program  . . . . . *NONE         Name, *NONE
  Library  . . . . . .                     Name, *LIBL, *CURLIB
Printer error message  . . . . . *INQ          *INQ, *INFO
Message queue  . . . . . QSYSOPR       Name, QSYSOPR
  Library  . . . . . .   *LIBL         Name, *LIBL, *CURLIB
Application type . . . . . *NONE         *NONE, *NRF, *DEVINIT...
Text 'description' . . . . . > '3287 attached to 3174'
```

Figure 5-30. Prompt Display for TRLAN3287 Printer Device Description

The following display is used during customization of a 3174 Control Unit.

```
      ------------ Token-Ring Network ------------

106 - 4000 3174 0004   107 - 4000 0319 0001   108 - 0324000   116 - 0

121 - 01               125 - 00000000         127 - 0 0

132 - 0 0 0 0          136 - 1 1 1 1          137 - 0 0 0 0   138 - 0

141 - A                165 - 1                166 - C

173 - 00000000         175 - 000000

213 - 1                215 - 00000            220 - 3

380 - 1994             381 - 7                382 - 1994      383 - 4
```

Figure 5-31. Prompt Display for Token-Ring Network

Item 106, the adapter address of the 3174 Control Unit, must match the ADPTADR parameter on the Create Controller Description (Remote Work Station) (CRTCTLRWS) command.

Item 107 is the adapter address of the AS/400 system that this 3174 Control Unit connects with. This must be equal to the adapter address (ADPTADR) parameter on the TOKENRING1 line description.

Item 380 is the largest frame the 3174 Control Unit can accept. This should be set to 1994 so that the AS/400 system can send the largest possible frame to the 3174 Control Unit.

Item 382 is the largest frame the 3174 Control Unit sends. This can be no larger than the MAXFRAME parameter on the TOKENRING1 line description.

Part 3. Distributed Data Interface Networks

Chapter 6. DDI Networks

This chapter describes the DDI physical environment and general considerations for configuring a DDI network.

DDI Physical Environment

A DDI network consists of stations connected using optical fiber or shielded twisted pair (STP) media to form a physically closed loop. DDI allows many attachment units, including stations, concentrators, and bridges. These can be attached in various ways allowing a tree topology.

DDI uses two rings:

- The primary ring, similar to the main ring of a token-ring network.
- The secondary ring, similar to the backup ring path of a token-ring network.

A fiber DDI (FDDI) ring consists of two fibers, one for transmitting and one for receiving. Each fiber is equivalent to a pair of copper conductors used on a shielded twisted pair DDI (SDDI) ring.

Unlike token-ring networks, DDI networks allow devices to be attached to one or both of the rings and do not require attachment through a concentrator such as the token-ring multistation access unit (MAU). DDI networks identify two classes of devices, depending on how the device is attached to the rings.

Dual-Attached (Class A)
Stations or concentrators that are directly attached to both the primary and secondary ring.

Single-Attached (Class B)
Stations or concentrators that are directly attached to only one ring or that are attached through a concentrator.

The AS/400 DDI adapters allow the system to function as either a single- or dual-attached station.

Normally, only the primary ring in a DDI network is active. The secondary ring is used to maintain the network when a dual access station or concentrator becomes inactive.

Figure 6-1 on page 6-2 shows an example of a DDI network using both single- and dual-attached stations.

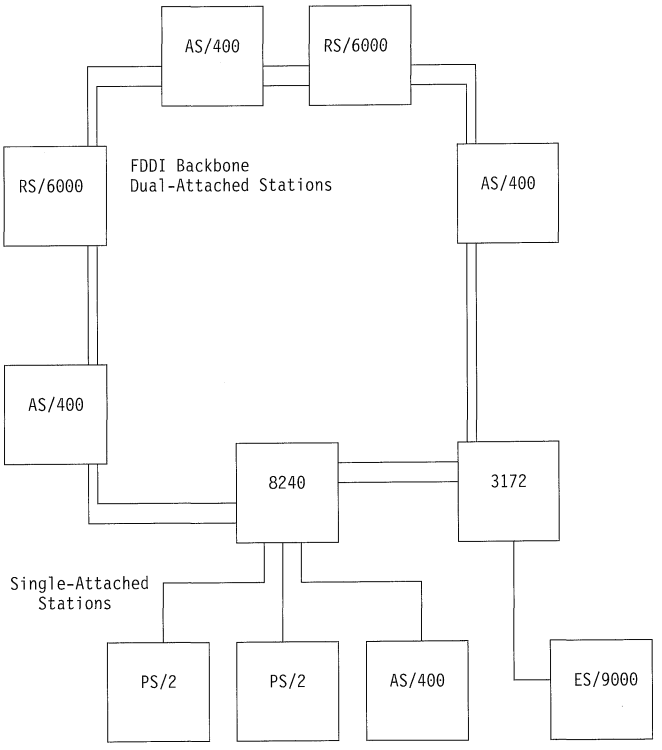


Figure 6-1. Example of DDI Network with Single- and Dual-Attached Stations

IBM 8240 FDDI Concentrator

The IBM 8240 FDDI Concentrator is a single media access control (MAC) concentrator that allows attachment of up to 24 devices using either copper or multimode optical fiber. The 8240 FDDI Concentrator contains the following modules:

Concentrator Control (CC) Module

The CC Module contains the electronics that:

- Control access to the network for attaching devices.
- Perform error recovery.

Ring Attachment (RA) Module

The RA Module allows the 8240 Concentrator as a dual-attached station to an FDDI ring topology or as a dual-attached or single-attached station to other concentrators using multimode optical fiber.

Device Attachment (DA) Modules

Up to six DA Modules can be installed in the 8240 Concentrator. Two types of DA Module are supported:

- The Optical Fiber Cable Device Attachment Module is used for devices connected to the network using multimode optical fiber cabling.
- The Copper Device Attachment Module is used for devices attached using shielded twisted pair wiring.

Each DA Module allows attachment of up to four devices.

8240 Concentrators can be installed in either ring or tree topologies. When installed in a tree topology, 8240s can be configured as dual-attached concentrators.

See the *FDDI Network Introduction and Planning Guide* for detailed information about the 8240 FDDI Concentrator and how to use it in various network topologies.

Dual-Homing Stations

The AS/400 DDI adapter allows the system to be connected to an FDDI concentrator in a dual-homing configuration. In this configuration, both adapter ports (A and B) are connected to the master ports on the concentrator. The B port connection is identified as the primary connection; the A port is identified as the secondary connection.

The dual-homing station operates like a single-attached (Class B) station, except that the secondary connection is available as a backup to the primary connection. The connection automatically switches from primary to secondary if a problem is detected in the primary connection.

DDI Physical Address Format

The AS/400 DDI adapters use the same 48-bit adapter address format that is used for token-ring adapters. See "Token-Ring Physical Address Format" on page 3-3 for more information.

Frame Size Considerations for DDI Networks

Data is transmitted to remote stations in frames, the basic unit of transmission for all data. Frame size indicates how large each transmission is.

A DDI network provides an environment with few errors. Therefore, data transmission is more efficient if data is sent in as large a frame as possible. The largest frame size that can be sent by the AS/400 system is specified by the MAXFRAME parameter on the CRTLINDDI command. The MAXFRAME parameter can be set to any value in the range 265 through 4444. The default value is 4105.

Note: DDI frame sizes are sometimes described in terms of **symbols**. A symbol represents half of a byte (four bits); 4105 bytes is equivalent to 8210 symbols.

Except for the allowed range of frame sizes, frame size considerations for DDI networks are the same as those for token-ring networks. See "Frame Size Considerations for Token-Ring Networks" on page 3-5 for more information.

Token Rotation Time (TKNRTTTIME Parameter)

The token rotation time (TKNRTTTIME) parameter on the CRTLINDDI command represents the target token rotation timer (TTRT) in the FDDI architecture. The TTRT value is used to control ring scheduling: the longer the TTRT value, the more frames that can be transmitted by a station at one time. Possible values for the TKNRTTTIME parameter are *CALC (the default) or any value from 4 through 167 milliseconds.

A claim token process is used to negotiate the target token rotation time used by all stations on the ring. When the ring is initialized, the lowest TTRT value bid by stations on the ring is the value that is used.

The default value for the TKNRTTTIME parameter, *CALC, normally sets the timer to 167 milliseconds. This value should provide good ring utilization but may not be appropriate for some applications that require frequent, short transmissions from a large number of stations.

Unless changing the TKNRTTTIME value is specifically required, use *CALC. If an application requires a shorter target rotation time, the TKNRTTTIME value should be lowered only on the machine running the application.

Chapter 7. DDI Network Configuration Examples

This chapter provides an example of a DDI configuration for two AS/400 systems.

Configuration Example for Connecting Two AS/400 Systems

In the following example, two AS/400 systems, RCHAS1 and RCHAS2, are directly linked using either FDDI or SDDI cables. Both RCHAS1 and RCHAS2 are defined as APPN end nodes.

Because the line descriptions specify AUTOCRTCTL(*YES), only one APPC controller description needs to be created as APPN(*YES). The other system automatically creates the corresponding APPC controller description as APPN(*YES). Since the APPC controller descriptions are APPN(*YES), the device descriptions are created automatically.

Considerations for controller descriptions attached to DDI lines are essentially the same as those attached to token-ring network lines. See Chapter 3 and Chapter 5 for information about configuring controller descriptions.

Configuration on AS/400 System RCHAS1

Figure 7-1 shows the prompt displays used to create the line description on system RCHAS1.

```
                    Create Line Desc (DDI) (CRTLINDDI)

Type choices, press Enter.

Line description . . . . . > RCHAS1DDI      Name
Resource name  . . . . . > LIN441         Name, *NWID
Online at IPL  . . . . . .   *YES           *YES, *NO
Vary on wait . . . . . .   *NOWAIT        *NOWAIT, 15-180 (1 second)
Maximum controllers  . . . .   40             1-256
Maximum frame size . . . . .   4105           265-4444
Local adapter address  . . . . > 400070008001  400000000000-7FFFFFFFFFFF...
Exchange identifier  . . . . .   *SYSGEN        05600000-056FFFFF, *SYSGEN
SSAP list:
  Source service access point  .   *SYSGEN        02-FE, *SYSGEN
  SSAP maximum frame . . . . .                    265-4444, *MAXFRAME
  SSAP type  . . . . . .                          *CALC, *NONSNA, *SNA
              + for more values
Text 'description' . . . . . > 'DDI line on RCHAS1'


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

Figure 7-1 (Part 1 of 2). Prompt Displays for CRTLINDDI Command

```
                    Create Line Desc (DDI) (CRTLINDDI)

Type choices, press Enter.

                            Additional Parameters

Group address  . . . . . .   *NONE          800000000000-FFFFFFFFFFFE...
             + for more values
Token rotation time  . . . . .  *CALC        4-167, *CALC
Link speed . . . . . . . . . .  *MAX         *MIN, 1200, 2400, 4800...
Cost/connect time  . . . . . .  0            0-255
Cost/byte  . . . . . . . . . .  0            0-255
Security for line  . . . . . .  *NONSECURE   *NONSECURE, *PKTSWTNET...
Propagation delay  . . . . . .  *LAN         *PKTSWTNET, *LAN, *MIN...
User-defined 1 . . . . . . . .  128          0-255
User-defined 2 . . . . . . . .  128          0-255
User-defined 3 . . . . . . . .  128          0-255
Autocreate controller  . . . . > *YES        *YES, *NO
Autodelete controller  . . . . .  1440       1-10000 (minutes), *NONE
                                                                   More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
F24=More keys
```

Figure 7-1 (Part 2 of 2). Prompt Displays for CRTLINDDI Command

Configuration on AS/400 System RCHAS2

The following commands are used to create the DDI configuration on system RCHAS2.

```
CRTLINDDI  LIND(RCHAS2DDI) RSRCNAME(LIN441) +
             ADPTADR(400070008002) AUTOCRTCTL(*YES) +
             TEXT('DDI Line On RCHAS2')

CRTCTLAPPC CTLD(RCHAS2) LINKTYPE(*LAN) +
             SWTLINLST(RCHAS2DDI) +
             RMTNETID(*NETATR) RMTCPNAME(RCHAS1) +
             ADPTADR(400070008002) +
             TEXT('Controller description for DDI to RCHAS1')
```

Part 4. Ethernet Networks

Chapter 8. Ethernet Networks

This chapter discusses considerations for Ethernet network configurations and describes some aspects of Ethernet hardware.

Ethernet Physical Environment

Figure 8-1 shows an example of the hardware used to set up an Ethernet network using coaxial cable. A device called a **transceiver** is part of or is attached to the coaxial cable. A transceiver cable is used to connect the AS/400 controller to the transceiver, which is used to transmit and receive data. You can purchase your IEEE 802.3-compliant transceiver cable, transceiver, and cable from any vendor.

Note: IEEE 802.3 and Ethernet Version 2.0 standards specify that compliant transceivers must support the signal-quality-error function. Although AS/400 Ethernet adapters can use transceivers with or without the signal-quality-error function, it is recommended that this function be active. If a cable or transceiver failure occurs, and this support is not active, the AS/400 system may not be able to isolate the failure to the cable or transceiver. In this case, you see a general application-generated message stating that a controller has lost contact or a time-out to the host connection has occurred.

Ethernet uses baseband transmission at a rate of 10 Mbps.

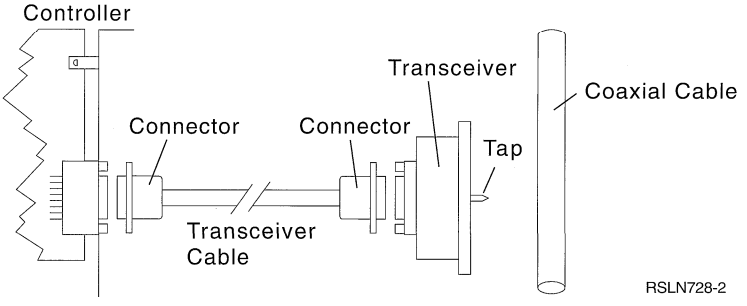


Figure 8-1. Ethernet Attachment Using Coaxial Cable

Bus Configuration

With **Carrier Sense Multiple Access with Collision Detection (CSMA/CD)** as used on Ethernet, multiple stations share the transmission medium, typically configured in a bus topology. When a station has data to send, it listens to the transmission medium to determine if it is available (no other stations are transmitting). If it is available, it begins to transmit. The station continues to listen during the transmission to determine if a **collision** occurs. A collision occurs when two or more stations begin transmitting at about the same time. If a collision does occur, the transmitting station stops its transmission and waits a random amount of time before attempting to transmit again.

The load on the Ethernet bus will have some effect on performance. At light loads, very few collisions will occur and performance will be good. As the load on the bus increases, the chance of a collision also increases. Increased collisions will result in degraded performance. Under extreme circumstances, heavy loads can cause severe performance problems.

Ethernet Adapter Considerations

The Ethernet 2625 and 2635 adapters begin to discard inbound frames when they arrive at a rate in excess of 100 frames per second (assuming a frame size of 1500 bytes). The Ethernet 2617 adapter has more storage and can provide better performance than the 2625 and 2635 adapters.

SNA uses the flow control of the IEEE 802.2 protocol. When using this protocol or TCP/IP, discarding of frames only occurs on heavily loaded networks.

Because those programs that rely on the User Datagram Protocol (UDP) use an unacknowledged service, it is more likely that discarding of frames can occur. This means that a single application with a single user can cause a burst of frames to the adapter that is great enough to cause discarding of frames. You should be aware of this tendency if you are developing applications for this protocol.

If IEEE 802.3 support is used and SNA sessions experience excessive delay, the traffic directed at the overloaded adapter should be reduced. If SNA sessions are disconnected due to an excessive number of frames being discarded, you should reduce the amount of traffic or increase the maximum number of allowable retries (LANFRMRTY parameter).

Ethernet Physical Address Format

As mentioned in Chapter 2, every system, controller, or personal computer that is attached to a local area network has a physical address for its attachment adapter. This physical level is called the medium access control (MAC), and the IEEE architecture has defined the 48-bit (6-byte) MAC address formats to be used for IEEE 802.3 Ethernet LANs. Figure 8-2 defines how the MAC addresses are displayed on the AS/400 system for the Ethernet LAN. The order of bit transmission on the medium starts with byte 0, bit 7 through bit 0, then byte 1, from bit 7 through bit 0 until byte 5, bit 0 is reached. This order of transmission is called least significant bit because the least significant bit is transmitted first. This ordering for Ethernet differs from the ordering for token ring, which starts with byte 0, bit 0 through bit 7 and ends with byte 5, bit 7.

The following figure describes the preferred IEEE format.

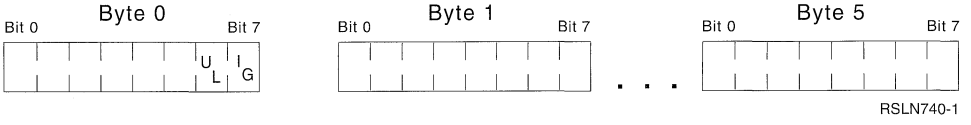


Figure 8-2. Ethernet Physical Address Format

- Bit 7 of byte 0 (called the I/G bit) indicates whether the destination address is an individual address (B'0') or group address (B'1').
- Bit 6 of byte 0 (called the U/L bit) indicates whether the address is universally administered (B'0') or locally administered (B'1').

The above indicators are an integral part of each station address.

Note the following:

- Byte 0, bit 7 = 0. This assignment controls the values of the local adapter address (ADPTADR parameter on the CRTLINETH command) to the range of individual addresses where byte 0 must be even numbers.
- Byte 0, bit 6 =1 further restricts locally assigned addresses resulting in the address range of hex 020000000000 through hex FEFFFFFFFFFF. The second digit must be 2, 6, A, or E.
- IEEE standards reserve a range of adapter addresses for use as preset addresses. This results in byte 0, bit 6 = 0 occupying the remaining even values in the range of hex 000000000000 to FFFFFFFFFFFF.

Bridged LAN Addressing Considerations

It is important to note that MAC addresses are always displayed in the above format for AS/400 Ethernet configuration displays even if they represent stations on other LAN media, such as token-ring stations reached through bridges. The format of token-ring MAC addresses is described under "Token-Ring Physical Address Format" on page 3-3.

Ethernet Frame Size Considerations

Ethernet line descriptions do not have a maximum frame size (MAXFRAME) parameter. However, maximum frame sizes can be configured for each SAP associated with the line description. In addition, a controller description also has a MAXFRAME size. When the connection process begins, the frame size is the smaller of the three values: line description maximum frame size (see Figure 8-3), SSAP MAXFRAME, or the controller MAXFRAME. However, the frame size may become even smaller because of the XID negotiations or bridge considerations.

The system determines the maximum frame size for the line description based on the value specified for the Ethernet standard (ETHSTD) parameter as shown in Figure 8-3.

Figure 8-3. Maximum Frame Size Based On ETHSTD Parameter

ETHSTD Parameter Value	Frame type	Maximum Frame Size
*ALL	IEEE 802.3	1496
	Ethernet Version 2	1500
*IEEE8023	IEEE 802.3	1496
*ETHV2	Ethernet Version 2, SNA data	1493
	Ethernet Version 2, non-SNA data	1500

Bridged LAN Frame Size Considerations

If a frame is being transmitted to a station that resides on a different LAN, the frame must be copied and transmitted again by a bridge. If the bridge is not configured to support a frame size as large as that configured on the token-ring or Ethernet line description, the frame will be discarded.

In the Ethernet environment, no indication of a smaller frame size is received. This condition is detected when a connection is being established with the remote system and a CPA57A1 message is sent to the QSYSOPR message queue.

If it is not possible to configure the bridge to support larger frame sizes, you may need to adjust one of the following to a value acceptable to the bridge:

- MAXFRAME parameter on the controller description
- SSAP MAXFRAME parameter on the line description

If an adjustment is made, it is recommended that the MAXFRAME value on the controller description be adjusted.

Chapter 9. Ethernet Network Configuration Examples

Figure 9-1 demonstrates a possible Ethernet network.

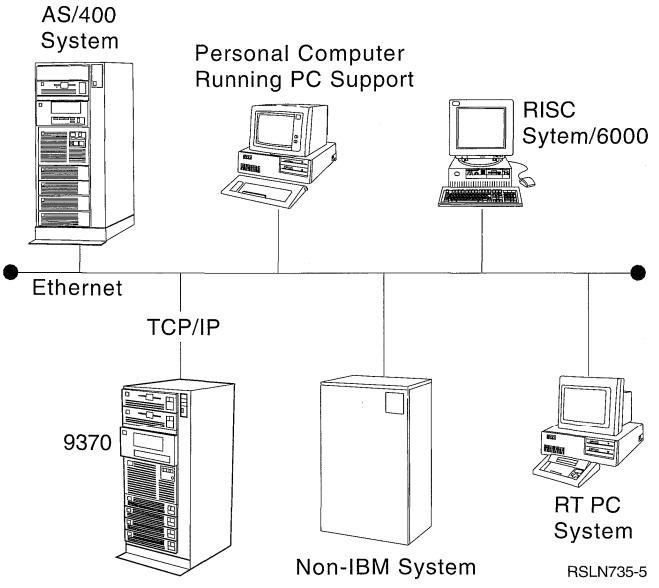


Figure 9-1. AS/400 Ethernet Network

The following configuration example covers two connections. The first part of the example shows how to run APPC to the same system over a single connection to the Ethernet network. The AS/400 system with a single connection to the Ethernet network can be useful in the initial testing of a connection, configuration, or application program. The adapter card handles the case where the destination address is the same as the source address.

The second part of this example shows the addressing considerations that must take place for PC Support/400 and the AS/400 system to communicate over an Ethernet network.

For more information on TCP/IP configuration, see the *TCP/IP Guide*. For more APPN configuration examples, see the *APPN Guide*. The *System Programmer's Interface Reference* has examples of user-defined communications over Ethernet networks.

AS/400 System to an Ethernet Line

The AS/400 system on the Ethernet network in this example uses the following line description to communicate.

```
                    Create Line Desc (Ethernet) (CRTLINETH)

Type choices, press Enter.

Line description . . . . . > ETHLINE       Name
Resource name  . . . . . . > LIN121        Name, *NWID
Online at IPL  . . . . . .   *YES          *YES, *NO
Vary on wait . . . . . .     *NOWAIT       *NOWAIT, 15-180 (1 second)
Local adapter address  . . . > 020071032000 1  020000000000-FEFFFFFFFFFF...
Exchange identifier  . . . .   *SYSGEN       05600000-056FFFFF, *SYSGEN
Ethernet standard  . . . . .   *ALL 2        *ETHV2, *IEEE8023, *ALL
```

```
                    Create Line Desc (Ethernet) (CRTLINETH)

Type choices, press Enter.

SSAP list:
  Source service access point  . > 04          02-FE, *SYSGEN
  SSAP maximum frame . . . . . .   *CALC       *CALC, 265-1496, 265...
  SSAP type  . . . . . .           *CALC       *CALC, *NONSNA, *SNA

  Source service access point  . > 08 3        02-FE
  SSAP maximum frame . . . . . .   *CALC       *CALC, 265-1496, 265...
  SSAP type  . . . . . .           *CALC       *CALC, *NONSNA, *SNA
               + for more values
Text 'description' . . . . . > 'ETHLINE line description'
```

Figure 9-2. Prompt Displays for ETHLINE Line Description

Considerations for specifying the CRTLINETH command:

1 This address is used to transmit and receive on the local area network. Either the preset address assigned to the card by the manufacturer or an address assigned by the user can be specified. For more information on valid addresses, see the discussion about the ADPTADR parameter in the *OS/400* Communications Configuration Reference*. All controllers that want to communicate with the AS/400 system must use this value in their configurations for the remote adapter address.

2 The Ethernet standard (ETHSTD) parameter cannot be changed on the CHGLINETH command. When ETHSTD(*ALL) is configured, the AS/400 system sends SNA data in IEEE 802.3 frames. When *ALL is specified, the AS/400 system sends SNA data for both Ethernet Version 2 and IEEE 802.3 standards.

3 To run APPC to the same system over one connection to the Ethernet network, an additional SNA SAP value must be defined in the line description. This is necessary to provide a unique LAN address in the form of SSAP/DSAP/MAC address.

The following controller descriptions are used to run APPC to the same system over one connection.

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

Type choices, press Enter.

Controller description . . . . . > APPC1          Name
Link type  . . . . . . . . . . . > *LAN           *FAX, *FR, *IDLC, *LAN...
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
APPN-capable . . . . . . . . . . > *NO            *YES, *NO
Controller type  . . . . . . . .   *BLANK        *BLANK, *FBSS, 3174, 3274...
Switched line list . . . . . . . > ETHLINE 1      Name
             + for more values
Maximum frame size . . . . . .     *LINKTYPE     265-16393, 256, 265, 512...
Remote network identifier  . . .   *NETATR       Name, *NETATR, *NONE, *ANY
Remote control point . . . . . .                 Name, *ANY
Exchange identifier  . . . . . .                 00000000-FFFFFFFF
Initial connection . . . . . . .   *DIAL         *DIAL, *ANS
Dial initiation  . . . . . . . .   *LINKTYPE     *LINKTYPE, *IMMED, *DELAY
LAN remote adapter address . . . > 020071032000 2 000000000001-FFFFFFFFFFFF
Text 'description' . . . . . . . > 'APPC1 controller attached to ETHLINE'

                                                                        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.

Disconnect timer:
  Minimum connect timer  . . . .   170          0-65535 seconds
  Disconnection delay timer  . .   30           0-65535 seconds
SDLC poll priority . . . . . . .   *NO          *NO, *YES
SDLC poll limit  . . . . . . . .   0            0-4
SDLC out limit . . . . . . . . .   *POLLLMT      0-4, *POLLLMT
SDLC connect poll retry  . . . .   *CALC         0-65534, *CALC, *NOMAX
SDLC NDM poll timer  . . . . . .   *CALC         *CALC, 0-3000 (0.1 seconds)
LAN DSAP . . . . . . . . . . . .   04 3          04, 08, 0C, 10, 14, 18, 1C...
LAN SSAP . . . . . . . . . . . . > 08 4          04, 08, 0C, 10, 14, 18, 1C...
LAN frame retry  . . . . . . . .   *CALC         0-254, *CALC
LAN connection retry . . . . . .   *CALC         0-254, *CALC
LAN response timer . . . . . . .   *CALC         0-254 (0.1 seconds)
LAN connection timer . . . . . .   *CALC         0-254 (0.1 seconds)
LAN acknowledgement timer  . . .   *CALC         0-254 (0.1 seconds)
LAN inactivity timer . . . . . .   *CALC         0-255 (0.1 seconds)
                                                                        More...
F3=Exit   F4=Prompt   F5=Refresh   F12=Cancel   F13=How to use this display
```

Figure 9-3. Prompt Displays for APPC1 Controller Description

Considerations for specifying the CRTCTLAPPC command:

1 Note that both the controller descriptions specify ETHLINE as the switched line list value. The line description specified for this parameter must exist before being specified.

2 The adapter address (ADPTADR parameter) specifies the address of the remote controller. Because this example is testing a connection to itself, the adapter address on the line description and the remote adapter address are the same. This is not the case if two remote systems are communicating.

3 The LAN destination service access point (DSAP parameter) is the logical address with which this controller communicates. This value must equal the LAN source service access point in the remote controller configuration.

4 The LAN source service access point (SSAP parameter) is the logical address that this system sends with any data to a remote system. This value must match the DSAP of the remote controller.

The preceding discussion of the CRTCTLAPPC command also relates to the APPC2 controller configuration below.

```
CRTCTLAPPC CTLD(APPC2) LINKTYPE(*LAN) APPN(*NO) SWTLINLST(ETHLINE) +
           ADPTADR(020071032000) DSAP(08) SSAP(04) +
           TEXT('AS/400 at address 020071032000, DSAP 08')
```

The following displays show the creation of the APPC device descriptions needed to complete the configuration. The remote location name (RMTLOCNAME parameter) is the name of the device with which your system is communicating. Note that the remote location name on device APPC1 matches the local location name on APPC2.

```
CRTDEVAPPC DEVD(APPC1) RMTLOCNAME(APPC2) LCLLOCNAME(APPC1) +
           CTL(APPC1) APPN(*NO) TEXT('Device for APPC2 controller')

CRTDEVAPPC DEVD(APPC2) RMTLOCNAME(APPC1) LCLLOCNAME(APPC2) +
           CTL(APPC2) APPN(*NO) TEXT('Device for APPC1 controller')
```

PC Support/400 Considerations

When using PC Support/400 and the AS/400 system in an Ethernet network, you need to be aware of the Ethernet physical address format. This address format is discussed in "Ethernet Physical Address Format" on page 8-2. PC Support/400 uses the same addressing format as the token-ring physical address format, which is discussed in "Token-Ring Physical Address Format" on page 3-3.

Because these two address formats are in reversed bit order, the configured physical addresses will appear in reversed bit order when viewed on each system. For the following example, the addresses are viewed as follows:

Figure 9-4. Addresses from AS/400 View

AS/400 View	**Address**
AS/400 Address	020071032000
Personal Computer using PC Support/400	02000A000010

The following figure illustrates the addresses when viewed from the personal computer.

Figure 9-5. Addresses from Personal Computer View

Personal Computer View	**Address**
Personal Computer Address	400050000008
AS/400 System	40008EC00400

PC Support/400 considerations for environments other than those described in this example are discussed in "PC Support/400 Configuration Considerations" on page 9-18.

APPC Controller Description for PC Support/400

The APPC controllers and devices needed to communicate with the personal computer running PC Support/400 can be created automatically. Automatic configuration is highly recommended when using PC Support/400. For more information on automatic creation of configuration objects to be used for PC Support/400, see the *Device Configuration Guide*.

The following controller description demonstrates the configuration parameters that need to correspond with values in the PC Support/400 configuration.

```
CRTCTLAPPC CTLD(PCSUPPORT) LINKTYPE(*LAN) SWTLINLST(ETHLINE) +
             RMTNETID(RPC) RMTCPNAME(PC004) +
             ADPTADR(02000A000010) 1  +
             TEXT('APPC controller description for PC Support')
```

Consideration for specifying the CRTCTLAPPC command:

1 The adapter address specified in the controller description must correspond to the address of the personal computer using PC Support/400 specified in the CONFIG.SYS file. Notice that the address has been converted because the personal computer represents locally administered addresses in token-ring format.

DOS PC Support/400 Configuration

When using DOS PC Support/400 to communicate in an Ethernet network, you should be aware of two files, CONFIG.SYS and CONFIG.PCS. These two files designate the address of the personal computer using PC Support/400 and the address of the remote system with which to communicate.

The following is an example of the CONFIG.SYS file, which identifies the local address of the personal computer.

```
BREAK=ON
FILES=15
device=C:\ether\dxma0mod.sys
device=C:\ether\dxme0mod.sys 400050000008 1
DEVICE=C:\PCS\EIMPCS.SYS
DEVICE=C:\PCS\ECYDDX.SYS
```

1 Notice that the personal computer identifies itself as adapter address 400050000008. The adapter address is used to transmit and receive on the local area network. Notice that this adapter address is converted to 02000A000010 when the personal computer sends the address in a frame. Because the personal computer represents locally administered addressing in token-ring format, conversion of addresses is necessary.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. For more information on valid addresses, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration*

Reference. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address.

The next example is of the CONFIG.PCS file, which identifies the remote control point name (RTLN), the remote system address (TRLI), and the maximum frame size allowed (TRMF).

```
SFLR 1,I,QIWSFLR
RTLN RPC.PC004
TRLI RCHSX400,40008EC00400 1
RTYP ITRN
TRMF 1500 2
MDEF 1,1
MMRI 60
MTIM 60
```

1 The address given in the TRLI entry of the CONFIG.PCS file corresponds to the adapter address of the AS/400 line description. Because the personal computer represents locally administered addressing in token-ring format, conversion of addresses is necessary.

2 The TRMF value specifies the maximum frame size on the personal computer. For Ethernet, the maximum is 1500. The AS/400 value of *CALC on the SSAP parameter of the line description corresponds to this value.

OS/2 PC Support/400 Considerations

When using OS/2* PC Support/400 to communicate in an Ethernet network, you should be aware of the locations of the different LAN addresses.

The personal computer LAN adapter address 400050000008 should be entered on the OS/2 configuration menu Local LAN Adapter Address. This field is the OS/2 equivalent of the entry in DOS CONFIG.SYS: `Device=c:\ether\dxme0mod.sys 40050000008`.

The AS/400 LAN adapter address 40008EC00400 should be entered in the LAN destination address field on the OS/2 configuration menu 5250 Work Station Feature LAN Defaults. This field is the OS/2 equivalent of the TRLI field in the DOS CONFIG.PCS file. The address corresponds to the adapter address of the AS/400 line description. Because the personal computer represents locally administered addressing in token-ring format, conversion of addresses is necessary.

PC Support/400 Address Conversion Considerations

The example of PC Support/400 demonstrated the configuration when using a locally administered address on the personal computer. Because this address is represented in token-ring format, the address conversion is necessary.

If the personal computer is configured to use the preset adapter address of the Ethernet adapter card in the personal computer itself, no address conversion is necessary when creating the controller description on the AS/400 system. No address conversion is needed because the address already corresponds to the personal computer preset adapter address. However, the addresses in the TRLI entry,

which corresponds to the address of the AS/400 line description, must always be converted.

Token-Ring-to-Ethernet Bridge Configuration Example

Figure 9-6 demonstrates a token-ring and an Ethernet network communicating through an 8209 LAN Bridge. The following configuration example shows AS/400 System 1 using the ETHERNET1 line description to communicate with the 3174 Control Unit and its attached devices.

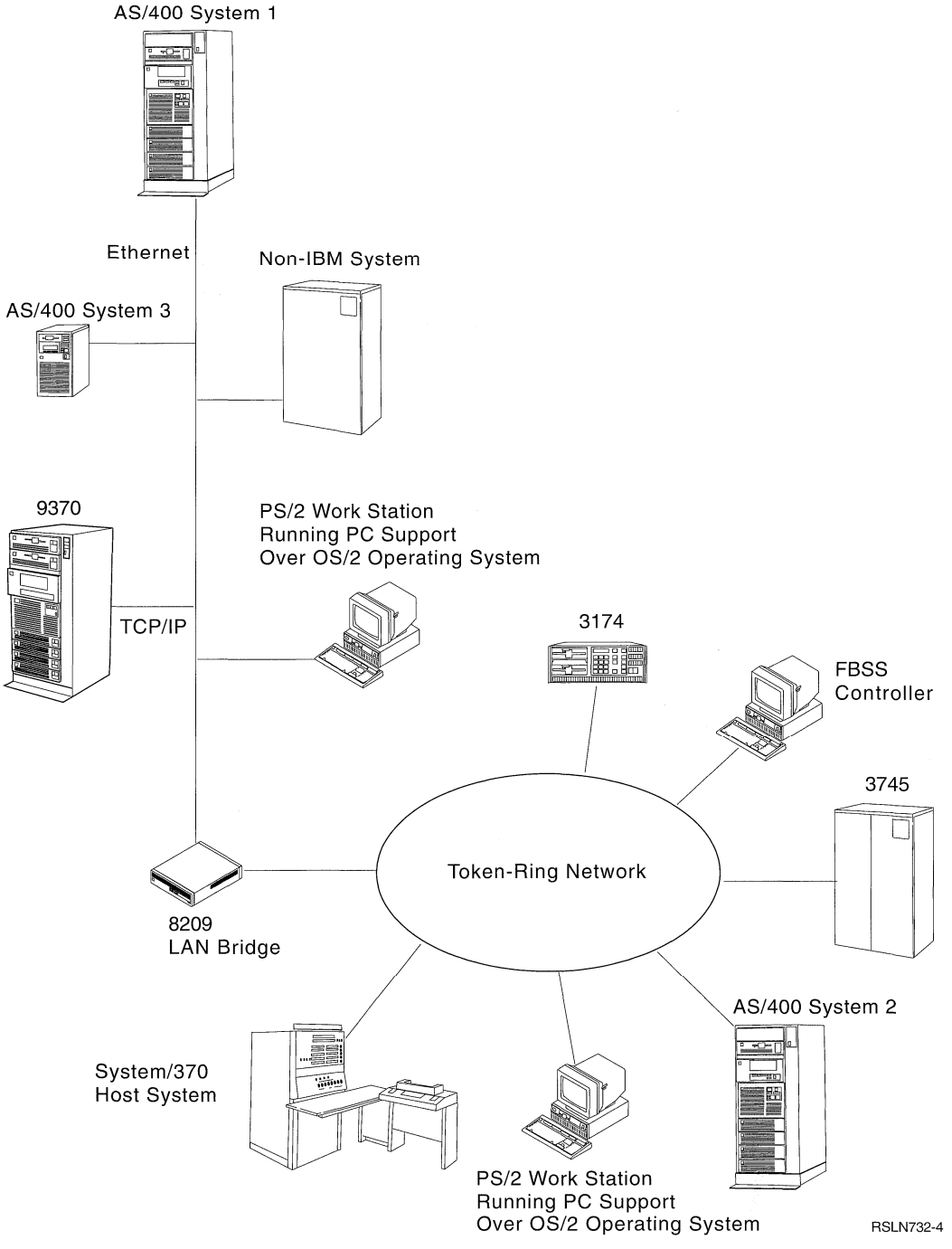


Figure 9-6. AS/400 Ethernet Bridged Environment

AS/400 System 1 is using the same line description to communicate with AS/400 System 2 on the token ring. AS/400 System 2 uses its own token-ring line description (TOKEN) to communicate with AS/400 System 1. AS/400 System 1 and AS/400 System 2 communicate using APPN. AS/400 System 3 uses the ETHNET line description to communicate with the FBSS controller and the 3745 communications controller on the token ring.

Address Conversion for Ethernet Bridged Environment

The following figure demonstrates the address conversion for the configuration shown in Figure 9-6 on page 9-7. A configuration example showing the address conversion follows this topic.

Figure 9-7. Address Mapping

System	TOKEN Address	ETHERNET1 Address
AS/400 1 on ETHERNET1	400003200001	0200C0040080
AS/400 2 on TOKEN	400010050001	020008A00080
3174 Control Unit	400031740004	02008C2E0020
3745 Communications Controller	400000001590	02000000A809
AS/400 3 on ETHNET	400000200099	020000040099
FBSS Controller	400011111111	020088888888

Creating the ETHERNET1 Line Description

This Ethernet line description connects AS/400 System 1 to the Ethernet network in Figure 9-6 on page 9-7.

```
CRTLINETH LIND(ETHERNET1) RSRCNAME(LIN121) +
            ADPTADR(0200C0040080) 1 +
            ETHSTD(*ALL) 2 TEXT('ETHERNET1 line description')
```

Considerations for specifying the CRTLINETH command:

1 The adapter address is used to transmit and receive on the local area network. Either the preset address assigned to the card by the manufacturer or an address assigned by the user can be specified. This adapter address is converted to 400003200001 after it has gone through the 8209 LAN Bridge to the token-ring network. For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2.

For more information on valid addresses, see the ADPTADR parameter in *OS/400* Communications Configuration Reference*. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address.

2 The Ethernet standard (ETHSTD) parameter cannot be changed on the CHGLINETH command. When ETHSTD(*ALL) is configured, the AS/400 system sends SNA data in IEEE 802.3 frames.

Creating the CTL3174 Remote Work Station Controller Description

The following controller description associates the 3174 Control Unit with the ETHERNET1 line description.

```
CRTCTLRWS CTLD(CTL3174) TYPE(3174) MODEL(0) LINKTYPE(*LAN) +
            SWTLINLST(ETHERNET1) 1  MAXFRAME(1496) 2  +
            ADPTADR(02008C2E0020) 3  +
            TEXT('3174 controller description')
```

Considerations for specifying the CRTCTLRWS command:

1 The ETHERNET1 line description must exist before this value can be specified for the switched line list (SWTLINLST parameter). By specifying this value in the AS/400 controller description, the 3174 controller is recognized by AS/400 System 1 on the Ethernet network.

2 The maximum frame size (MAXFRAME parameter) for this controller is configured as 1496 because the remote system is on the other side of the bridge. The largest information field that can pass through the 8209 LAN Bridge is 1496 bytes.

3 The LAN remote adapter address (ADPTADR parameter) is the address the AS/400 system will send data to when it communicates with the remote controller. This adapter address is converted to 400031740004 after it has gone through the 8209 LAN Bridge to the token-ring network. Refer to Figure 9-8 on page 9-10 to see this address configured on the 3174 Control Unit.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the DEV3277, DEV3279, and DEV3287 Device Descriptions

The following device descriptions associate 3277, 3278, and 3279 display stations and a 3287 printer with the 3174 controller description. Notice that all the device descriptions created here name CTL3174 as the attached controller. All of the following device descriptions have the same considerations for specifying the CRTDEVDSP and CRTDEVPRT commands.

```
CRTDEVDSP DEVD(DEV3277) DEVCLS(*RMT) TYPE(3277) MODEL(0) +
            LOCADR(04) 1  CTL(CTL3174) +
            TEXT('3277 display attached to 3174')

CRTDEVDSP DEVD(DEV3278) DEVCLS(*RMT) TYPE(3278) MODEL(0) +
            LOCADR(05) 1  CTL(CTL3174) +
            TEXT('3278 display attached to 3174')

CRTDEVDSP DEVD(DEV3279) DEVCLS(*RMT) TYPE(3279) MODEL(0) +
            LOCADR(02) 1  CTL(CTL3174) +
            TEXT('3279 display attached to 3174')

CRTDEVPRT DEVD(DEV3287) DEVCLS(*RMT) TYPE(3287) MODEL(0) +
            LOCADR(03) 1  CTL(CTL3174) +
            TEXT('3287 printer attached to 3174')
```

Considerations for specifying CRTDEVDSP and CRTDEVPRT commands:

1 The location address must be unique for each device attached to the same controller. For more information on valid values, see the discussion on the LOCADR parameter in the *OS/400* Communications Configuration Reference*.

Configuring the 3174 Controller

The following display is used during customization of a 3174 Control Unit.

```
       ------------ Local Area Network ------------

106 - 4000 3174 0004   107 - 4000 0320 0001   108 - 0324000   116 - 0
121 - 01               125 - 00000000         127 - 0 0
132 - 0 0 0 0          136 - 1 1 1 1          137 - 0 0 0 0   138 - 0
141 - A                165 - 1                166 - C
173 - 00000000         175 - 000000
213 - 1                215 - 00000            220 - 3
380 - 2042             381 - 7                382 - 1496      383 - 4
```

Figure 9-8. Prompt Display for Ethernet Network

Item 106, the adapter address of the 3174 Control Unit, must match the converted form of the ADPTADR parameter on the Create Controller Description (Remote Work Station) (CRTCTLRWS) command. This adapter address is converted to 02008C2E0020 when it has gone through the 8209 LAN Bridge to the Ethernet network. Refer to "Creating the CTL3174 Remote Work Station Controller Description" on page 9-9 to see this address configured on the AS/400 system.

Item 107 is the adapter address of the AS/400 system to which this 3174 Control Unit is connected. This must match the converted form of the adapter address (ADPTADR) parameter on the ETHERNET1 line description. This adapter address is converted to 0200C0040080 when it has gone through the 8209 LAN Bridge to the Ethernet network.

For more information on valid addresses, see the discussion on the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Item 380 is the largest frame the 3174 Control Unit can accept. This should be set to 2042 so that the AS/400 system can send the largest possible frame to the 3174 Control Unit.

Item 382 is the largest frame the 3174 Control Unit sends. This can be no larger than the SSAP maximum frame size on the ETHERNET1 line description and should not be larger than the largest frame the 8209 LAN Bridge can pass.

Creating the APPNETH APPC Controller Description

The following display shows the controller description needed to use APPN between two AS/400 systems, one on the Ethernet line description created previously and the other on a token ring. This controller description automatically creates the necessary device descriptions when the controller is varied on because APPN is used.

```
CRTCTLAPPC CTLD(APPNETH) LINKTYPE(*LAN) SWTLINLST(ETHERNET1) 1 +
             MAXFRAME(1496) 2 RMTCPNAME(S1000005) 3 +
             ADPTADR(020008A00080) 4 +
             TEXT('APPN controller for token-ring-to-Ethernet')
```

Considerations for specifying the CRTCTLAPPC command:

1 Notice that the previously created ETHERNET1 line description is specified as the switched line list (SWTLINLST parameter). By specifying this value in the AS/400 controller description, the controller can recognize the AS/400 1 on the Ethernet network.

2 The maximum frame size (MAXFRAME parameter) for this controller is configured as 1496 because the remote system is on the other side of the bridge. The largest information field that can pass through the 8209 LAN Bridge is 1496 bytes.

3 The remote control point name (RMTCPNAME parameter) and remote network identifier (RMTNETID parameter) describe the adjacent system control point name and network identifier for APPN. These values must match the network attributes of the remote system. For more information, see the discussion of the RMTCPNAME parameter in the *OS/400* Communications Configuration Reference*.

4 The LAN remote adapter address (ADPTADR parameter) is the address to which the AS/400 system sends data when it communicates with the remote controller. This adapter address is converted to 400010050001 after it has gone through the 8209 LAN Bridge to the token-ring network. This value matches the adapter address of the AS/400 system on the token-ring line in "Creating the TOKEN Token-Ring Line Description."

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the TOKEN Token-Ring Line Description

The following line description describes the token-ring line on the AS/400 System 2.

```
CRTLINTRN LIND(TOKEN) RSRCNAME(LIN031) ADPTADR(400010050001) 1 +
             TEXT('Token-ring line for APPN to Ethernet')
```

Considerations for specifying the CRTLINTRN command:

1 The LAN remote adapter address (ADPTADR parameter) is the address to which the AS/400 system sends data when it communicates with the remote controller. Either the preset address assigned to the card by the manufacturer or an address assigned by the user can be specified. This adapter address is

converted to 020008A00080, which matches the address configured on the APPNETH controller in "Creating the APPNETH APPC Controller Description," after it has gone through the 8209 LAN Bridge to the Ethernet network.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the APPNTRLAN APPC Controller Description

The following controller description is used with the token-ring line description for the AS/400 system running APPN over the token ring. This controller description automatically creates APPC device descriptions for use when the controller is varied on.

```
CRTCTLAPPC CTLD(APPNTRLAN) LINKTYPE(*LAN) SWTLINLST(TOKEN) +
           MAXFRAME(1496) 1 RMTCPNAME(RCHAS400) +
           INLCNN(*ANS) ADPTADR(400003200001) 2 +
           TEXT('APPC controller attached to TOKEN')
```

Considerations for specifying the CRTCTLAPPC command:

1 The maximum frame size (MAXFRAME parameter) for this controller is configured as 1496 because the remote system is on the other side of the 8209 LAN Bridge. The largest information field that can pass through the 8209 LAN Bridge is 1496 bytes.

2 The LAN remote adapter address (ADPTADR parameter) is the address to which the AS/400 system sends data when it communicates with the remote controller. This adapter address is converted to 0200C0040080, which matches the adapter address of the ETHERNET1 line description on AS/400 System 1 (see "Creating the ETHERNET1 Line Description" on page 9-8) after it has gone through the 8209 LAN Bridge to the Ethernet network.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the ETHNET Ethernet Line Description

The following Ethernet line description is for the 9404 System Unit on the Ethernet network.

```
CRTLINETH LIND(ETHNET) RSRCNAME(LIN131) ADPTADR(020000040099) 1 +
          ETHSTD(*ALL) 2 TEXT('Ethernet line description')
```

Considerations for specifying the CRTLINETH command:

1 The local adapter address (ADPTADR parameter) is the address the AS/400 system uses when it sends data to the remote controller. This adapter address is converted to 400000200099 after it has gone through the 8209 LAN Bridge to the token-ring network. Notice that this address matches the address for the

3745 communications controller in "Creating the ETHCTL SNA Host Controller Description" on page 9-13.

2 The Ethernet standard (ETHSTD) parameter cannot be changed on the CHGLINETH command. When ETHSTD(*ALL) is configured, the AS/400 system sends SNA data in IEEE 802.3 frames.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

The System/370* host system requires the DIALNO VTAM parameter if the host system calls out. For this example, the DIALNO is 0304400000200099, where:

- 03 is the NCP port number
- 04 is the source service access point
- 400000200099 is the AS/400 adapter address

The adapter address must match the adapter address (or its converted equivalent if a 8209 LAN Bridge is used) on the AS/400 system.

The LINE macroinstruction for the System/370 must also be specified as follows:

- ECLTYPE=PHYSICAL.
- PORTADD=03: This must be the same value as the NCP port address specified in the DIALNO parameter.
- LOCADDR=400000001590: This value is the adapter address of the 3745 communications controller. This value must match the adapter address (or its converted equivalent if the 8209 LAN Bridge is used) on the AS/400 controller description.

Creating the ETHCTL SNA Host Controller Description

The following SNA host controller description is used by AS/400 system 3 to communicate with the 3745 communications controller on the token ring.

```
CRTCTLHOST CTLD(ETHCTL) LINKTYPE(*LAN) SWTLINLST(ETHNET) 1 +
           MAXFRAME(1496) 2 RMTCPNAME(R1CDRM) +
           LCLEXCHID(056A001A) ADPTADR(02000000A809) 3
           NODETYPE(*LENNODE) TEXT('SNA host controller on Ethernet line')
```

Considerations for specifying the CRTCTLHOST command:

1 For this example, notice that the value specified for the switched line list is ETHNET, the Ethernet line description created for the AS/400 System 3.

2 The maximum frame size (MAXFRAME parameter) for this controller is configured as 1496 because the remote system is on the other side of the 8209 LAN Bridge. The largest information field that can pass through the 8209 LAN Bridge is 1496 bytes.

3 The LAN remote adapter address (ADPTADR parameter) is the address to which the AS/400 system sends data when it communicates with the remote controller. This adapter address is converted to 400000001590 after it has gone through the 8209 LAN Bridge to the token-ring network. Notice that this address matches the configuration in "Creating the ETHNET Ethernet Line Description" on page 9-12.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent, if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the ETHAPN1 APPC Device Description

The following APPC device description is an example of a device associated with the ETHCTL SNA host controller created previously. This APPC device description is created automatically and is shown here to illustrate parameter values.

```
CRTDEVAPPC DEVD(ETHAPN1) RMTLOCNAME(CICS) LCLLOCNAME(SWHSA01) +
           CTL(ETHCTL) TEXT('Automatically created by QLUS')
```

Creating the FBSSETHCTL Finance Controller Description

The following finance controller is attached to the 9404 System Unit on the Ethernet network in Figure 9-6 on page 9-7.

```
                    Create Ctl Desc (Finance) (CRTCTLFNC)

Type choices, press Enter.

Controller description . . . . . > FBSSETHCTL     Name
Controller type  . . . . . . . . > *FBSS          *FBSS, 3694, 4701, 4702...
Controller model . . . . . . . . > 0              0
Link type  . . . . . . . . . . . > *LAN           *LAN, *SDLC, *X25
Online at IPL  . . . . . . . . .   *YES           *YES, *NO
Switched line list . . . . . . . > ETHNET 1       Name
             + for more values
Maximum frame size . . . . . .     521            265-1033, 256, 265, 512...
Exchange identifier  . . . . .     05712345 2     00000000-FFFFFFFF
Initial connection . . . . . .     *DIAL          *DIAL, *ANS
LAN remote adapter address . . .   020088888888 3 000000000001-FFFFFFFFFFFF
Text 'description' . . . . . . . > 'FBSS controller through 8209 LAN Bridge'
```

Figure 9-9. Prompt Display for FBSSETHCTL Controller Description

Considerations for specifying the CRTCTLFNC command:

1 For this example, notice that the value specified for the switched line list is ETHNET, the Ethernet line description created for AS/400 System 3.

2 The exchange identifier on the AS/400 system must match the SNA XID block number and identification number on the FBSS controller as shown in Figure 9-17 on page 9-17.

3 The LAN remote adapter address (ADPTADR parameter) is the address to which the AS/400 system sends data when it communicates with the remote controller. This adapter address is converted to 400011111111 after it has gone through the 8209 LAN Bridge to the Ethernet network.

For more information on address conversion, see "Token-Ring to Ethernet Address Conversion" on page C-2. All remote systems must use the adapter address value (or converted equivalent, if using the 8209 LAN Bridge) in its configuration for the remote adapter address. For more information on valid values, see the discussion

of the ADPTADR parameter in the *OS/400* Communications Configuration Reference*.

Creating the EFBSSLAN2, EFBSSLAN3, and EFBSS278A Device Descriptions

The following device descriptions for both the finance and display station devices are attached to the FBSSETHCTL finance controller.

```
CRTDEVFNC DEVD(EFBSSLAN2) TYPE(*FNCICF) LOCADR(02) +
          RMTLOCNAME(EFBSS2) CTL(FBSSETHCTL) +
          TEXT('ICF finance device at LU address 02')

CRTDEVFNC DEVD(EFBSSLAN3) TYPE(*FNCICF) LOCADR(03) +
          RMTLOCNAME(EFBSS3) CTL(FBSSETHCTL) MAXLENRU(4096) +
          TEXT('ICF finance device at LU address 03')

CRTDEVDSP DEVD(EFBSS3277A) DEVCLS(*RMT) TYPE(3277) MODEL(0) +
          LOCADR(07) CTL(FBSSETHCTL) +
          TEXT('3277 attached to FBSS at LU address 07')
```

Configuring the FBSS Controller

The following displays show the configuration of an FBSS controller. The highlighted option on each display is the option you should select to configure your finance controller to communicate with the AS/400 system as in this example.

```
MEN0000              FINANCIAL BRANCH SYSTEM SERVICES
                      Functional Customization Areas


                General System Customization
                Communication Profiles and Emulators
                Data Management and System Profiles
                Banking Devices Customization
                LAN and Communication Configuration
                LAN Building and Distribution

                DOS Access
                FBSS Back-up and Start-up Options
```

Figure 9-10. Prompt Display for FBSS Functional Customization Areas

```
MEN5000              FINANCIAL BRANCH SYSTEM SERVICES
                    LAN and Communication Configuration


                LAN Configuration
                LAN and Communication Configuration

                LAN Variable Data Generation
```

Figure 9-11. Prompt Display for FBSS LAN and Communication Configuration

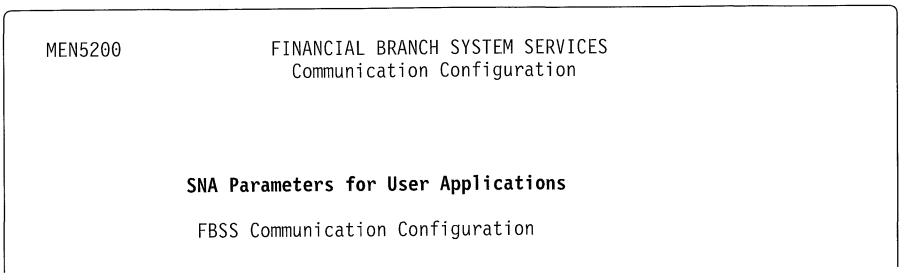


Figure 9-12. Prompt Display for FBSS Communication Configuration

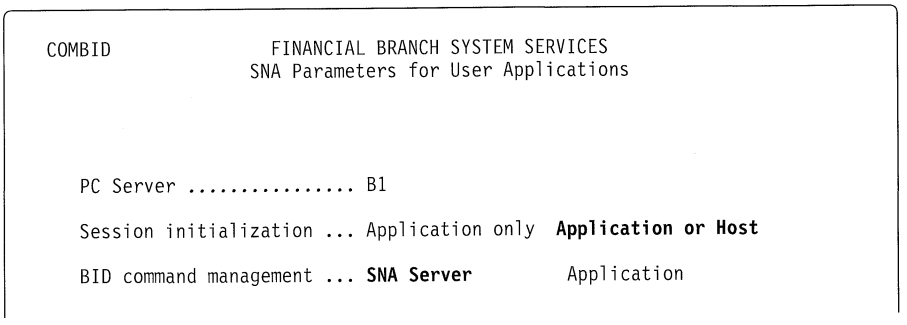


Figure 9-13. Prompt Display for FBSS SNA Parameters for User Applications

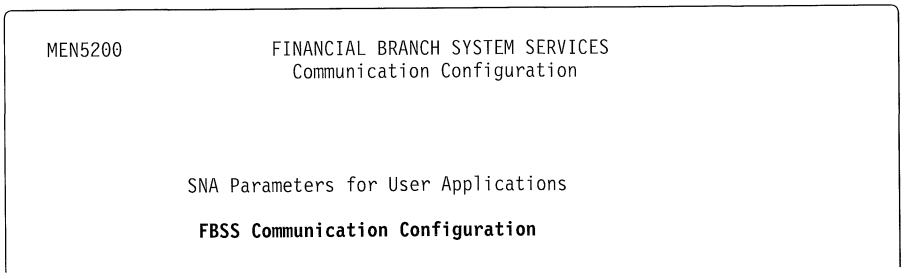


Figure 9-14. Prompt Display for FBSS Communication Configuration

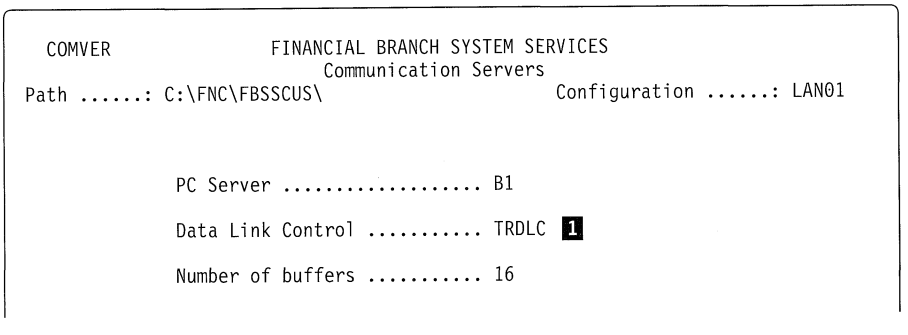


Figure 9-15. Prompt Display for FBSS Communication Servers

Consideration for specifying Communication Servers:

1 The data link control field of the FBSS controller must match the link type configured on the AS/400 system. For this example, LINKTYPE(*LAN) must be specified on the AS/400 controller description.

```
  COMVER              FINANCIAL BRANCH SYSTEM SERVICES
                                SSCP Names
Path ......: C:\FNC\FBSSCUS\                    Configuration ......: LAN01
PC Server..: B1

    SSCP name01 ...... X'        ' 1          SSCP name02 ...... X'        '
    SSCP name03 ...... X'        '            SSCP name04 ...... X'        '
    SSCP name05 ...... X'        '            SSCP name06 ...... X'        '
    SSCP name07 ...... X'        '            SSCP name08 ...... X'        '
    SSCP name09 ...... X'        '            SSCP name10 ...... X'        '
    SSCP name11 ...... X'        '            SSCP name12 ...... X'        '
    SSCP name13 ...... X'        '            SSCP name14 ...... X'        '
    SSCP name15 ...... X'        '            SSCP name16 ...... X'        '
```

Figure 9-16. Prompt Display for FBSS SSCP Names

Consideration for specifying SSCP Names:

1 If the SSCP name is used on the FBSS controller, the value specified for the AS/400 system SSCPID parameter must match.

```
  COMTOK              FINANCIAL BRANCH SYSTEM SERVICES
                        Token Ring Communications
Path ......: C:\FNC\FBSSCUS\                    Configuration ......: LAN01
PC Server..: B1


      Service access point for PC ..............    X'04' 1
      Service access point for Host/37xx/4700 ...    X'04' 2
      PC address ...............................    X'11111111'
      Host/37xx/4700 address ...................    X'00200099' 3
      SNA XID Block number .....................    X'057' 4
      SNA XID Identification number ............    X'12345' 5
```

Figure 9-17. Prompt Display for FBSS Token Ring Communications

Considerations for specifying Token Ring Communications:

1 The value for the service access point for PC must match the destination service access point (DSAP parameter) value in the controller description on the AS/400 system.

2 The value for the service access point for Host/37xx/4700 must match the source service access point (SSAP parameter) value in the controller description on the AS/400 system.

3 The value for the Host/37xx/4700 address must match the converted form of the last 8 digits of the remote LAN adapter address specified on the ETHNET line description. The first 4 digits of the address (4000) are automatically included. See "Creating the ETHNET Ethernet Line Description" on page 9-12 for the configuration of the line description on the AS/400 system.

4 The SNA XID block number is a hexadecimal number to indicate the type of system to the host system.

5 The SNA XID identification number is a 5-digit hexadecimal number. The identification block number and the identification number are concatenated; the result forms the SNA exchange identifier (EXCHID parameter) on the AS/400 controller description.

```
 COMSLU               FINANCIAL BRANCH SYSTEM SERVICES
                        Session-Id and LU Assignments
Path ......: C:\FNC\FBSSCUS\                     Configuration ......: LAN01
PC Server..: B1                                  Data Link Control ..: TRDLC
Circuit type .......: Switched        Permanent       Not applicable

                  <---------------------Application Session IDs------------>

       PC Served   01| 02| 03| 04| 05| 06| 07| 08| 09| 10| 11| 12| 13| 14| 15
        B1               003
        B1            002

                   <--------------Host Logical Unit Numbers---------------->
```

Figure 9-18. Prompt Display for FBSS Session-Id and LU Assignments

The logical units specified for the FBSS controller must match those defined for the AS/400 system. The logical units on the FBSS controller and the LOCADR parameter on the AS/400 system must match. The logical unit identifier must be unique.

```
 COMEMU               FINANCIAL BRANCH SYSTEM SERVICES
                    LU Assignments for Display Emulators
Path ......: C:\FNC\FBSSCUS\                     Configuration ......: LAN01
PC Server..: B1                                  Data Link Control ..: TRDLC
Circuit type .......: Switched        Permanent       Not applicable

       PC Served   Emu32701 | Emu32702 | Emu32703 | Emu32704 | Emu32705
        B1            007

                  <---------------Host Logical Unit Numbers-------------->
```

Figure 9-19. Prompt Display for FBSS LU Assignments for Display Emulators

Creating the Network Controller and Devices for TCP/IP

One network controller and device are adequate for communications with all TCP/IP systems in the Ethernet network. This configuration is done automatically by TCP/IP. For more information on TCP/IP configuration, see the *TCP/IP Guide*.

PC Support/400 Configuration Considerations

The environment that the personal computer and AS/400 system exist in determines the address conversion that must be done. The following discussion demonstrates when address conversion is done.

Personal Computer on a Token Ring and AS/400 System in an Ethernet Network: When using PC Support/400 with a personal computer on a token ring and the AS/400 system on an Ethernet network, address conversion considerations

(as discussed in "PC Support/400 Configuration Considerations") always apply. Address conversion in this environment is not dependent on whether a locally administered address or the personal computer adapter burned-in address is used.

Personal Computer in an Ethernet Network and AS/400 System on a Token-Ring Network: When using PC Support/400 with a personal computer on an Ethernet network and the AS/400 system on a token ring, some special attention must be given to addresses. Because locally administered addresses on the personal computer are in token-ring format, the address is converted to Ethernet format when the personal computer sends the address. Because the address passes through an 8209 LAN Bridge, which then converts the address to the token-ring format, no conversion is necessary.

However, if the preset adapter address for the personal computer is used, address conversion considerations do apply. In this case, the AS/400 controller description must have the converted form of the personal computer preset address.

For DOS, the TRLI entry in the CONFIG.PCS file contains the address of the AS/400 line. Because the TRLI entry must be in token-ring format, no address conversion is necessary for this part of the configuration.

For OS/2 PC Support/400, the address is in the LAN destination address field on the Work Station Feature LAN Defaults menu.

Part 5. Frame Relay Networks

Chapter 10. Frame Relay Networks

This chapter discusses the physical environment, frame formats, and configuration considerations for frame relay networks.

Frame Relay Physical Environment

The equipment used to attach to a frame relay network (such as an AS/400 system) is referred to as the terminal equipment (TE). A frame relay network node is referred to as a frame handler (FH).

The connection from the TE to the FH is normally made through a data service unit (DSU) and channel service unit (CSU) pair. The DSU/CSU converts the TE physical interface to the FH interface used by the frame relay network.

The AS/400 system supports three physical interface types for attachment to the DSU/CSU:

- EIA RS-449, CCITT V.36
- CCITT X.21
- CCITT V.35

The physical interface (INTERFACE parameter) and data transmission rate (LINESPEED parameter) are both specified using the CRTNWIFR command. The type of physical interface specified depends on the cable used. Figure 10-1 lists the supported physical interfaces, cable connectors, and the maximum data transmission speed available for each interface.

Figure 10-1. Frame Relay Physical Interfaces

Physical Interface	INTERFACE Parameter Value	Cable Connector	Maximum Data Transmission Rate
EIA RS-449 and CCITT V.36	*RS449V36	ISO 4902 (37-pin)	2048000 bps
CCITT X.21	*X21	ISO 4903 (15-pin)	2048000 bps
CCITT V.35	*V35	ISO 2593	64000 bps

AS/400 frame relay connections are made using the 2666 High Speed Communications Input/Output Processor (IOP). This IOP has a single Input/Output Adapter (IOA) and is compatible with each of the supported physical interface types. The value specified for the INTERFACE parameter must match the physical interface and cable attached to the IOA.

The CLOCK parameter on the CRTNWIFR command allows you to specify whether clocking is provided by the modem (*MODEM) or by the AS/400 system (*LOOP). If clocking is provided by the modem, the system transmits at the modem rate. If clocking is done by the system, the system inverts the modem clock signal and uses it as the transmit clock on the line. In either case, the modem controls the transmission speed on the line.

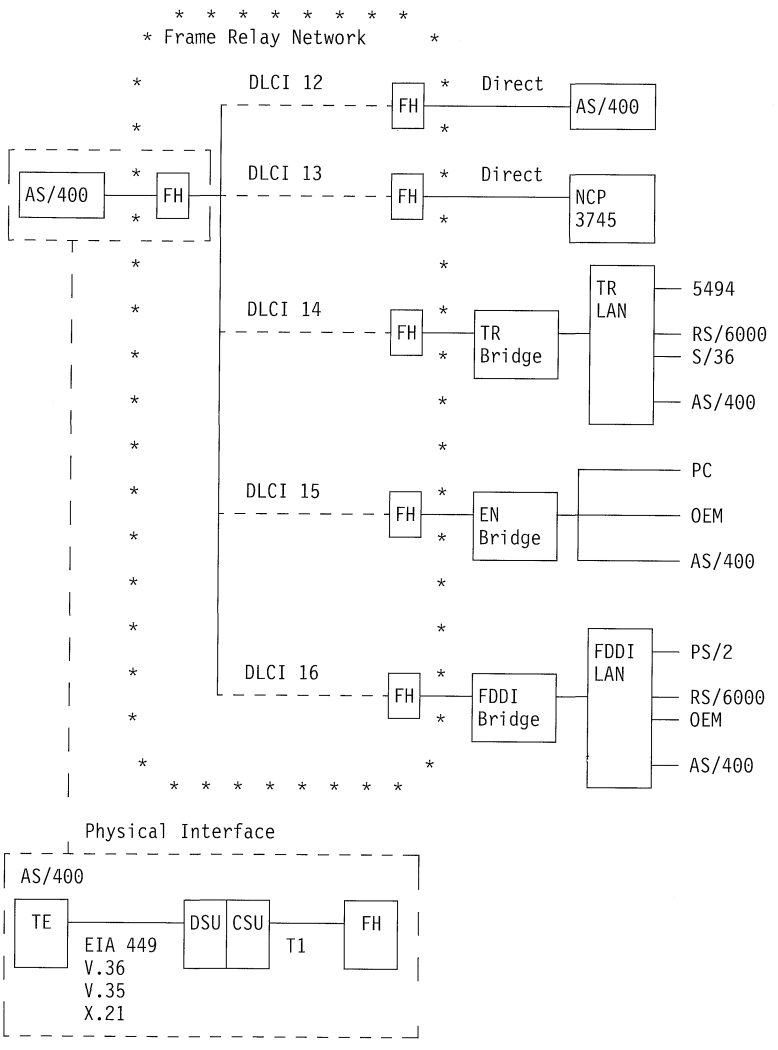


Figure 10-2. Example of a Frame Relay Network

SNA Direct Configurations

The AS/400 system allows frame relay connections to remote systems that support the SNA direct format defined by RFC-1294. In this format, SNA data is encapsulated within the frame relay packets.

Figure 10-2 shows an example of SNA direct connections to a remote AS/400 system and to a 3745 Communications Controller on DLCIs 12 and 13. The frame format used for SNA direct connections is described under "Frame Relay Protocol Headers and Frame Formats" on page 10-6.

Bridged Frame Relay Configurations

The AS/400 system allows frame relay connections to remote local area networks that support the bridged frame relay formats defined by RFC-1294. Bridges that support these formats include the IBM 6611 Network Processor and the RouteXpander/2.

Note: The AS/400 system can be used to bridge APPN networks, and the integrated frame relay support may eliminate the need for a bridge between the

AS/400 system and the frame relay network. However, the AS/400 system does not provide complete, integrated bridging function.

Bridged frame relay connections support both SNA and TCP/IP data traffic by encapsulating the token-ring, Ethernet, or DDI frames within the frame relay packet.

Figure 10-2 on page 10-2 shows an example of bridged frame relay connections to remote systems on DLCIs 14, 15, and 16. The frame formats used for bridged frame relay connections are described under "Frame Relay Protocol Headers and Frame Formats" on page 10-6.

Connecting Systems Without a Frame Relay Network

Frame relay connections can be established without a frame relay network, similar to the X.25 DTE-to-DTE mode. This type of configuration supports both SNA direct and bridged frame relay formats.

For example, by configuring one of a pair of AS/400 systems as a frame handler (LMIMODE(*FH) on the network interface description) and the other as terminal equipment (LMIMODE(*TE)), the two systems can be connected using a modem eliminator or a high-speed communications line. In this configuration, the system configured as the FH responds to LMI polls received from the TE and reports the status of PVCs configured on the FH system.

See "Local Management Interface (LMI)" on page 10-11 for more information about LMI modes.

Frame Relay Configuration Objects

The configuration objects used for frame relay communications include the following:

Network Interface Description

The network interface description (NWI) defines the characteristics of the physical connection, including:

- The physical interface used
- LMI mode
- LMI timer and retry values
- DLCI numbers assigned to the virtual connections

One network interface description is created for each frame relay port (IOP) by using the Create Network Interface Description (Frame Relay) (CRTNWIFR) command.

Line Descriptions

The line description defines the logical connection to the network. Up to 256 line descriptions can be attached to each frame relay network interface. One line description must be created for each DLCI used. The following CL commands can be used to create line descriptions attached to frame relay network interface descriptions:

CRTLINFR	SNA direct connections to remote systems, such as the AS/400 system, 3745 Communications Controller, or other systems that support the SNA direct format
CRTLINTRN	Bridged token-ring network connections
CRTLINDDI	Bridged DDI network connections

CRTLINETH Bridged Ethernet network connections

Controller Descriptions

The controller description is used to define the remote system or controller. Up to 256 controller descriptions can be attached to each line description. However, the network interface description is limited to support of no more than 256 active controllers; controller descriptions are normally spread across a number of line descriptions. The following CL commands can be used to create controller descriptions for frame relay communications:

CRTCTLAPPC
: APPC controllers are used to represent systems that support APPC or APPN communications. AS/400 systems and personal computers are typically represented by APPC controllers.

CRTCTLHOST
: SNA host controllers are used to represent controllers such as the 3745 controller running NCP.

The value specified for the LINKTYPE parameter on the controller description determines the type of line description to which the controller can be attached:

- Controller descriptions that specify LINKTYPE(*FR) can attach only to frame relay line descriptions.
- Controller descriptions that specify LINKTYPE(*LAN) can attach to token-ring, DDI, or Ethernet lines.

Both APPC and SNA host controllers can be configured as APPN(*YES). If the controllers configured as APPN(*NO), APPC or SNA host device descriptions must also be created for each session that the remote system will support.

Figure 10-3 shows an example of objects configured for frame relay communications, including the network interface, line descriptions (LINDs), and controller descriptions (CTLDs).

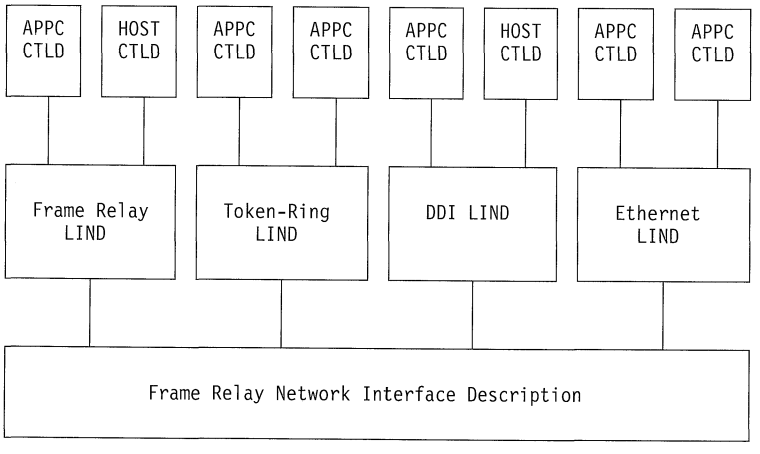


Figure 10-3. Example of Objects Configured for Frame Relay Communications

Frame Relay Addressing Considerations

Frame relay addressing is provided through data link connection identifiers and, for bridged connections, LAN adapter addresses.

Data Link Connection Identifiers (DLCIs)

Data link connection identifiers (DLCIs) are used to identify the logical connections between nodes.

A single physical connection to the frame relay network is used to support multiple logical, or virtual, connections. Each virtual connection, called a permanent virtual circuit (PVC), is identified by a DLCI number assigned by the frame relay network. The AS/400 system supports up to 256 virtual circuits for each physical connection.

The DLCI number used to identify a virtual circuit is assigned by the frame relay network provider, usually at subscription time. The DLCI number applies only to the connection between nodes (TE-to-FH or FH-to-FH). Figure 10-4 shows an example of DLCI assignments for a frame relay connection.

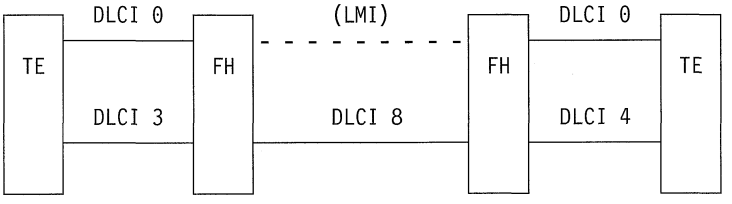


Figure 10-4. Example of DLCI Assignments for PVC Connections

DLCI values are configured for the AS/400 system by specifying the NWIDLCI parameter on the line description commands (for frame relay and bridged LAN line descriptions) or by specifying the DLCI number and line description name on the the DLCI parameter of the CRTNWIFR command.

The AS/400 system uses DLCI 0 for the local management interface (LMI). The LMI is used to manage the physical and virtual connections between the terminal equipment (TE) and the frame handler (FH). DLCIs 1 through 1018 can be used to identify logical connections to remote TEs.

See "Local Management Interface (LMI)" on page 10-11 for more information about the LMI.

Frame Relay Adapter Addresses

The frame relay communications IOP is not given a preset (burned-in) adapter address. This address must be specified for the local adapter address (ADPTADR parameter) on token-ring, DDI, and Ethernet line descriptions used for bridged frame relay connections. The frame relay adapter address is configured the same as for locally attached LAN lines. The local adapter address is not required for SNA direct configurations.

The remote adapter address (ADPTADR parameter on the controller description) must be configured to match the adapter address of the remote system.

SNA direct frames do not include the source or destination addresses and therefore do not need to be configured for frame relay line descriptions or for controllers that specify LINKTYPE(*FR).

Frame Relay Protocol Headers and Frame Formats

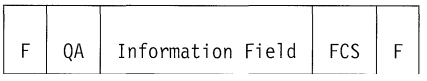
The frame relay network routes frames through the network by examining the DLCI field and then routing the frame to an outgoing link. It is assumed that the network will deliver frames to the remote TE in the same sequence as they were provided to the network by the local TE.

At each node within the frame relay network, the frame format and size are checked and the frame check sequence (FCS) is verified. If the frame is valid, the DLCI and FCS are replaced and the frame is routed to the next node. If the frame is invalid or damaged, it is discarded. The network node provides no error recovery.

The following topics describe the frame format used for frame relay communications, including the various protocol headers used for SNA direct, bridged LAN, and LMI frames.

Frame Relay Core Services (FRCS) Frame Format

Figure 10-5 shows the basic frame format used for frame relay communications.




```
F   = HDLC or Q.922 flag
QA  = HDLC or Q.922 address field (2 bytes)
FCS = HDLC or Q.922 frame check sequence (2 bytes)
```

Figure 10-5. Frame Relay Frame Format

The frame relay core services (FRCS) portion of the frame is used to route the frame through the frame relay network. The frame structure is based on the CCITT Q.922 protocol. Figure 10-6 on page 10-7 shows the FRCS frame format and the fields within the 2-byte Q.922 address field (QA). The protocol headers used within the frame are described under "Frame Relay Protocol Headers and Frame Formats" on page 10-7.

```
DLCI0 = DLCI high order bits (6 bits)
DLCI1 = DLCI low order bits (4 bits)
C/R   = Command/Response bit (not used)
EA0/1 = Extended address indicators
CC    = Congestion control (3 bits)
```

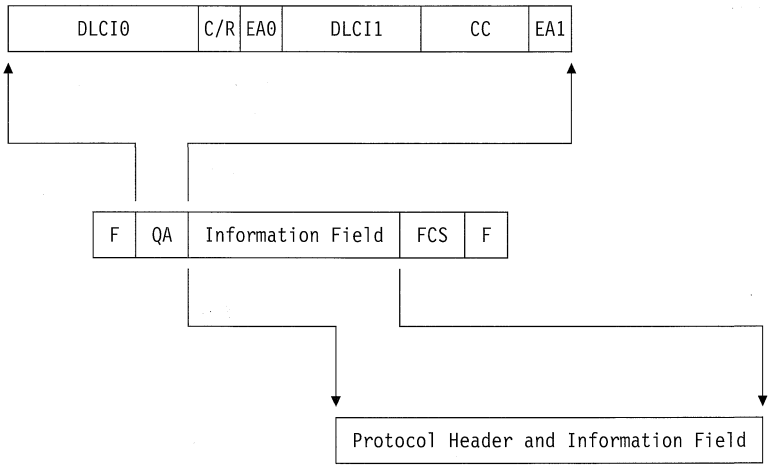


Figure 10-6. Frame Format for Frame Relay Core Services (FRCS)

Frame Relay Protocol Headers and Frame Formats

Frame relay protocol headers are used by the end nodes (TEs) to provide routing for frames, assure data integrity, and to perform recovery when frames are corrupted or lost. AS/400 frame relay support uses protocol headers defined in *Request for Comment 1294 (RFC-1294)* of the TCP/IP forum.

Figure 10-7 shows the protocol header formats used by the AS/400 system for SNA direct, bridged LAN, and LMI connections. These headers and information fields (protocol data units or IP packets) are contained in the information field of the frame relay core services frame (see "Frame Relay Core Services (FRCS) Frame Format" on page 10-6). Figure 10-8 describes the protocol header fields shown in Figure 10-7.

SNA Direct Frame Format

C	NLPID	L2	L3	DSAP	SSAP	Ctl	Information Field

Bridged Token-Ring and DDI LAN Frame Format (RFC-1294)

C	PAD	NLPID	OUI	PID	AC	FC	DA	SA	RI	DSAP	SSAP	Ctl	Information Field

Bridged IEEE 802.3 Ethernet LAN Frame Format (RFC-1294)

C	PAD	NLPID	OUI	PID	AC	FC	DA	SA	Lth	DSAP	SSAP	Ctl	Information Field

Bridged Ethernet Version 2 LAN Frame Format (RFC-1294)

C	PAD	NLPID	OUI	PID	DA	SA	Type	Information Field

LMI Messages Frame Format

C	PD	Null	Type	LMI Information Elements

Figure 10-7. Formats for the Frame Relay Protocol Header

Figure 10-8. Format Fields for the Frame Relay Protocol Header

Field	Description	Values/Notes
C	Q.922 (HDLC) control field	
PAD	Pad characters	Pad characters (hex 00) are permitted between the control field and the NLPID field. Pad characters are used for boundary alignment.
NLPID	Network-level protocol identifier	08 CCITT Q.931 (SNA direct) 80 IEEE Subnetwork Access Protocol (SNAP) for bridged LAN connections
PD	Protocol discriminator	LMI frames use hex 08
OUI	Organization-unique identifier	0080C2 IEEE 802.1
PID	Protocol identifier	The AS/400 system supports the following formats not using frame check sequence (FCS): 0007 Ethernet 0009 Token-ring network 000A DDI network The AS/400 system provides receive-only support for the following formats using FCS: 0001 Ethernet 0003 Token-ring network 0004 DDI network
L2	Layer 2 protocol	For AS/400 systems using SNA direct connections, 4C80 is placed in the L2 field. Byte 1 4C IEEE 802.2 (ISO 8802/2) 4E Q.922 (IDLC) 46 LAP-B (X.25) 4A HDLC NRM (SDLC) 51 ISO 7776 Byte 2 80 Undefined 81 MAC address included (IEEE 802.2, ISO 8802/2) or HDLC address included (ISO 7776)
L3	Layer 3 protocol	For AS/400 systems using SNA direct connections, 7082 is placed in the L3 field. Byte 1 66 CCITT X.25 67 ISO 8208 (X.25 PLC) 70 User-specified Byte 2 81 SNA subarea (FID4) 82 SNA peripheral (FID2) 83 APPN (FID2)
	Information field	AS/400 support for direct frame relay connections requires the information field to contain a FID2 protocol data unit (PDU). Information fields sent over bridged connections may contain FID2 PDUs or Internet Protocol (IP) packets.

Other Protocol Header Field Abbreviations:

AC	Access control
FC	Frame control
DA	Destination address
SA	Source address
RI	Routing information
Lth	Length
Type	Ethernet type
DSAP	Destination service access point
SSAP	Source service access point
Ctl	IEEE 802.2 control field

Frame Relay Frame Size Considerations

The frame relay network provider will define and usually establish a tariff for the frame information field size provided. This size is referred to as N203. The N203 value is used to determine the value specified for the AS/400 maximum frame size (MAXFRAME parameter).

The MAXFRAME parameter specifies the maximum protocol data unit (PDU) that can be transmitted or received. The AS/400 system supports MAXFRAME values from 262 to 8192 bytes. The common N203 frame size that must be supported by all networks and attached equipment is 1600 bytes.

The MAXFRAME value configured must take into account the amount of overhead required for the various line types and their associated protocol headers. The length of these headers varies, depending on the type of frame relay connection. For example, bridged connections typically require a longer header than that used for SNA direct since these headers must include source and destination adapter addresses. DDI and token-ring connections also include up to 18 bytes of routing information.

Figure 10-9 shows the number of bytes required for SNA direct and bridged frame relay headers.

Figure 10-9. Lengths for 802.2, Remote LAN, and Frame Relay Headers

Connection Type and Protocol	802.2 LLC Header	Remote LAN Headers				Frame Relay Headers			Total Bytes
		RI	AC/FC	Type/Length	DA/SA	C/NLPID	OUI/PID	L2/L3	
SNA direct	4					2		4	10
Bridged token-ring	4	18	2		12	3	5		44
Bridged DDI	4	18	2		12	3	5		44
Bridged IEEE 802.3	4			2	12	3	5		26
Bridged Ethernet V2				2	12	3	5		22

Abbreviations Used:

RI	Routing information
AC/FC	Access control (AC) and frame control (FC)
DA/SA	Destination address (DA) and source address (SA)
C/NLPID	Q.922 control field (C), Network Level Protocol Identifier (NLPID), and optional PAD
OUI/PID	Organization Unique ID (OUI) and Protocol Identifier (PID)
L2/L3	Layer 2 (L2) and Layer 3 (L3) Protocol

Figure 10-7 on page 10-7 shows the formats used by these protocol headers.

The MAXFRAME value configured for the line description should be equal to the N203 value subscribed to from the network minus the total length of the header for the connection type and protocol shown in Figure 10-9. For example:

- If the N203 subscription is 1600 and you are configuring for SNA direct communications, the MAXFRAME value specified on the CRTLINFR command should be set to 1590 (1600 – 10 bytes).
- If the N203 subscription is 8192 and you are configuring a bridged frame relay connection to a token-ring network, the MAXFRAME value specified on the CRTLINTRN command should be set to 8148 (8192 – 44 bytes).

Additional MAXFRAME Parameter Considerations

The maximum frame size specified on the AS/400 system must be based on the following:

- N203 value (see "Frame Relay Frame Size Considerations" on page 10-9)
- Maximum frame size supported by the protocol or connection type
- Maximum frame size supported by the remote station

The minimum of these values, minus the adjustment for the protocol header, is used to configure the MAXFRAME parameter for frame relay connections. Figure 10-10 shows the maximum frame size limits for supported connection types.

Figure 10-10. Maximum Frame Size Limits for Connection Types

Connection Type	Maximum Frame Size (MAXFRAME Parameter) Limits
SNA direct	8182
Bridged token-ring	8148
Bridged DDI	4444
Bridged Ethernet	1496 for ETHSTD(*IEEE8023) 1500 for non-SNA data using ETHSTD(*ETHV2) 1493 for SNA data using ETHSTD(*ETHV2)

The maximum frame size used for a connection can be configured at several levels of the AS/400 configuration:

Line Description MAXFRAME Parameter

The maximum frame size used for an individual PVC (DLCI) is specified on the MAXFRAME parameter of the frame relay, token-ring, or DDI line description.

The MAXFRAME parameter cannot be configured on Ethernet line descriptions. Ethernet LANs normally use a frame size of 1500 bytes. An N203 value of 1600 is recommended for Ethernet connections to accommodate the standard 1500-byte frame size. For an N203 value less than 1600, the maximum frame size must be configured on the line description SSAP parameter or on the controller description.

Line Description SSAP Parameter

The maximum frame size for an individual SSAP can be specified for the maximum frame size element of the line description SSAP parameter.

Controller Description MAXFRAME Parameter

Maximum frame size for connections to individual remote stations can be specified on the controller description MAXFRAME parameter.

The AS/400 system uses the smallest of the above values when selecting the maximum frame size used for connection to the remote station. For SNA connections, the frame size may also be negotiated downward based on the XID exchange with the remote station.

Frame Relay Performance Tuning Parameters

APPC and SNA host controller descriptions allow specification of a group of LANxxxxxx parameters to provide performance tuning capabilities for both LAN and frame relay connections. Because frame relay networks operate at slower speeds than local area networks, it may be necessary to adjust some of these parameters when the controller description is used for frame relay connections.

If *CALC (the default) is specified for the LANxxxxxx parameters, the AS/400 system will automatically use the values recommended for frame relay connections. These values are adjusted to allow for network delays; they may be reduced when using a high speed network running at J1/T1/E1 speeds. Reducing these values allows quicker error detection but also reduces the time allowed for error recovery.

The values chosen by the system can be displayed by using the DSPCTLD command when the controller is active. Figure 10-11 shows the values used for frame relay connections when *CALC is specified for the LANxxxxxx parameters.

*Figure 10-11. *CALC Values for Controller Description Performance Parameters*

Parameter	Function	*CALC Value
LANCNNTMR	Sets wait time for polling remote station	20 seconds
LANCNNRTY	Sets number of poll retries sent to remote station	10
LANRSPTMR	Sets wait time for frame retransmission	20 seconds
LANFRMRTY	Sets number of frame retransmission attempts	10
LANACKTMR	Sets wait time for acknowledgement to remote station	1 second
LANACKFRQ	Sets number of frames received before sending acknowledgement	1
LANINACTMR	Sets wait time for requesting response from remote station	25 seconds
LANMAXOUT	Sets number of outstanding frames allowed before requesting acknowledgement from remote station	2
LANWDWSTP	Provides an alternative value equivalent to the LANMAXOUT parameter for use during periods of network congestion. The system provides an algorithm for returning the effective maximum outstanding frames value to that specified by the LANMAXOUT parameter as congestion subsides.	*NONE

Local Management Interface (LMI)

The local management interface (LMI) is used to exchange status information between the frame relay network (or the frame handler system) and systems attached to the network (terminal equipment). The LMI uses DLCI 0 to provide verification of the physical connection and status for logical connections.

LMIMODE Parameter

The LMIMODE parameter on the network interface description is used to specify the type of LMI exchange done by the AS/400 system. The AS/400 system can be configured as the terminal equipment (*TE), as the frame handler (*FH), or it can be configured to exchange no LMI information (*NONE).

Use the default value, LMIMODE(*TE), when connecting to a frame relay network. When connection is made without a network (using a modem eliminator or non-switched line), the AS/400 system can be configured as a frame handler (LMIMODE(*FH)). In this configuration, the AS/400 system responds to LMI messages as an FH.

POLLITV and FULLINQITV Parameters

The polling interval (POLLITV) and full inquiry interval (FULLINQITV) parameters are used to control the exchange of information over the LMI.

- The POLLITV parameter represents the frame relay T391 timer. The POLLITV parameter sets the interval at which the TE sends a status inquiry message to the FH. POLLITV can be set to any value between 5 and 30 seconds; the default value is 10 seconds.
- The FULLINQITV parameter represents the frame relay N391 count. The FULLINQITV parameter sets the interval at which the TE requests full status from the FH. The FULLINQITV parameter can be set to any value between 1 and 255 cycles; the default value is 6.

LMI Exchanges

The POLLITV and FULLINQITV parameters are used to control the keep-alive and PVC status exchanges over the LMI.

Keep-Alive Exchange

The keep-alive exchange is used to maintain contact between the TE and FH. It consists of an exchange of sequenced messages.

At intervals specified by the POLLITV parameter, the TE sends Status Inquiry messages to the FH. The FH is expected to respond with a Status message that includes the correct sequence number (both Status Inquiry and Status messages include sequence numbers).

PVC Status Exchange

After the number of Status Inquiry messages specified by the FULLINQITV parameter have completed, the TE requests a full status from the FH. The FH responds with a Status message that includes a list of the PVCs (DLCIs) assigned to the physical connection and the status of each PVC.

You can use the Display Network Interface Description (DSPNWID) command to show the PVC status reported by the network (see Figure 10-12).

```
                    Display NWI Description (Frame Relay)          RCHAS320
                                                                   02/17/93  10:48:49
Network interface description  . . :   FR1
Category of NWI  . . . . . . . . . :   *FR
Option . . . . . . . . . . . . . . :   *DLCIENTRY

Data link connection ID  . . . . . :

           Active or
DLCI       Attached       DLCI
Number     Line           Status
1          FR1TRN1        ACTIVE
2          FR1DDI1        ACTIVE
3          FR1ETH1        ACTIVE
1018       FR1DIR1        ACTIVE




                                                                        Bottom
Press Enter to continue.

F3=Exit   F5=Refresh   F11=Display keywords   F12=Cancel
```

Figure 10-12. Display NWI Description Display

Chapter 11. Frame Relay Network Configuration Examples

This chapter provides examples of SNA direct and bridged frame relay configurations.

SNA Direct Frame Relay Configuration Examples

This topic includes configuration examples of SNA direct connections. The examples include:

- Connecting two AS/400 systems over a frame relay network
- Connecting two AS/400 systems using a modem eliminator
- Connecting an AS/400 system to a 3745 host controller over a frame relay network

SNA Direct Connection of Two AS/400 Systems

In the example shown in Figure 11-1, an AS/400 system in Minneapolis is connected to an AS/400 system in Madison over a frame relay network. The two systems have an APPN connection configured on the frame relay DLCI. Note that the frame relay link in Minneapolis has much more traffic and is operating at 1536000 bps. The link in Madison is operating at 64000 bps. The frame relay network allows for this difference in subscriptions at the two sites.

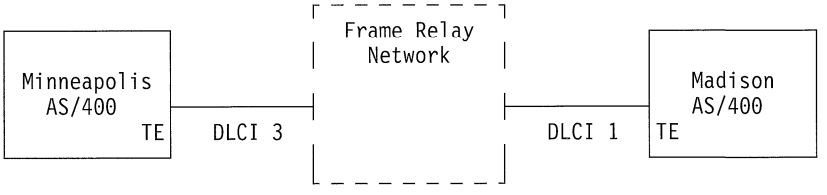


Figure 11-1. SNA Direct Connection between Minneapolis and Madison Systems

The Minneapolis connection to the network uses DLCI 3; in Madison, the DLCI number is 1. If a frame relay network is being used, the DLCI numbers have only local (TE-to-FH) significance and may be different on the two interfaces. The network is responsible for setting up the connection between the DLCIs at administration time.

If more than one APPC connection is required between the two sites, additional SSAP and DSAP values would need to be defined on the lines, and the additional controllers would need different SSAP/DSAP combinations.

Configuration for the AS/400 System in Minneapolis

Figure 11-2 shows the prompt display for the CRTNWIFR command used to create the network interface description on the Minneapolis system.

```
                    Create Network Interface Desc (CRTNWIFR)

Type choices, press Enter.

Network interface description  . > FRMINNEAP     Name
Resource name  . . . . . . . . . > LIN211        Name
Online at IPL  . . . . . . . . .   *YES          *YES, *NO
Vary on wait . . . . . . . . . .   *NOWAIT       *NOWAIT, 15-180 (1 second)
Data link connection ID:
  DLCI number  . . . . . . . . .   *NONE         1-1018, *NONE
  Line description . . . . . . .                 Name
               + for more values
NRZI data encoding . . . . . . .   *NO           *NO, *YES
Physical interface . . . . . . .   *RS449V36 1    *RS449V36, *V35, *X21
Clocking . . . . . . . . . . . .   *MODEM        *MODEM, *LOOP
Line speed . . . . . . . . . . .   1536000 1    56000-2048000, 56000...
LMI mode . . . . . . . . . . . .   *TE 2   *TE, *FH, *NONE
Polling interval . . . . . . . .   10            5-30
Full inquiry interval  . . . . .   6             1-255

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

```
                    Create Network Interface Desc (CRTNWIFR)

Type choices, press Enter.

Text 'description' . . . . . . . > 'Frame relay NWI at Minneapolis'
```

Figure 11-2. Prompt Display for Create Network Interface Description (Frame Relay)

1 The INTERFACE and LINESPEED parameter values must match the network subscription.

2 Specify LMIMODE(*TE) when communicating over a frame relay network. The LMI uses DLCI 0.

Figure 11-3 on page 11-3 shows the prompt display for the CRTLINFR command used to create the frame relay line description on the Minneapolis system.

```
                    Create Line Desc (FR) (CRTLINFR)

Type choices, press Enter.

Line description . . . . . > FRMADISON     Name
Attached nonswitched NWI . . . > FRMINNEAP     Name, *NONE
DLC identifier . . . . . .   3 1           1-1018, *NONE
Online at IPL  . . . . . .   *YES          *YES, *NO
Vary on wait . . . . . .     *NOWAIT       *NOWAIT, 15-180 (1 second)
Maximum controllers  . . . . .   40          1-256
Maximum frame size . . . . . .   1590 2   265-8182, 1590
Exchange identifier  . . . . . > 05601300      05600000-056FFFFF, *SYSGEN
SSAP list:
  Source service access point  .   *SYSGEN       02-FE, *SYSGEN
  SSAP maximum frame . . . . . .                 *MAXFRAME, 265-8182
  SSAP type  . . . . . .                         *CALC, *NONSNA, *SNA
              + for more values
Text 'description' . . . . . > 'Frame relay DLCI to Madison Branch'


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

Figure 11-3. Prompt Display for Create Line Description (Frame Relay)

1 The DLCI specified for the line must match the network subscription.

2 The maximum frame size is 1600. Because ten bytes of overhead are needed for frame relay SNA direct addresses, a frame size of 1590 is configured for the MAXFRAME parameter.

Figure 11-4 shows the prompt display for the CRTCTLAPPC command used to create the APPC controller description on the Minneapolis system.

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

Type choices, press Enter.

Controller description . . . . . > FRMADISON     Name
Link type  . . . . . .  . . . > *FR    1      *FAX, *FR, *IDLC, *LAN...
Online at IPL  . . . . . .   *YES          *YES, *NO
APPN-capable . . . . . .     *YES          *YES, *NO
Switched line list . . . . . . > FRMADISON     Name
            + for more values
Maximum frame size . . . . . .   *LINKTYPE     265-16393, 256, 265, 512...
Remote network identifier  . . .   *NETATR       Name, *NETATR, *NONE, *ANY
Remote control point . . . . . > MADISON       Name, *ANY
Exchange identifier  . . . . . > 05633966      00000000-FFFFFFFF
Initial connection . . . . . .   *DIAL         *DIAL, *ANS
Dial initiation  . . . . . .     *LINKTYPE     *LINKTYPE, *IMMED, *DELAY
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
                                                                    More...
F3=Exit   F4=Prompt   F5=Refresh   F10=Additional parameters   F12=Cancel
F13=How to use this display        F24=More keys
```

Figure 11-4 (Part 1 of 2). Prompt Display for Create Controller Description (APPC)

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

Type choices, press Enter.

User-defined 1 . . . . . .   *LIND         0-255, *LIND
User-defined 2 . . . . . .   *LIND         0-255, *LIND
User-defined 3 . . . . . .   *LIND         0-255, *LIND
Text 'description' . . . . . > 'APPN frame relay connection to Madison'
```

Figure 11-4 (Part 2 of 2). Prompt Display for Create Controller Description (APPC)

1 LINKTYPE(*FR) is specified for SNA direct connections.

Note: The default values for SSAP and DSAP are both 04. These values must match the remote system. If more controllers are to be created using the same line description (DLCI), they must specify a unique SSAP/DSAP pair. This may require more SAPs to be configured on the frame relay line description.

Configuration for the AS/400 System in Madison

The following commands can be used to create the frame relay configuration for the AS/400 system in Madison.

```
CRTNWIFR   NWID(FRMADISON) RSRCNAME(LIN121) INTERFACE(*RS449V36) +
           CLOCK(*MODEM) LINESPEED(64000) LMIMODE(*TE) +
           TEXT('Frame Relay NWI in Madison')

CRTLINFR   LIND(FRMINNEAP) NWI(FRMADISON) NWIDLCI(1) MAXFRAME(1590) +
           EXCHID(05633966) TEXT('Frame Relay DLCI to Minneapolis +
           Branch')

CRTCTLAPPC CTLD(FRMINNEAP) LINKTYPE(*FR) SWTLINLST(FRMINNEAP) +
           RMTCPNAME(MINNEAP) EXCHID(05601300) DSAP(04) SSAP(04) +
           TEXT('APPN Connection to Minneapolis Central Office')

CRTDEVAPPC DEVD(FRMINNEAP) RMTLOCNAME(MINNEAP) CTL(FRMINNEAP) +
           LOCADR(00) TEXT('APPC connection to AS/400 in Minneapolis')
```

Figure 11-5. Configuration for the Madison AS/400 System

SNA Direct Connection Using a Modem Eliminator

The following example shows the configuration of two AS/400 systems for SNA direct frame relay communications without a frame relay network.

In the example shown in Figure 11-6, AS/400 system RCHAS1 is connected to AS/400 system RCHAS2 through an X.21 modem eliminator. The modem eliminator operates at a speed of 1.536 Mbps. One data link connection identifier (DLCI) is defined between the two systems. Both RCHAS1 and RCHAS2 are defined as APPN end nodes. It is necessary to create the APPC controller descriptions, but the device descriptions will be created automatically.

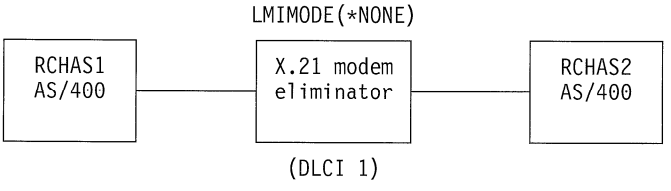


Figure 11-6. SNA Direct Connection Using a Modem Eliminator

Configuration for the RCHAS1 System

The following commands are used to configure the RCHAS1 AS/400 system.

```
CRTNWIFR   NWID(RCHAS2) RSRCNAME(LIN301) INTERFACE(*X21) 1 +
           LINESPEED(1536000) 1 LMIMODE(*NONE) 2 +
           TEXT('Frame relay connection through modem eliminator')

CRTLINFR   LIND(RCHAS2FR) NWI(RCHAS2) NWIDLCI(1) 3 MAXCTL(40) +
           MAXFRAME(1590) 4 EXCHID(05610441) LINKSPEED(1536000) 5 +
           TEXT('Frame Relay direct line to RCHAS2')

CRTCTLAPPC CTLD(RCHAS2FR) LINKTYPE(*FR) 6 APPN(*YES) +
           SWTLINLST(RCHAS2FR) RMTNETID(*NETATR) +
           RMTCPNAME(RCHAS2) EXCHID(05600033) DSAP(04) 7 SSAP(04) +
           TEXT('FR direct controller for RCHAS2')
```

Figure 11-7. Configuration on RCHAS1 System

1. The INTERFACE and LINESPEED parameter values must match modem eliminator.
2. LMIMODE is *NONE, meaning that the systems will not exchange LMI data. The LMI is not needed for attachments without a network.
3. The DLCI used for the line must match the DLCI configured on the remote system for this connection. If multiple lines are configured, all DLCIs must match the remote system.
4. The maximum frame size is 1600. Because ten bytes of overhead are needed for frame relay SNA direct addresses, a frame size of 1590 is configured for the MAXFRAME parameter.
5. APPN link speed (LINKSPEED parameter) is set according to the speed specified on the NWI.
6. LINKTYPE(*FR) is specified for SNA direct connections.
7. SSAP is 04 and DSAP is 04. These values must match the values specified for the remote system. If more controllers are to be created using the same line description (DLCI), they must specify a unique SSAP/DSAP pair. This may require more SAPs to be configured on the frame relay line description.

Configuration for the RCHAS2 System

The following commands are used to configure the RCHAS2 AS/400 system.

```
CRTNWIFR   NWID(RCHAS1) RSRCNAME(LIN291) +
           INTERFACE(*X21) LINESPEED(1536000) LMIMODE(*NONE) +
           TEXT('Frame Relay Interconnect through modem eliminator')

CRTLINFR   LIND(RCHAS1FR) NWI(RCHAS1) NWIDLCI(1) MAXCTL(40) +
           MAXFRAME(1590) EXCHID(05600033) LINKSPEED(1536000) +
           TEXT('Frame Relay direct line to RCHAS1')

CRTCTLAPPC CTLD(RCHAS1FR) LINKTYPE(*FR) APPN(*YES) +
           SWTLINLST(RCHAS1FR) RMTNETID(*NETATR) +
           RMTCPNAME(RCHAS1) EXCHID(05610441) DSAP(04) SSAP(04) +
           TEXT('FR direct controller for RCHAS1')
```

Figure 11-8. Configuration on RCHAS2 System

SNA Direct Connection to Host System

The following example shows the configuration of an AS/400 system for frame relay communications with a 3745 Host Controller. As shown in Figure 11-9, the 3745 is providing frame relay network (frame handler) function, and the AS/400 is configured as a TE.

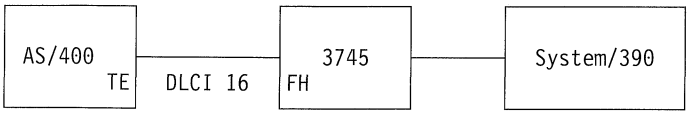


Figure 11-9. SNA Direct Connection to 3745 Host Controller

A 64000 bps V.35 line is between the AS/400 and the 3745. The AS/400 system may also have DLCI connections to multiple 3745s, 6611s, and RouteXpanders through the 3745. However, these configurations are not shown as part of this example.

There is a single PVC connection between the AS/400 and the host system. This connection supports a 3270 emulation device used to access applications on the host. It also includes a distributed host command facility (DHCF) session.

Configuration for the AS/400 System

The following commands are used to configure the AS/400 system using an SNA direct connection with the 3745 and the host system.

```
CRTNWIFR    NWID(FR3745) RSRCNAME(LIN121) +
            INTERFACE(*V35) 1 LINESPEED(64000) 1 +
            LMIMODE(*TE) 2 TEXT('Frame relay connection to 3745')

CRTLINFR 3  LIND(FR3745) NWI(FR3745) NWIDLCI(16) 4 +
            EXCHID(05636759) TEXT('DLCI connection to the host')

CRTCTLHOST  CTLD(FRHOST) LINKTYPE(*FR) APPN(*NO) +
            SWTLINLST(FR3745) MAXFRAME(8182) +
            SSCPID(050000000001) SWTDSC(*YES) +
            TEXT('Remote Host system')

CRTDEVDSP   DEVD(FRDHCF) DEVCLS(*RMT) TYPE(3277) +
            MODEL(*DHCF) LOCADR(02) CTL(FRHOST) +
            TEXT('Remote host system dhcf device')

CRTDEVHOST  DEVD(FREML) LOCADR(01) RMTLOCNAME(HOSTSYS) +
            CTL(FRHOST) APPTYPE(*EML) +
            TEXT('Emulation device to remote host')
```

Figure 11-10. Configuration for the AS/400 System

1. The INTERFACE and LINESPEED parameters must match the characteristics of the line to the 3745.
2. The LMI mode is *TE (the default), which means that the AS/400 acts as the terminal equipment. The 3745 must be configured as the frame handler (FH) using ANSI Annex D (DLCI 0).
3. By creating a frame relay line description (CRTLINFR), you are indicating that the DLCI you are configuring is connected to another device that supports the frame relay SNA direct frame format of RFC-1294, such as the 3745.
4. The DLCI used for the line must match the DLCI assigned in the configuration of the 3745.

Bridged Frame Relay Configuration Examples

This topic includes configuration examples of bridged frame relay connections. The examples include:

- Connecting an AS/400 system on a frame relay network to systems on two remote token-ring networks. The 6611 Network Processor and PS/2-based RouteXpander/2 are used as bridges between the frame relay network and the remote LANs.
- Connecting an AS/400 system to an Ethernet LAN using a 6611 Network Processor. The 6611 is used both as the frame relay frame handler and as a bridge.

The configurations of the 6611 and the RouteXpander/2 are not included, but some general considerations for configuring them are provided.

Bridged Connections to Remote Token-Ring Networks

The following examples show the configuration of an AS/400 system for frame relay communications with devices on two different token-ring networks. One token-ring network is connected using a 6611 Network Processor as a bridge. The other is connected using a RouteXpander/2.

The T1 connection into the frame relay network is configured using two DLCIs, each providing a link to one of the bridges. DLCI 32 defines a PVC to the RouteXpander/2 and DLCI 33 defines a PVC to the 6611. (See Figure 11-11.)

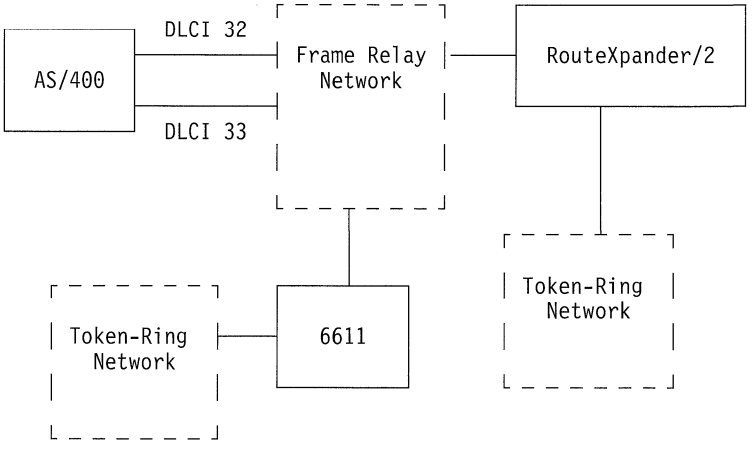


Figure 11-11. Bridged Connections to Remote Token-Ring Networks

The source route bridging protocol is implemented on both bridges in this configuration. Both SNA APPC/APPN and TCP/IP traffic are possible in these configurations. The TCP/IP configuration for lines ROUTE6611 and ROUTEEX is done similarly to the way all token-ring network lines are configured for TCP/IP on the AS/400 system.

Creating the Frame Relay Network Interface Description

The following command is used to configure the AS/400 system connection to the frame relay network.

```
CRTNWIFR  NWID(FRMRLY) RSRCNAME(LIN031) INTERFACE(*RS449V36) 1  +
          LINESPEED(1536000) 1  LMIMODE(*TE) 2  +
          TEXT('T1 link to frame relay network')
```

Figure 11-12. Network Interface Description for Bridged LAN Connections

1 Values specified for the INTERFACE and LINESPEED parameters must match the frame relay services supplied by the network provider.

2 LMI mode is *TE, which means that the AS/400 system exchanges information with the network on DLCI 0. If the network does not support the LMI on DLCI 0, then the LMIMODE parameter must be configured to *NONE, and the network provider must configure the frame relay switch to not perform LMI functions on the line.

Bridged Token-Ring Configuration through the 6611 Network Processor

The following commands are used to configure the AS/400 connection to a remote token-ring network through a 6611 Network Processor. This configuration can be used to communicate using either SNA or TCP/IP data.

```
CRTLINTRN 1  LIND(ROUTE6611) RSRCNAME(*NWID) NWI(FRMRLY) +
             NWIDLCI(33) 2  LINESPEED(*NWI) MAXFRAME(8148) 3  +
             ADPTADR(400000036760) 4  EXCHID(05636760) +
             AUTOCRTCTL(*YES) 5  TEXT('DLCI to the 6611')

ADDTCPLNK 6  LIND(ROUTE6611) INTNETADR('59.1.2.222')

CRTCTLAPPC   CTLD(PC3) LINKTYPE(*LAN) SWTLINLST(ROUTE6611) +
             RMTNETID(APPN) RMTCPNAME(PC3) ADPTADR(400000051718) +
             TEXT('PC3 on 6611 Token Ring Network')

CRTDEVAPPC   DEVD(PC3) RMTLOCNAME(PC3) LCLLOCNAME(RCHAS320) CTL(PC3) +
             TEXT('PC3 on 6611 Token Ring Network')

CRTCTLAPPC   CTLD(PC4) LINKTYPE(*LAN) SWTLINLST(ROUTE6611) +
             RMTNETID(APPN) RMTCPNAME(PC4) ADPTADR(400000564318) +
             TEXT('PC4 on 6611 Token Ring Network')

CRTDEVAPPC   DEVD(PC4) RMTLOCNAME(PC4) LCLLOCNAME(RCHAS320) CTL(PC4) +
             TEXT('PC4 on 6611 Token Ring Network')
```

Figure 11-13. Bridged Configuration through 6611 Network Processor

1 By creating a token-ring line (CRTLINTRN), you are indicating that the DLCI for which you are configuring is connected to a token-ring bridge. The bridge provides RFC-1294 bridging and performs source route bridging.

2 The DLCI configured for the line must match that which is supplied by the network provider. At administration time, the network provider must establish a PVC connection to the location of the bridge. If more than one bridge is being connected, multiple DLCIs and token ring line descriptions need to be configured.

3 The MAXFRAME values for each line may be different. The values selected must take into account the maximum size supported by the network and the maximum size supported by the bridge. See "Frame Relay Frame Size Considerations" on page 10-9 for information about determining a frame size to configure in the line descriptions.

4 An adapter address (ADPTADR) must be generated for each line description that is configured for bridging over frame relay. The frame relay adapter does not have a preset address.

5 AUTOCRTCTL is configured so that any devices that dial in to the AS/400 will have controller and device descriptions automatically created.

6 The ADDTCPLNK command is used to add the lines to the TCP/IP configuration.

Note: If the 6611 Network Processor is used to pass TCP/IP data from a frame relay network to a token-ring or Ethernet network, you must ensure that the 6611 does not filter data for SAP AA. Filtering for SAP AA must be turned off on both the frame relay port and on the token-ring or Ethernet port.

Bridged Token-Ring Configuration through RouteXpander/2

The following commands are used to configure the AS/400 connection to a remote token-ring network through a RouteXpander/2. This configuration can be used to communicate using either SNA or TCP/IP data.

```
CRTLINTRN  LIND(ROUTEEX) RSRCNAME(*NWID) NWI(FRMRLY) NWIDLCI(32) +
           LINESPEED(*NWI) MAXFRAME(4052) ADPTADR(400000036759) +
           EXCHID(05636759) AUTOCRTCTL(*YES) +
           TEXT('DLCI to RouteXpander/2')

ADDTCPLNK  LIND(ROUTEEX) INTNETADR('59.1.2.211')

CRTCTLAPPC CTLD(PC1) LINKTYPE(*LAN) SWTLINLST(ROUTEEX) RMTNETID(RPC) +
           RMTCPNAME(PC1) ADPTADR(400000049605) TEXT('PC1 on +
           RouteXpander/2 Token Ring Network')

CRTDEVAPPC DEVD(PC1) RMTLOCNAME(PC1) LCLLOCNAME(RCHAS320) CTL(PC1) +
           TEXT('PC1 on RouteXpander/2 Token Ring Network')

CRTCTLAPPC CTLD(PC2) LINKTYPE(*LAN) SWTLINLST(ROUTEEX) RMTNETID(RPC) +
           RMTCPNAME(PC2) ADPTADR(400000047605) TEXT('PC2 on +
           RouteXpander/2 Token Ring Network')

CRTDEVAPPC DEVD(PC2) RMTLOCNAME(PC2) LCLLOCNAME(RCHAS320) CTL(PC2) +
           TEXT('PC2 on RouteXpander/2 Token Ring Network')
```

Figure 11-14. Bridged Configuration through RouteXpander/2.

Bridged Connection to an Ethernet Network

The following example shows the configuration of an AS/400 system for frame relay communications with devices on an Ethernet network. The Ethernet LAN is connected using a 6611 bridge and transparent bridging. The bridge is connected to the AS/400 using a T1 link.

As shown in Figure 11-15, no frame relay network exists in the connection between the AS/400 and the 6611. In this example, the AS/400 is providing the frame handler (FH), or DCE function; the 6611 bridge is the terminal equipment (TE). Both SNA APPC/APPN and TCP/IP traffic are possible in this configuration. The TCP/IP configuration for line ETHER6611 is done similarly to the way all Ethernet lines are configured for TCP/IP on the AS/400.

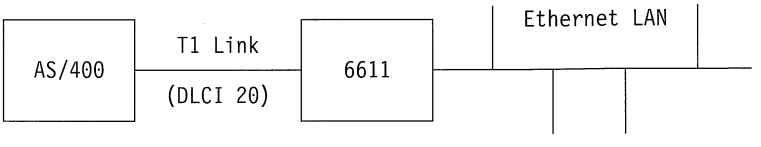


Figure 11-15. Bridged Configuration to the Ethernet Network

Bridged Configuration to the Ethernet Network

The following commands are used to configure the AS/400 connection to the Ethernet network through a 6611 Network Processor. This configuration can be used to communicate using either SNA or TCP/IP data.

```
CRTNWIFR    NWID(FRT1) RSRCNAME(LIN231) NRZI(*YES) 1 +
            INTERFACE(*RS449V36) 2 LINESPEED(1536000) 2 +
            LMIMODE(*FH) 3 +
            TEXT('Network Interface for T1 link to Ethernet Bridge')

CRTLINETH 4 LIND(ETHER6611) RSRCNAME(*NWID) NWI(FRT1)
            NWIDLCI(20) 5 ADPTADR(020000036759) 6 +
            EXCHID(05636759) LINKSPEED(1536000) AUTOCRTCTL(*YES) 7 +
            TEXT('DLCI to the 6611 Ethernet LAN')

ADDTCPLNK 8 LIND(ETHER6611) INTNETADR('59.1.2.201')

CRTCTLAPPC  CTLD(PC5) LINKTYPE(*LAN) SWTLINLST(ETHER6611) RMTNETID(RPC) +
            RMTCPNAME(PC5) ADPTADR(020000043405) TEXT('PC5 on +
            6611 Ethernet Network')

CRTDEVAPPC  DEVD(PC5) RMTLOCNAME(PC5) LCLLOCNAME(RCHAS320) CTL(PC5) +
            TEXT('PC5 on 6611 Ethernet Network')

CRTCTLAPPC  CTLD(PC6) LINKTYPE(*LAN) SWTLINLST(ETHER6611) RMTNETID(RPC) +
            RMTCPNAME(PC6) ADPTADR(400000455405) TEXT('PC6 on +
            6611 Ethernet Network')

CRTDEVAPPC  DEVD(PC6) RMTLOCNAME(PC6) LCLLOCNAME(RCHAS320) CTL(PC6) +
            TEXT('PC6 on 6611 Ethernet Network')
```

Figure 11-16. Bridged Configuration to the Ethernet Network

1 NRZI(*YES) must be configured when communicating directly with a 6611 without a frame relay network (such as on a T1 link). The 6611 must also be configured to use NRZI.

2 The INTERFACE and LINESPEED parameters must match the characteristics of the T1 line being used.

3 The LMI mode is *FH, which means that the AS/400 acts as the frame handler and the 6611 acts as the terminal equipment. LMI is exchanged on DLCI 0.

4 By creating an Ethernet line (CRTLINETH), you are indicating that the DLCI for which you are configuring is connected to an Ethernet bridge that has implemented RFC-1294 bridging and performs transparent bridging.

5 The AS/400 system is communicating with the 6611 bridge on DLCI 20.

6 An adapter address (ADPTADR) must be generated for each line description that is configured for bridging over frame relay. The frame relay adapter does not have a preset address.

7 AUTOCRTCTL is configured so that any devices that dial in to the AS/400 will have controller and device descriptions automatically created.

8 The ADDTCPLNK command is used to add the lines to the TCP/IP configuration.

Part 6. Appendixes

Appendix A. LAN Link Test

The link test option on the Verify Communications (VFYCMN) command allows you to test connectivity between the AS/400 system and remote stations on the local area network. The link test can be used to verify that the adapter address, SSAP, and DSAP values configured for local area network controller descriptions are accessible for a specified line description. The link test can also be used to ensure that the local AS/400 LAN adapter is connected to the network.

Before running the link test, the token-ring, DDI, or Ethernet line description must be created and varied on. The connection to a specific controller description may be tested, but a controller description is not required. No controller description needs to be varied on to perform the link test.

Running the LAN Link Test

To run the link test, determine the name of the line description and the controller description (if any) that will be used in the test. Use the Vary Configuration (VRYCFG) or Work with Configuration Status (WRKCFGSTS) command to vary on the line description. Then type VFYCMN to begin the verification procedure. Select the link test option and specify the name of the line description on the appropriate displays.

The values you specify on the Verify a Communications Line and Verify Controller Information displays depend on the type of link test you choose to run.

When the link test is complete you will be shown a display containing completion codes for each of the parameters tested (see "Link Test Completion Codes" on page A-4).

Link Tests for Remote Stations

Link tests for remote stations can be run with or without a controller description. The link test can be used to verify that a connection can be made between the AS/400 system and a remote station based on the following parameters:

ADPTADR	LAN remote adapter address
DSAP	LAN destination service access point
SSAP	LAN source service access point
LANCNNTMR	LAN connection timer
LANCNNRTY	LAN connection retry

Each of these values can be entered directly on the Verify Controller Information display (see Figure A-2 on page A-2). Values used for the remote adapter address, SSAP, and DSAP can be taken from an existing controller description by specifying a controller name on the Verify a Local Area Network Line display (see Figure A-1 on page A-2). Any of the following methods can be used to test the connection to a remote station.

Existing Controller Description: To test the connection to a remote station for which the controller description has already been created, type the name of the controller description on the Verify a Communications Line display (see Figure A-1 on page A-2). Parameter values from the specified controller description will be

shown on the next display, Verify Controller Information (see Figure A-2). Press Enter to run the link test.

Referenced Controller Description: To test the connection to a remote station for which the controller description has not yet been created, you can run the link test using some of the parameter values specified in an existing controller description. Type the name of the referenced controller description on the Verify a Communications Line display (see Figure A-1). Parameter values from the referenced controller description will be shown on the Verify Controller Information display (Figure A-2). Change the controller name to *NONE and the LAN remote adapter address to the adapter address of the station you want to test.

No Controller Description: The connection to a remote station can also be tested without referring to any controller description. Type *NONE in the controller description field on the Verify a Communications Line display (see Figure A-1). Specify the adapter address and other parameters shown on the Verify Controller Information display (Figure A-2).

```
                    Verify a Local Area Network (LAN) Line

To test a Local Area Network controller:

Type choice, press Enter.

  Controller to be tested . . . . . _________       *NONE

If a specific remote address is to be tested and no controller
is configured, select *NONE.
```

Figure A-1. Verify a Communications Line Display

```
                         Verify Controller Information

Please verify or update the following controller information.

Line name  . . . . . .  _________

Controller . . . . . .  _________

LAN remote adapter address . . .  __________  *SELF, valid addr

DSAP (Destination SAP) . . . . .  04        00 to FE

SSAP (Source SAP)  . . . . . .  04        *A, 02 to FE

LANCNNTMR  . . . . . .  03        1-25 seconds

LANCNNRTY  . . . . . .  003       1-254
```

Figure A-2. Verify Controller Information Display

Link Test for Local Adapters

The connection between the LAN adapter on the local AS/400 system and the network can also be tested.

- For DDI and token-ring adapters, the local adapter test verifies that the LAN adapter can be accessed from the network.
- For Ethernet adapters, the local adapter test sends a test frame internally. The Ethernet bus is not tested.

Local Adapter: To test the connection between the local system and the network, type *NONE in the controller description field on the Verify a Communications Line display (see Figure A-1 on page A-2). Then specify *SELF as the LAN remote adapter address on the Verify Controller Information display (see Figure A-3).

```
                    Verify Controller Information

Please verify or update the following controller information.

Line name . . . . . .  TOKENRING1

Controller . . . . . .  *NONE

LAN remote adapter address . . . > *SELF       *SELF, valid addr

DSAP (Destination SAP) . . . . . > 00          00 to FE

SSAP (Source SAP)  . . . . . . . > *A          *A, 02 to FE

LANCNNTMR  . . . . . . . . . . . > 7           1-25 seconds

LANCNNRTY  . . . . . . . . . . . > 10          1-254
```

Figure A-3. Verify Controller Information Display for Local Adapter Test

Link Test Adapter Address Considerations

The following restrictions exist for the adapter address specified for LAN link tests:

- Broadcast addresses cannot be specified.
- Adapter addresses of remote stations accessed using bridges between Ethernet and token-ring or Ethernet and DDI networks must be converted using the procedure described under "Token-Ring to Ethernet Address Conversion" on page C-2.

Link Test Completion Codes

The LAN link test provides a set of hexadecimal completion codes to indicate whether or not the remote adapter and SAP values can be reached from the AS/400 system. Figure A-4 lists the completion codes, their meanings, and possible recoveries.

Figure A-4. LAN Link Test Completion Codes

Code	Meaning	Recovery
00000000	Parameter value found and valid	None
45002ABF	Link test timed out. The parameter cannot be reached using the supplied values. Possible causes include the following: 1. Remote adapter address is incorrect. 2. Remote SAP (DSAP) value is incorrect. 3. LAN connection timer (LANCNNTMR parameter) or both LANCNNTMR and LAN connection retry (LANCNNRTY parameter) values are not large enough. 4. Remote adapter is not attached to the network or is attached to a network other than that represented by the line description. 5. Bridges between the AS/400 system and the remote adapter are unable to transmit the test frame.	Possible recoveries include the following. Verify the values specified for the link test and change the values as indicated. Then run the link test again. 1. Verify the remote adapter address (controller description ADPTADR parameter). 2. Verify the remote SAP (controller description DSAP parameter). 3. Increase the values specified for the LANCNNTMR or for both LANCNNTMR and LANCNNRTY parameters. 4. Verify that the remote adapter is attached to the same network as the line description. 5. Check the bridge and network configurations.
FFFFFFFF	Parameter value was not found. This completion code may indicate that the local SAP (SSAP parameter on the controller description) is not included in the SSAP list for the associated line description.	Change the value specified and run the link test again.
Any other values	Link test not run.	No recovery available. Record the completion code for the next level of support.

Appendix B. LAN Communications Trace

This appendix discusses communications trace functions available for local area network lines, as well as for frame relay line and network interface descriptions. Communications traces can be used to collect and format data exchanged between the AS/400 system and remote systems, controllers, or personal computers. Trace data can then be displayed or printed for analysis and diagnosis of communications errors. Before running a communications trace you can run the link test described in Appendix A to ensure that the remote station can be accessed by the AS/400 system.

Communications trace functions can be accessed using either CL commands or through the system service tools (SST) menu interface. This appendix uses the SST displays to describe communications trace functions. See the *Diagnostic Aids – Volume 1* for more information about running communications traces using SST.

The following CL commands can be used to provide communications trace functions similar to that provided by SST. See the *CL Reference* for complete descriptions of the following commands:

STRCMNTRC	Start Communications Trace
ENDCMNTRC	End Communications Trace
PRTCMNTRC	Print Communications Trace
CHKCMNTRC	Check Communications Trace
DLTCMNTRC	Delete Communications Trace

Procedure for Tracing Data Exchanged at Vary On Time

The purpose of running a communications trace is most often to collect data that is exchanged with a remote station when a configuration object is varied on.

For example, if a personal computer attached to the AS/400 system on a DDI line cannot communicate with the AS/400 system, you might use a communications trace to diagnose the problem. Using SST, the following procedure could be used to trace data exchanged with the personal computer when the controller description representing it is varied on. (This example assumes that the DDI line description is already varied on.)

1. Use the STRSST command to show the System Service Tools display. Choose the option to start a service tool.
2. Choose the option on the Start a Service Tool display to work with communications traces.
3. On the Work with Communications Traces display, press F6 to start a trace.
4. Specify the trace parameters shown on the Start Trace display shown in Figure B-1 on page B-2. See "Starting the Trace" on page B-2 for more information about these parameters. Press Enter to continue to the next display.
5. On the Select Trace Options display (shown in Figure B-2 on page B-4), choose the type of data you want to trace. In this example, you might choose to trace only data sent to and received from the controller associated with the personal computer. After selecting the option to trace data for a remote controller, another display prompts for the name of the controller to trace. Enter

the name of the controller and then press Enter to return to the Work with Communications Traces display.

See "Trace Filters for High-Speed Communications" on page B-3 for more information about the Select Trace Options displays.

6. The trace status shown on the Work with Communications Traces display should now be waiting. The trace cannot begin until the controller being traced is varied on. Press F3 to return to the Start a Service Tool display, and then press F16 to return to the System Service Tools display. Press F10 to show the Command Entry display and use the Vary Configuration (VRYCFG) or Work with Configuration Status (WRKCFGSTS) command to vary on the controller description for the personal computer.
7. Return to the Work with Communications Traces display. The trace status should be active or stopped, depending on the buffer size selected and whether the trace was specified to stop or wrap when the buffer is full. Use F5 to refresh the trace status.
8. When the trace is stopped, use option 6 to format and print the trace data.

Starting the Trace

Figure B-1 shows the Start Trace display used for SST communications traces. The Start Trace display allows you to control the size and use of the trace buffer and to select whether inbound or outbound data (or both) is traced.

```
                              Start Trace

Type choices, press Enter.

  Configuration object . . . . . .  FDDILINE

  Type . . . . . . . . . . . . . .  1       1=Line, 2=Network interface

  Trace description . . . . . . .  FDDI line trace

  Buffer size . . . . . . . . . .  4       1=128K, 2=256K, 3=2048K
                                            4=4096K, 5=6144K, 6=8192K

  Stop on buffer full . . . . . .  Y       Y=Yes, N=No

  Data direction . . . . . . . . .  3       1=Sent, 2=Received, 3=Both

  Number of bytes to trace:
    Beginning bytes . . . . . . .  *CALC   Value, *CALC
    Ending bytes . . . . . . . . .  *CALC   Value, *CALC


F3=Exit   F5=Refresh   F12=Cancel
```

Figure B-1. Start Trace Display

Configuration object
Specify the name of the line or network interface description to trace.

Type Specify whether the traced object is a line or a network interface description.

Trace description

The trace description is optional but can be helpful in identifying trace data if many traces or many variations of a trace are run.

Buffer size

Specify the amount of storage the system should allocate for the trace buffer. For high-speed communications types, such as DDI and frame relay, a large buffer size is recommended.

Stop on buffer full

This value determines whether or not collected trace data is overwritten with later data once the trace buffer is filled. To trace data exchanged when an attached controller is varied on, select Y to stop the trace when the buffer is full.

Data direction

Determines whether data sent, data received, or both are traced. For example, select 3 to trace both the data sent from the AS/400 system to the remote station and the responses of the remote station to the AS/400 system.

Number of bytes to trace

This field allows you to specify the number of bytes traced from the beginning of each frame. For local area network lines, the beginning bytes value must be at least 72.

The default value, *CALC, determines the number of bytes to trace based on the protocol header length plus the frame size specified in the line or network interface description.

The ending bytes value is ignored for local area network lines, frame relay lines, and network interface descriptions.

Trace Filters for High-Speed Communications

The high data rates of DDI and frame relay communications can cause the trace buffer to fill very quickly. AS/400 communications trace support provides dynamic filtering options to save buffer space and exclude unwanted trace data. Formatting options can also be specified to limit the amount of data shown in the spooled file output of the trace.

Trace Filter Options for DDI Lines

Trace data for DDI line descriptions can be filtered to include only frames sent to or received from a specified:

- Controller
- Remote MAC (adapter) address
- Remote SAP
- Local SAP

Figure B-2 on page B-4 shows the Select Trace Options display used for DDI, Ethernet, and token-ring network line descriptions.

```
                          Select Trace Options

Configuration object  . . . . :   FDDILINE
Type  . . . . . . . . . . . . :   LIN

Select one of the following:

     1. All data (no filtering)
     2. Remote controller data
     3. Remote MAC address data
     4. Remote SAP data
     5. Local SAP data



Selection
     1

 F3=Exit    F5=Refresh    F12=Cancel
```

Figure B-2. Select Trace Options Display

The Format Trace Data display (Figure B-3) provides formatting options for collected trace data.

```
                          Format Trace Data

 Configuration object  . . . . :   FDDILINE
 Type  . . . . . . . . . . . . :   LINE

 Type choices, press Enter.

   Controller . . . . . . . . . .   *ALL          *ALL, name

   Data representation  . . . . .   2            1=ASCII, 2=EBCDIC
   Format SNA data only . . . . .   N            1=Yes, 2=No

   Format RR, RNR commands  . . .   N            1=Yes, 2=No

   Format TCP/IP data only  . . .   N            1=Yes, 2=No

   Format UI data only  . . . . .   N            1=Yes, 2=No

   Format MAC or SMT data only  .   N            1=Yes, 2=No

   Format broadcast data  . . . .   N            1=Yes, 2=No

 F3=Exit    F5=Refresh    F12=Cancel
```

Figure B-3. Format Trace Data Display

Trace Options for Frame Relay Lines and Network Interfaces

Communications trace data for frame relay network interfaces can be filtered to exclude local management interface (LMI) data or to include only LMI data. Figure B-4 shows the Select Trace Options display for a frame relay network interface description.

A trace can be started either for the frame relay network interface or for a single line attached to the network interface, but not both. Only one active communications trace is allowed on the frame relay I/O adapter.

Running a communications trace on a frame relay network interface without filtering collects trace data for all lines (DLCIs) attached to the network interface and can quickly fill the trace buffer. Use the option to trace only LMI data to trace data using DLCI 0 (the DLCI reserved for LMI data). Use the option to exclude LMI data to trace all other data on DLCIs attached to the network interface. To trace data using a particular DLCI, run the communications trace on the line description corresponding to that DLCI.

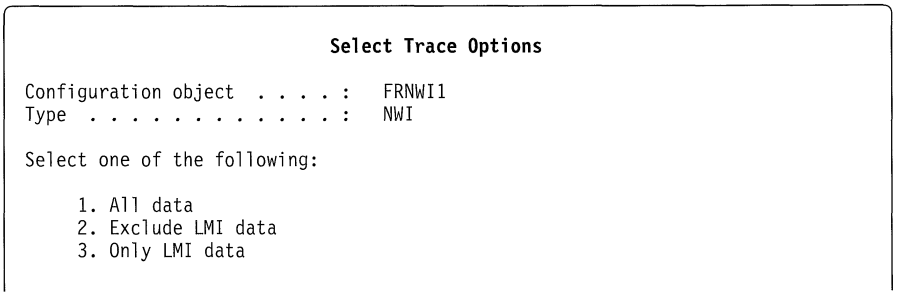


Figure B-4. Select Trace Options Display for Frame Relay NWI

The Format Trace Data display (Figure B-5) provides options similar to those on the Select Trace Options display but is used to format data already collected.

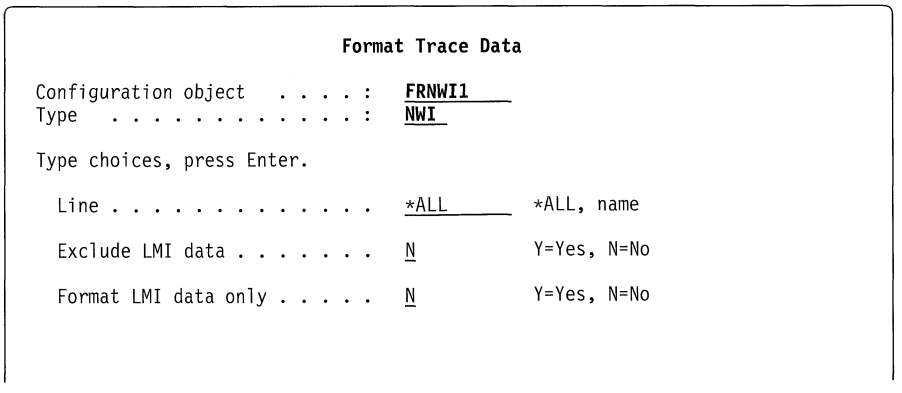


Figure B-5. Format Trace Data Display for Frame Relay NWI

Appendix C. 8209 LAN Bridge Environment

It is important to note that MAC addresses are always displayed in the physical address format for either the token ring or Ethernet environment even if they represent stations on other LAN media. Refer to "Token-Ring Physical Address Format" on page 3-3 for the format of token-ring MAC addresses or to "Ethernet Physical Address Format" on page 8-2 for the format of Ethernet MAC addresses.

Because MAC address formats are in a different bit order, the configured physical addresses will appear in reversed bit order when viewed from different LAN types on opposite sides of the 8209 LAN Bridge. "Token-Ring to Ethernet Address Conversion" on page C-2 provides a conversion table for determining the equivalent addresses.

Note: If you are using the same LAN types on both sides of a series of bridges, no address conversion is necessary. For example, an AS/400 system in an Ethernet network communicating with another AS/400 system in an Ethernet network across a token ring and two LAN Bridges does not need to convert addresses.

Consider the following example of different address views.

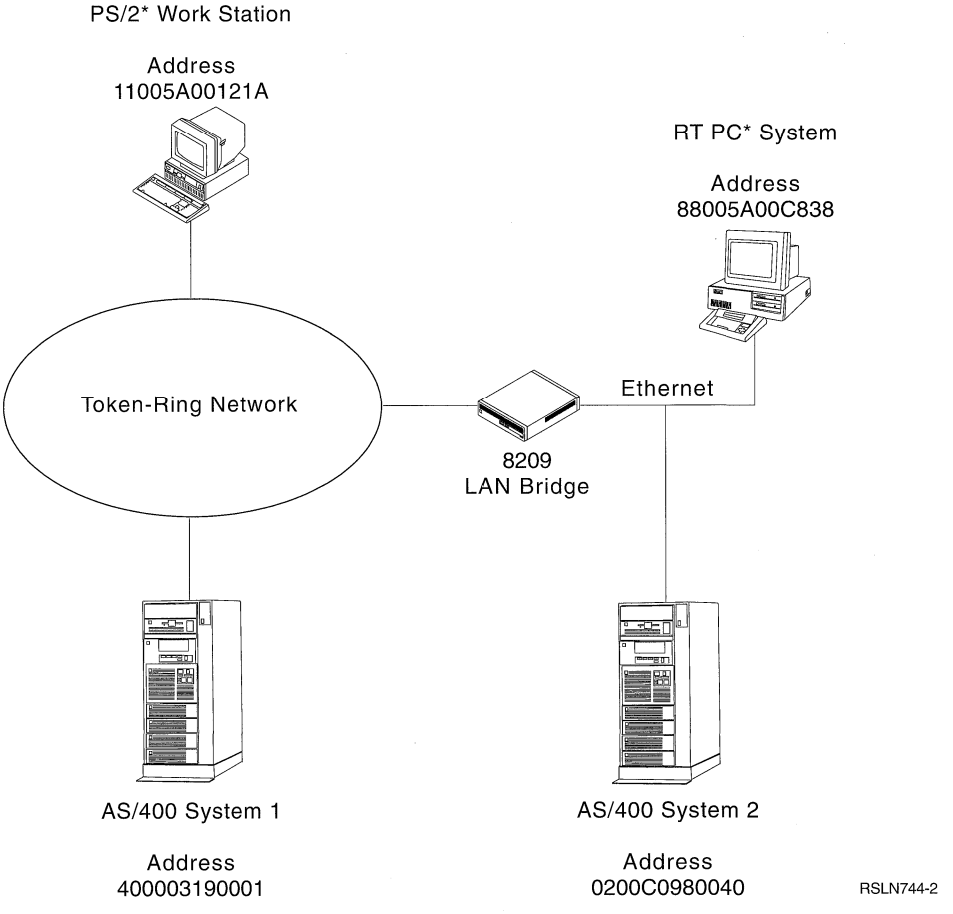


Figure C-1. 8209 LAN Bridge Addressing

Configuration Records for AS/400 System on Token-Ring Network: When System 1 in Figure C-1 is being configured, the addresses of the various systems in the network are viewed as being in token-ring addressing format of most significant bit. The following figure demonstrates System 1 viewpoint.

Figure C-2. Addresses from AS/400 1 View

AS/400 1 View	**Address**
Local Address (System 1)	400003190001
Remote AS/400 System (System 2)	400003190002
PS/2 Address	11005A00121A
RT PC* Address	11005A00131C

Configuration Records for AS/400 System on Ethernet Network: When System 2 in Figure C-1 on page C-1 is being configured, the addresses of the various systems in the network are viewed as being in Ethernet addressing format of least significant bit. The following figure demonstrates System 2 viewpoint.

Figure C-3. Addresses from AS/400 2 View

AS/400 2 View	**Address**
Local Address (System 2)	0200C0980040
Remote AS/400 System (System 1)	0200C0980080
PS/2 Address	88005A004858
RT PC Address	88005A00C838

Token-Ring to Ethernet Address Conversion

The bit order of the 48-bit (12-hexadecimal digits) IEEE MAC address is reversed between the token-ring and Ethernet LANs. Some protocols that use this MAC address may not adjust for the inverted bits when communicating between LANs. Therefore, you must manually convert the address bit order. Use the following procedure and Figure C-4 to convert an address. For an example of how to convert an address, see "Example of Converting an Address" on page C-3.

1. Write the 12-hexadecimal-digit MAC address.

   Note: Separate the 12-hexadecimal digits into pairs. Use the first character of each pair as the row coordinate and the second character as the column coordinate.

2. Locate a bit order inverted pair in Figure C-4.
3. Combine the 6 pairs into a 12-hexadecimal-digit address.

Figure C-4. Example Conversion Table

2nd Char → (Column) 1st Char ↓ (Row)	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	00	80	40	C0	20	A0	60	E0	10	90	50	D0	30	B0	70	F0
1	08	88	48	C8	28	A8	68	E8	18	98	58	D8	38	B8	78	F8
2	04	84	44	C4	24	A4	64	E4	14	94	54	D4	34	B4	74	F4
3	0C	8C	4C	CC	2C	AC	6C	EC	1C	9C	5C	DC	3C	BC	7C	FC
4	02	82	42	C2	22	A2	62	E2	12	92	52	D2	32	B2	72	F2
5	0A	8A	4A	CA	2A	AA	6A	EA	1A	9A	5A	DA	3A	BA	7A	FA
6	06	86	46	C6	26	A6	66	E6	16	96	56	D6	36	B6	76	F6
7	0E	8E	4E	CE	2E	AE	6E	EE	1E	9E	5E	DE	3E	BE	7E	FE
8	01	81	41	C1	21	A1	61	E1	11	91	51	D1	31	B1	71	F1
9	09	89	49	C9	29	A9	69	E9	19	99	59	D9	39	B9	79	F9
A	05	85	45	C5	25	A5	65	E5	15	95	55	D5	35	B5	75	F5
B	0D	8D	4D	CD	2D	AD	6D	ED	1D	9D	5D	DD	3D	BD	7D	FD
C	03	83	43	C3	23	A3	63	E3	13	93	53	D3	33	B3	73	F3
D	0B	8B	4B	CB	2B	AB	6B	E8	1B	9B	5B	DB	3B	BB	7B	FB
E	07	87	47	C7	27	A7	67	E7	17	97	57	D7	37	B7	77	F7
F	0F	8F	4F	CF	2F	AF	6F	EF	1F	9F	5F	DF	3F	BF	7F	FF

Example of Converting an Address

Figure C-5 shows how token-ring address 10005A4DBC96 is converted into a bit-inverted Ethernet address of 08005AB23D69.

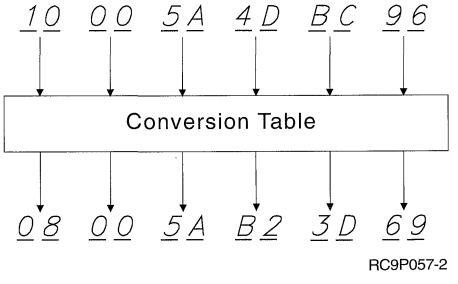


Figure C-5. An Example of Token-Ring Address Conversion

For more examples of converting adapter addresses for bridged configurations, see "Token-Ring-to-Ethernet Bridge Configuration Example" on page 9-7.

Bibliography

The publications listed here provide additional information about topics described or referred to in this guide. These manuals are listed with their full titles and order numbers. When these manuals are referred to in this guide, a shortened version of the title is used.

AS/400 Manuals

- *Communications: Advanced Peer-to-Peer Networking Guide*, SC41-8188, provides the information necessary to define and use advanced peer-to-peer networking (APPN). **Short title:** *APPN Guide*
- *Communications: Advanced Program-to-Program Communications Programmer's Guide*, SC41-8189, provides the information necessary to write application programs that use advanced program-to-program communications (APPC) support. **Short title:** *APPC Programmer's Guide*
- *Communications and Systems Management Guide (Alerts and Distributed Systems Node Executive)*, SC41-9661, provides information for configuring an AS/400 system to use the remote management support (distributed host command facility), the change management support (distributed systems node executive), and the problem management support (alerts). **Short title:** *Alerts and DSNX Guide*
- *Communications: Distribution Services Network Guide*, SC41-9588, provides the system operator or system administrator with information about configuring a network for SNA distribution services (SNADS) and VM/MVS bridge. Object distribution and the system distribution directory are also discussed. **Short title:** *Distribution Services Network Guide*
- *Communications: Finance Communications Programmer's Guide*, SC41-8099, provides the information necessary to define the OS/400 finance communications support and to write application programs that use the support. **Short title:** *Finance Communications Programmer's Guide*
- *Communications: Intersystem Communications Function Programmer's Guide*, SC41-9590, provides the information needed to write application programs that use AS/400 communications and the ICF file. It also contains examples of communications programs and describes return codes. **Short title:** *ICF Programmer's Guide*
- *Communications: Management Guide*, SC41-0024, contains information on working with communications support, such as working with configuration status, error recovery, performance, aggregate line speed, and subsystem storage. **Short title:** *Communications Management Guide*
- *Communications: Operating System/400* Communications Configuration Reference*, SC41-0001, contains general configuration information, including detailed descriptions of network interface, line, controller, device, mode, and class-of-service descriptions, configuration lists, and connection lists. **Short title:** *OS/400* Communications Configuration Reference.*
- *Communications: SNA Upline Facility Programmer's Guide*, SC41-9594, contains the programming information for using the Systems Network Architecture (SNA) upline facility with the AS/400 system. This guide describes how to set up the upline facility, how to write application programs for the SNA upline facility, and the return codes that the SNA upline facility can send to a program. **Short title:** *SNA Upline Facility Programmer's Guide*
- *Data Communications: Remote Work Station Networking Examples*, SA21-9977, provides complete configuration examples for 5294 and 5394 Remote Control Units, including hardware setup.
- *Communications: Remote Work Station Guide*, SC41-0002, provides concepts, examples, and information on preparing for and configuring 5250 display station pass-through and SNA pass-through. It also contains information about using 3270-type remote attachment, 5250-type remote work station controllers, SNA Primary LU 2 Support (SPLS), network routing facility, and the distributed host command facility (DHCF). **Short title:** *Remote Work Station Guide*
- *PC Support/400: DOS Installation and Administration Guide*, SC41-0006, provides the personal computer technical coordinator with information needed to set up, configure, and tailor PC Support/400 through batch and configuration files using DOS, as well as the PC Support/400 Organizer. **Short title:** *PC Support/400 DOS Installation and Administration Guide*
- *PC Support/400: OS/2 Installation and Administration Guide*, SC41-0007, provides the personal computer technical coordinator with information needed to set up, configure, and tailor PC Support/400 through batch and configuration files using the OS/2 operating system, as well as the PC Support/400 Organizer. **Short title:** *PC Support/400 OS/2 Installation and Administration Guide*
- *Programming: Control Language Reference*, SC41-0030, provides a description of the AS/400

control language (CL) and its commands. **Short title:** *CL Reference*

- *Publications Guide*, GC41-9678, lists manuals in the AS/400 library and lists tasks that are described in the manuals. **Short title:** *Publications Guide*
- *System Operator's Guide*, SC41-8082, explains how to use the system unit control panel, send and receive messages, respond to error messages, start and stop the system, use the display station keyboard function keys, control devices, and also process and manage jobs on the system. **Short title:** *Operator's Guide*
- *System Programmer's Interface Reference*, SC41-8223, provides the information necessary to define and use user-defined communications. **Short title:** *System Programmer's Interface Reference*
- *Transmission Control Protocol/Internet Protocol Guide*, SC41-9875, provides installing and configuration information for the AS/400 TCP/IP Connectivity Utilities. It also contains information about writing to the TCP/IP call-level interface and using the TCP/IP commands. **Short title:** *TCP/IP Guide*

Other AS/400 Printed Information

The following manuals contain detailed information you may find helpful. The information contained in these manuals has not been submitted to any formal IBM test and is distributed on an 'as is' basis without any warranty either expressed or implied. These manuals are written for a specific release and modification level of the Operating System/400* licensed program and may not describe all the functions available on your AS/400 system.

- *AS/400 Communications Configurations, Tips, and Techniques Newsletter*, GC21-8180
- *AS/400 Communications Definitions Examples*, GG24-3449
- *AS/400 Communications Highlights Newsletter*, GC21-8179
- *AS/400 Office in a DIA/SNADS Network*, GG24-3268
- *AS/400—System/370 Connectivity*, GG24-3336
- *AS/400, System/38, and PS/2 as T2.1 Nodes in a Subarea Network*, GG24-3420
- *AS/400 TCP/IP Configuration and Operation*, GG24-3442
- *Examples of Advanced Program-to-Program Communications Between the Application System/400 and CICS*, GC21-8183
- *Management of AS/400 in SNA Subarea Network Using Netview Products*, GG24-3289
- *Managing Multiple AS/400s in a Peer Network*, GG24-3614
- *System Design Aspects of APPN Networks*, ZZ81-0219
- *S3/X and AS/400 APPN Nodes Using the SNA/LEN Subarea Network*, GG24-3288

Communications Controllers

The following manuals contain information about communications controllers.

- *Financial Branch System Services Application Programming*, SC19-5174
- *Financial Branch System Services Installation, Planning, and Administration Guide*, SC19-5173
- *Communications: Retail Communications Programmer's Guide*, SC41-9858
- *3174 Establishment Controller Planning Guide, Configuration Support A and S, Release 5*, GA27-3844
- *3174 Establishment Controller Planning Guide, Configuration Support B, Release 1*, GA27-3862
- *3174 Establishment Controller Utilities Guide, Configuration Support A and S, Release 5*, GA27-3853
- *4700 Finance Communications System Controller Programming Library: Communications Programming*, GC31-2068
- *4700 Finance Communications System Controller Programming Library: Control Program Generation*, GC31-2071
- *4700 Finance Communications System Controller Programming Library: General Controller Programming*, GC31-2066
- *4700 Finance Communications System Controller Programming Library (Volume 6)*, GC31-2071
- *4700 Finance Communications System Controller Programming Library: Work Station Programming*, GC31-2069
- *4700 Finance Communications System: Subsystem Operating Procedures*, GC31-2032
- *5294 Control Unit Setup Procedure*, GA21-9369
- *5394 Remote Control Unit Setup Guide*, GA27-3804
- *5394 Remote Control Unit User's Guide*, GA27-3852

Communications Protocols

The following manuals provide information about communications protocols and local area network architectures:

- *SNA Format and Protocol Reference Architecture Logic for LU Type 6.2*, SC30-3269
- *SNA Format and Protocol Reference Architecture Logic for Type 2.1 Nodes*, SC30-3422
- *SNA Format and Protocol Reference Manual: Architectural Logic*, SC30-3112
- *SNA Format and Protocol Reference: SNA Network Interconnection*, SC30-3339
- *SNA Formats*, GA27-3136
- *SNA: Sessions between Logical Units*, GC20-1868
- *SNA Transaction Programmer's Reference Manual for LU Type 6.2*, GC30-3084
- *Systems Network Architecture Concepts and Products*, GC30-3072
- *Systems Network Architecture Distribution Services (SNADS) Reference*, SC30-3098
- *Systems Network Architecture File Services Reference*, SC31-6807
- *Systems Network Architecture Management Services Reference*, SC30-3346
- *Systems Network Architecture Technical Overview*, GC30-3073
- *IBM Local Area Network Technical Reference*, SC30-3383
- *Supplement to the Local Area Network Technical Reference*, SD21-0049
- *Token-Ring Network Architecture Reference*, SC30-3374
- *Token-Ring Network Problem Determination Guide Kit*, SX27-3710
- *Local Area Networks Concepts and Products*, GG24-3178
- *FDDI Concepts and Products*, GG24-3865
- *FDDI Network Introduction and Planning Guide*, GA27-3892

RISC System/6000

The following manuals provide information on connecting your AS/400 system to a RISC System/6000* system.

- *AIX AS/400 Connection Program User's Guide*, SB35-4069
- *AIX Communications Programming Concepts for RISC System/6000*, SC23-2206
- *Communications Concepts and Procedures for RISC System/6000*, SC23-2203
- *RISC System/6000 Communications Connectivity Overview*, GC23-2190

Systems Network Architecture (SNA) Hosts

The following manuals provide detailed information about the SNA communications controllers and the network programs. Refer to these manuals for network-dependent information.

- *ACF/NCP/VS NCP (System Support Program) General Information*, SC30-3058
- *ACF/NCP/VS SSP Installation*, SC30-3142
- *Network Control Program Resource Definition Reference*, SC30-3254

IBM 3172 Interconnect Controller

- *IBM 3172 Interconnect Controller Planning Guide*, GA27-3867
- *IBM 3172 Interconnect Controller Operator's Guide*, GA27-3860
- *IBM 3172 Interconnect Controller Installation and Service Guide*, GA27-3861
- *Interconnect Controller Program, Version 1.0., User's Guide*, GA27-3867

IBM 6611 Network Processor

- *The IBM 6611 Network Processor*, GG24-3870
- *IBM 6611 Network Processor: Introduction and Planning Guide*, GK2T-0334
- *IBM 6611 Network Processor: Installation and Service Guide*, GA27-3941
- *IBM 6611 Network Processor: Network Management Reference*, GC30-3567
- *IBM 6611 Network Processor: Operations Pocket Guide*, GX27-3909
- *IBM Multiprotocol Network Program: User's Guide*, SC30-3559

IBM 8209 LAN Bridge

The following manuals provide information on using the 8209 LAN Bridge:

- *8209 LAN Bridge Customer Information*, SA21-9994
- *8209 LAN Bridge: Service Information*, SY31-9077
- *8209 LAN Bridge Attachment Module Guide for the IBM Token-ring Network*, GA27-3915

- *8209 LAN Bridge Attachment Module Guide for Ethernet and IEEE 802.3 LANs*, GA27-3891

IBM 8240 FDDI Concentrator

- *FDDI Concepts and Products*, GG24-3865
- *FDDI Network Introduction and Planning Guide*, GA27-3892
- *IBM 8240 FDDI Concentrator Customer Setup Instruction*, GA17-0235
- *IBM 8240 FDDI Concentrator Service Guide*, SY17-0014
- *IBM 8240 FDDI Concentrator Maintenance Facility User's Guide*, GA17-0237

Other Printed Information

The following manuals provide detailed information about various communications standards.

- *American National Standards Institute/Institute of Electrical and Electronics Engineers 802.3a, b, d, c, 1988, Information Processing Systems -- Local Area Networks: Supplements to Carrier Sense Multiple Access with Collision Detection.*
- *The International Telegraph and Telephone Consultative Committee, Red Book, Volume VIII - Facscicle VIII.3, Data Communications Networks Interfaces, Recommendations X.20 - X.32, VIIIth Plenary Assembly, Malaga-Torremolinos, October 8-19, 1984.*
- *International Organization for Standardization 8802/2, 1989, Institute of Electrical and Electronics Engineers 802.2, 1989, Information Processing Systems -- Local Area Networks: Logical Link Control.*
- *International Organization for Standardization 8802/3, 1990, American National Standards Institute/Institute of Electrical and Electronics Engineers 802.3, 1990, Information Processing Systems -- Local Area Networks: Carrier Sense Multiple Access with Collision detection (CSMA/CD) access method and Physical Layer Specifications.*
- *International Standard 8802/5, 1990, Institute of Electrical and Electronics Engineers 802.5, 1989, Standards for Local Area Networks: Token Ring Access Method and Physical Layer Specifications.*
- Request for Comments (RFC) 1294: *Multiprotocol Interconnect over Frame Relay*

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