



System i
Networking
Frame relay

Version 6 Release 1





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Networking
Frame relay

Version 6 Release 1

Note

Before using this information and the product it supports, be sure to read the information in "Notices," on page 29.

This edition applies to version 6, release 1, modification 0 of IBM i5/OS (product number 5761-SS1) and to all subsequent releases and modifications until otherwise indicated in new editions. This version does not run on all reduced instruction set computer (RISC) models nor does it run on CISC models.

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Frame relay

Frame relay is a communications networking 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 the X.25 standard. The high speed that you can obtain through frame-relay networks makes them well suited for wide area network (WAN) connectivity. Administrators commonly use frame relay to connect two or more local area network (LAN) bridges over long distances.

The following figure shows the frame format that frame-relay networks use.

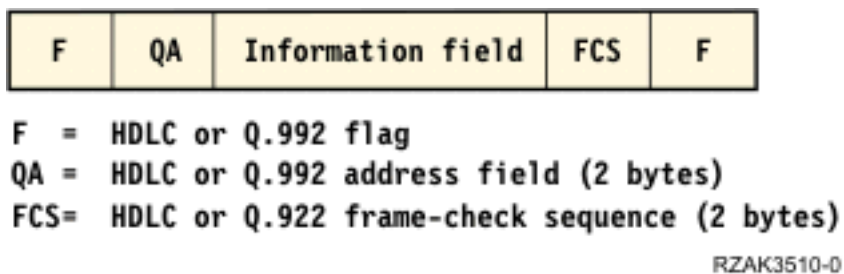


Figure 1. Frame format that frame-relay networks use

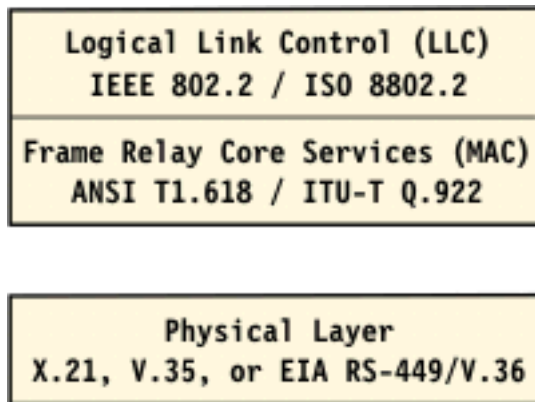
Frame-relay network architecture is based on the integrated systems digital network (ISDN) packet-mode bearer services. The following table shows the standards, either pending or approved, that define the services and the user-to-network interface of frame-relay networks.

Table 1. ANSI and equivalent ITU-T standards

ANSI standard	Equivalent ITU-T 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 System i[™] implementation of frame-relay network support uses protocol headers as defined in the TCP/IP Request for Comment (RFC) 1490.

Frame-relay networks achieve their greater efficiency by minimizing the error checking done by nodes within the network. For Systems Network Architecture (SNA), System i frame-relay support uses IEEE 802.2 logical link control to provide flow control and error recovery functions (see the following figure).



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Figure 2. System i implementation of frame-relay networking


As indicated previously, you can make the connection between the System i platform and the frame-relay network by using X.21, V.35, or RS-449 physical interfaces.

PDF file for Frame relay

You can view and print a PDF file of this information.

To view or download the PDF version of this document, select Frame relay (about 542 KB).

You can view or download this related topic:


The LAN, Frame-Relay and ATM Support (about 1597 KB)  manual contains the latest information about distributed data interface (DDI) networks and wireless networks.

Saving PDF files

To save a PDF on your workstation for viewing or printing:

1. Right-click the PDF link in your browser.
2. Click the option that saves the PDF locally.
3. Navigate to the directory in which you want to save the PDF.
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Network connections for frame relay

The direct frame-relay network and the bridged frame-relay network are the two types of network connections that you can configure.

Direct frame-relay network

The direct frame-relay network allows communications using Systems Network Architecture (SNA) or TCP/IP data over a frame-relay network at speeds of up to 2.048 Mbps. This support allows a network of systems to communicate using the frame-relay network as a backbone without the need for multiple-leased T1 lines. This function is also known as *boundary network node (BNN)* support.

Bridged frame-relay network

The bridged frame-relay network allows the System i platform to communicate over a frame-relay network. This communication takes place through a remote bridge that is attached to a token-ring, Ethernet, or distributed data interface (DDI) network. Bridged frame-relay connections allow the System i platform to communicate with stations on the remote local area network (LAN) as if they were attached locally to the LAN. This function is also known as *boundary network node (BNN)* support. The following figure shows an example of a bridged frame-relay connection.

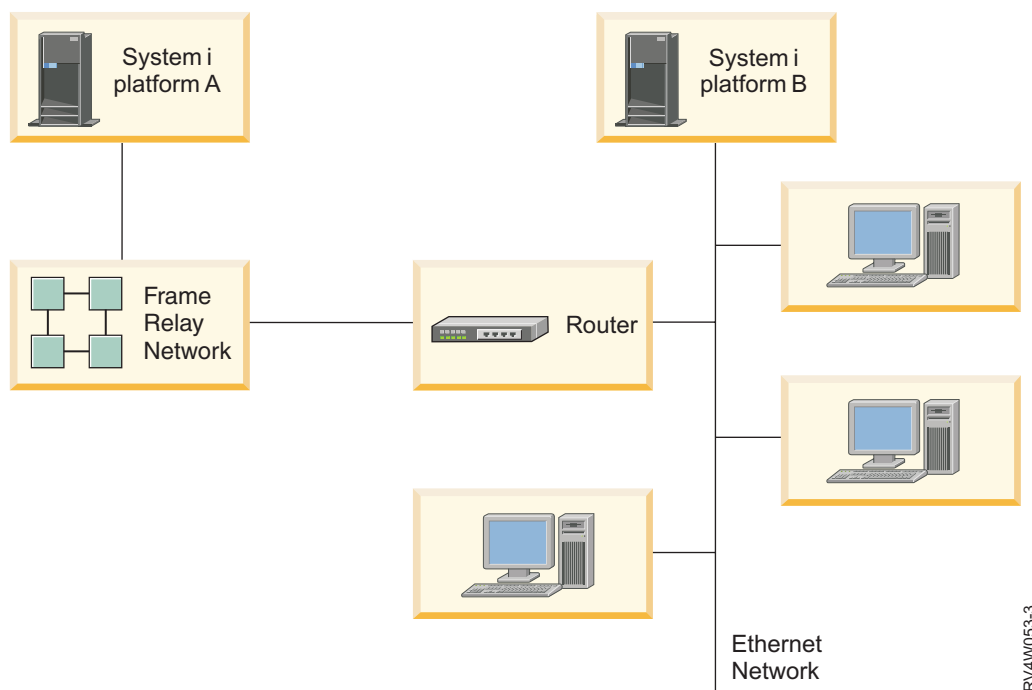


Figure 3. Example of a bridged frame-relay network connection

In this example, System i platform A communicates through the frame-relay network and the bridge to System i platform B. Bridged frame-relay connections support SNA and TCP/IP data communications.

Related concepts

“Bridged connections for frame relay” on page 6

The System i platform supports frame-relay connections to remote local area networks (LANs) that support the bridged frame-relay formats defined by the Frame-Relay Forum IA 3.1. Most bridges, routers, and communication controllers support these formats.

Physical environment for frame relay

The equipment that attaches to a frame-relay network, such as a System i platform, is the terminal equipment (TE). A frame-relay network node is a frame handler.

The connection from the TE to the frame handler normally exists through a data service unit (DSU) and channel service unit (CSU) pair. This DSU and CSU pair converts the TE physical interface to the frame handler interface that is used by the frame-relay network.

The System i platform supports these types of physical interfaces for attachment to the DSU and CSU pair:

- EIA RS-449, ITU-T V.36.
- ITU-T X.21.

- ITU-T V.35.

Create Network Interface (Frame-Relay Network) command

Use the Create Network Interface (Frame-Relay Network) (CRTNWIFR) command to specify both the physical interface (INTERFACE parameter) and data transmission rate (LINESPEED parameter). The type of physical interface that you specify depends on the cable that you use. The following table lists the supported physical interfaces, cable lengths, network interface (NWI) clock parameters, and the maximum data transmission speed available for each interface:

Table 2. Device types 2699, 2721, 2742, 2745, 2771, and 2793 high-speed communications IOAs

Physical interface	Cable length	NWI clock parameter	Maximum data transmission rate
*RS-449	6.1 m (20 ft)	*MODEM, *LOOP, *INVERT	2 048 000 bps
	15.2 m (50 ft)	*MODEM	64 000 bps
	24.4 m (80 ft)		
	45.7 m (150 ft)		
	15.2 m (50 ft)	*LOOP	2 048 000 bps
	24.4 m (80 ft)		
	45.7 m (150 ft)		
*V.35	20 ft (6.1 m)	*MODEM, *LOOP, *INVERT	2 048 000 bps
	50 ft (15.2 m)		
	24.4 m (80 ft)	*MODEM, *LOOP, *INVERT	64 000 bps
*X.21	6.1 m (20 ft)	*MODEM	2 048 000 bps
	15.2 m (50 ft)	*MODEM, *INVERT	64 000 bps

Notes:

1. *LOOP requires DCE support for looped clocking.
2. Data transmission rates greater than 512 000 bps might require *LOOP or *INVERT clocking.

On the frame-relay-supported hardware, the specified value for the INTERFACE parameter must match the physical interface and cable that you attached to the input-output adapter (IOA).

CLOCK parameter

The CLOCK parameter on the CRTNWIFR command specifies the method by which the clocking function is provided for the network interface. The parameter supports the following values:

*MODEM

The default value. The modem provides the clocking.

*LOOP

Loop indicates that the data circuit-terminating equipment (DCE) received clock is looped back to the DCE on the data terminal equipment (DTE) transmit clock. This value improves high-speed data transmission, but it is valid only if it is supported by the modem.

*INVERT

All three interfaces support *INVERT.

Related information

Create Network Interface (FR) (CRTNWIFR)

Connections for frame relay

Various options are available for you to configure the frame-relay network connections.

SNA direct connections

The System i platform supports frame-relay connections to remote systems that support the Systems Network Architecture (SNA) direct format. In this format, the frame-relay packets encapsulate the SNA data.

The following figure shows an example of SNA direct connections to a remote System i platform, a 5494 Remote Control Unit, and a 3745 Communications Controller on data link connection identifiers (DLCIs) 22, 23, and 24.

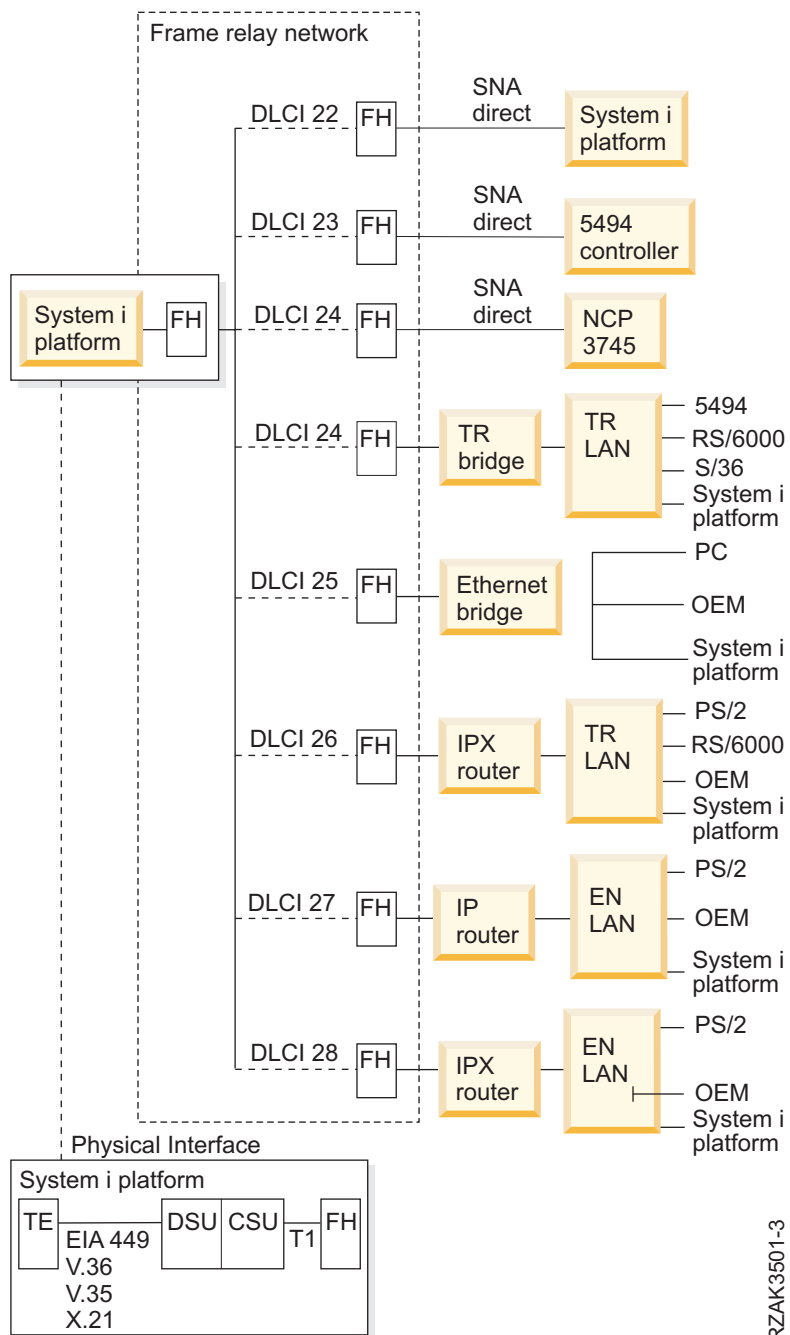


Figure 4. Example of a frame-relay network

IP direct connections

The System i platform supports frame-relay connections to remote systems that support the IP direct format. In this format, the frame-relay packets encapsulate the TCP/IP data.

Bridged connections for frame relay

The System i platform supports frame-relay connections to remote local area networks (LANs) that support the bridged frame-relay formats defined by the Frame-Relay Forum IA 3.1. Most bridges, routers, and communication controllers support these formats.

Bridged frame-relay connections support both Systems Network Architecture (SNA) and TCP/IP data traffic by encapsulating the token-ring, Ethernet, or distributed data interface (DDI) frames within the frame-relay packet.

Related concepts

“Network connections for frame relay” on page 2

The direct frame-relay network and the bridged frame-relay network are the two types of network connections that you can configure.

System connection without a frame-relay network

You can establish frame-relay connections without a frame-relay network, similar to the X.25 DTE-to-DTE mode. This type of configuration supports both Systems Network Architecture (SNA) direct and bridged frame-relay formats.

For example, by configuring one of a pair of System i platforms as a frame handler (LMIMODE(*FH)) on the network interface description and the other as terminal equipment (LMIMODE(*TE)), you can connect the two systems using a modem eliminator or a high-speed communications line. In this configuration, the system configured as the frame handler responds to local management interface (LMI) polls received from the terminal equipment (TE). It then reports the status of permanent virtual circuits (PVCs) configured on the frame handler system.

Related concepts

“SNA direct connections” on page 5

The System i platform supports frame-relay connections to remote systems that support the Systems Network Architecture (SNA) direct format. In this format, the frame-relay packets encapsulate the SNA data.

“Bridged connections for frame relay” on page 6

The System i platform supports frame-relay connections to remote local area networks (LANs) that support the bridged frame-relay formats defined by the Frame-Relay Forum IA 3.1. Most bridges, routers, and communication controllers support these formats.

“Scenario: SNA direct connection using a modem eliminator” on page 21

The example shows a direct Systems Network Architecture (SNA) connection that uses a modem eliminator.

Configuration objects for frame relay

The System i platform uses several configuration objects, such as network interface description, line description, and controller description, for frame-relay communications.

Network interface description

The network interface (NWI) description defines the following characteristics of the physical connection:

- Physical interface used.
- Local management interface (LMI) mode.
- LMI timer and retry values.
- Data link connection identifier (DLCI) numbers assigned to the virtual connections.

Use the Create Network Interface (Frame-Relay Network) (CRTNWIFR) command to create one NWI description for each input-output adapter (IOA).

Line description

The line description defines the logical connection to the network. You can attach up to 256 line descriptions to each frame-relay network interface. You must create one line description for each DLCI that is used. Use the following CL commands to create line descriptions attached to frame-relay NWI descriptions:

CRTLINFR

Systems Network Architecture (SNA) or IP direct connections to remote systems that support the frame-relay communications protocol, such as an SNA direct connection to another System i platform or 3745 Communications Controller.

CRTLINTRN

Bridged token-ring network connections.

CRTLINDDI

Bridged distributed data interface (DDI) network connections.

CRTLINETH

Bridged Ethernet network connections.

Controller description

Use the controller description to define the remote system or controller. You can attach up to 256 controller descriptions to each line description. However, the NWI description supports no more than 256 active controllers. Controller descriptions occur across a number of line descriptions. Use the following CL commands to create controller descriptions for frame-relay communications:

CRTCTLAPPC

Advanced Program-to-Program Communication (APPC) controllers represent systems that support APPC or Advanced Peer-to-Peer Networking® (APPN) communications. APPC controllers typically represent System i products and personal computers.

CRTCTLHOST

SNA host controllers represent controllers such as the 3745 controller running NCP.

CRTCTLNET

Network controllers are used for direct IP connections. They are automatically created when you configure and start TCP/IP communications for frame relay.

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) attach only to frame-relay line descriptions.
- Controller descriptions that specify LINKTYPE(*LAN) attach to token-ring, DDI, or Ethernet lines.

You can configure both APPC and SNA host controllers as APPN(*YES). If you configure the controllers as APPN(*NO), then you must also create APPC or SNA host device descriptions for each session that the remote system supports.

The following figure shows an example of objects that are configured for frame-relay communications, including the NWI, line descriptions (LINDs), and controller descriptions (CTLDs).

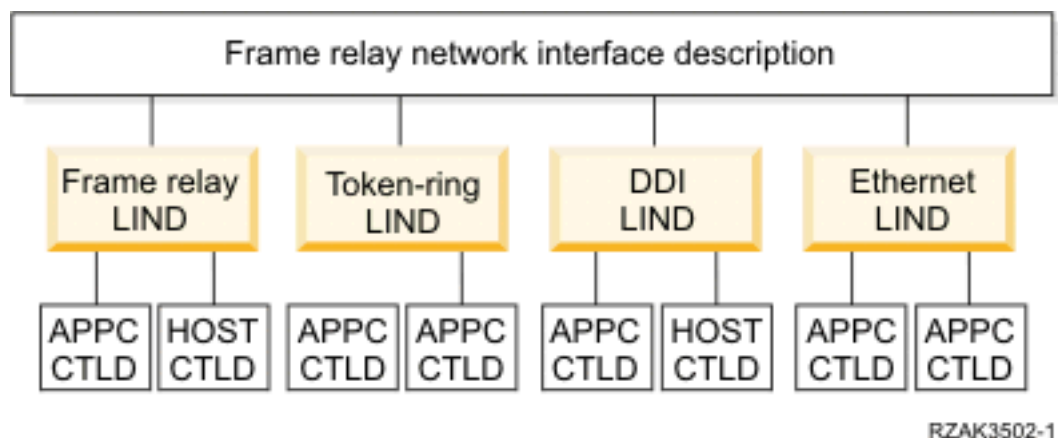


Figure 5. Example of objects configured for frame-relay communications

Frame-relay addressing

For direct connections, data link connection identifiers (DLCIs) provide frame-relay addressing. For bridged connections, local area network (LAN) adapter addresses provide frame-relay addressing.

Data link connection identifiers

The System i platform uses data link connection identifiers (DLCIs) 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. The frame-relay network assigns a DLCI number that identifies each virtual connection, called *permanent virtual circuit (PVC)*. The System i platform supports up to 256 virtual circuits for each physical connection.

The frame-relay network provider assigns the DLCI number, typically at subscription time, that is used to identify a virtual circuit. The DLCI number applies only to the connection between nodes (terminal equipment-to-frame handler or frame handler-to-frame handler).

The following figure shows an example of DLCI assignments for a frame-relay connection.

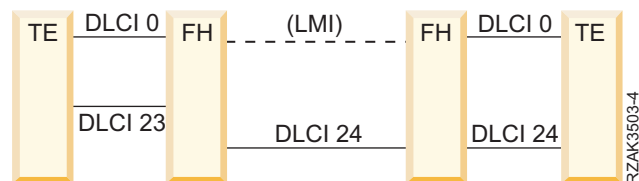


Figure 6. Example of DLCI assignments for PVC connections

To configure DLCI values for frame-relay and bridged local area network (LAN) line descriptions, specify the NWIDLCI parameter on the line description command. You can also configure DLCI values by specifying the DLCI number and the line description name on the DLCI parameter of the Create Network Interface (Frame-Relay Network) (CRTNWIFR) command.

The System i platform uses DLCI 0 for the local management interface (LMI). This corresponds to the ANSI Annex-D standard. The LMI manages the physical and virtual connections between the terminal equipment and the frame handler. Use DLCIs 1 through 1018 to identify logical connections to remote terminal equipments.

Related concepts

“Local management interface” on page 18

The System i platform uses the local management interface (LMI) to exchange status information between the frame-relay network (or the frame handler system) and systems that are attached to the network (terminal equipment).

Adapter addresses for frame relay

The frame-relay communications input/output processor (IOP) is not given a preset or burned-in adapter address. You must specify this address for the local adapter address (ADPTADR) parameter on token ring, distributed data interface (DDI), and Ethernet line descriptions used for bridged frame-relay connections.

Configure the frame-relay adapter address the same as for locally attached local area network (LAN) lines. Systems Network Architecture (SNA) or IP direct configurations do not require the local adapter address.

You must configure the remote adapter address (ADPTADR parameter on the controller description) to match the adapter address of the remote system.

SNA direct frames do not include adapter addresses. You do not need to configure the adapter address for frame-relay line descriptions or for controllers that specify LINKTYPE(*FR).

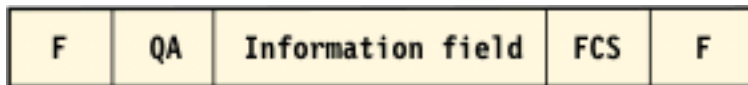
Routing characteristics for frame relay

The frame-relay network routes frames through the network by examining the data link connection identifier (DLCI) field and then routing the frame to an outgoing link. The network delivers frames to the remote terminal equipment (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 system verifies the frame check sequence (FCS) and checks the frame format and size. If the frame is valid, the system replaces the DLCI and FCS before routing the frame to the next node. If the frame is damaged or otherwise not valid, the system discards it. The network node provides no error recovery.

Frame-relay core services frame format

The following figure shows the basic frame format that is used for frame-relay communications.



F = HDLC or Q.992 flag

QA = HDLC or Q.992 address field (2 bytes)

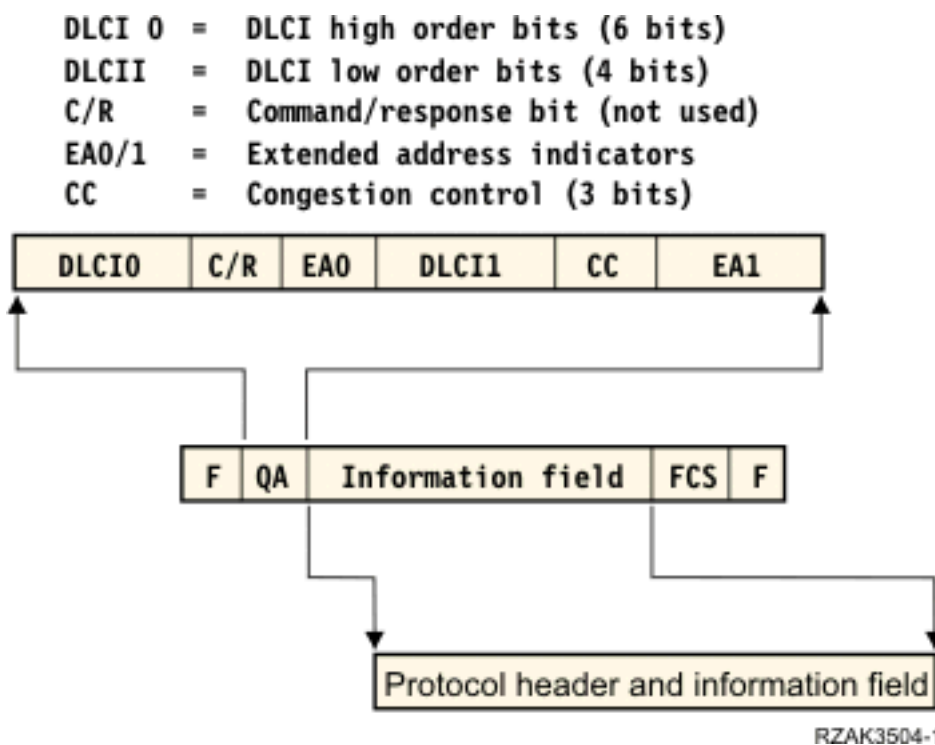
FCS= HDLC or Q.922 frame-check sequence (2 bytes)

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Figure 7. Frame format that frame-relay networks use

The frame-relay core services (FRCS) portion of the frame routes the frame through the frame-relay network. The frame structure is based on the ITU-T Q.922 protocol.

The following figure shows the FRCS frame format on the fields within the 2-byte Q.922 address field (QA).



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Figure 8. Frame format for frame-relay core services (FRCS)

Frame-relay protocol headers

Terminal equipment (TE) uses frame-relay protocol headers to provide routing for frames, to assure data integrity, and to perform recovery when frames are damaged or lost. System i frame-relay support uses protocol headers that are defined in Frame-Relay Forum IA 3.1.

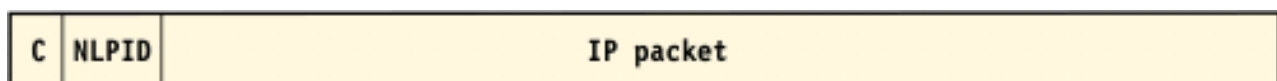
The System i platform uses protocol header formats for Systems Network Architecture (SNA) direct connections, for bridged local area network (LAN) connections, and for local management interface (LMI) connections. The Information field of the FRCS frame contains these headers and information fields, such as protocol data units or IP packets.

The following figures show the protocol header formats.



RZAK3518-0

Figure 9. SNA direct frame format



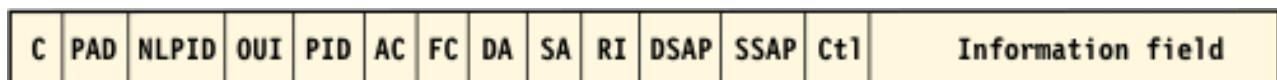
RZAK3517-0

Figure 10. IP direct frame format



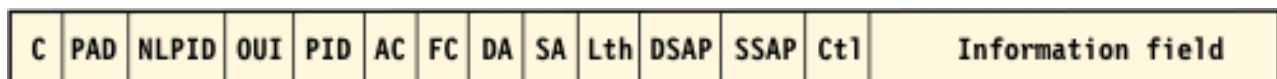
RZAK3516-0

Figure 11. High-Performance Routing (HPR) frame format



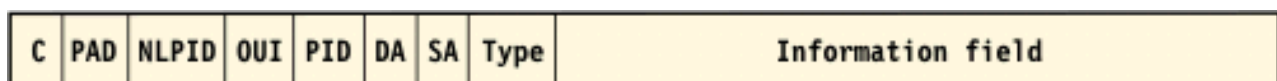
RZAK3513-0

Figure 12. Bridged token-ring and DDI LAN frame format (Frame-Relay Forum IA 3.1)



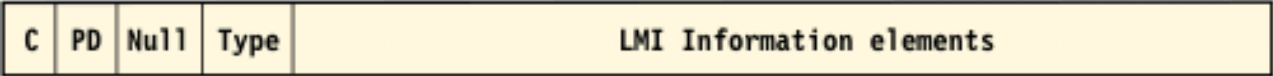
RZAK3512-0

Figure 13. Bridged IEEE Ethernet LAN frame format (Frame-Relay Forum IA 3.1)



RZAK3514-0

Figure 14. Bridged Ethernet version 2 LAN frame format (Frame-Relay Forum IA 3.1)



RZAK3515-0

Figure 15. LMI message frame format



RZAK3519-0

Figure 16. Address Resolution Protocol (ARP) format

The following table describes the protocol header fields.

Table 3. Format fields for the frame-relay protocol header

Field	Description	Values and 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 ITU-T Q.931 (SNA direct and HPR). 80 IEEE Subnetwork Access Protocol (SNAP) for bridged LAN connections. CC Internet Protocol (IP) direct.
PD	Protocol discriminator	LMI frames use hex 08.
OUI	Organization-unique identifier	0080C2 IEEE 802.1. 000000 Address Resolution Protocol (ARP).

Table 3. Format fields for the frame-relay protocol header (continued)

Field	Description	Values and notes
PID	Protocol identifier	<p>The System i platform supports the following formats without using frame check sequence (FCS):</p> <p>0007 Ethernet.</p> <p>0009 Token-ring network.</p> <p>000A Distributed data interface (DDI) network.</p> <p>0806 ARP.</p> <p>The System i platform provides receive-only support for the following formats using FCS:</p> <p>0001 Ethernet.</p> <p>0003 Token-ring network.</p> <p>0004 DDI network.</p>
L2	Layer 2 protocol	<p>For System i platform that uses SNA direct connections, 4C80 is placed in the L2 field.</p> <p>Byte 1</p> <p>4C IEEE 802.2 (ISO 8802/2).</p> <p>4E Q.922 (IDLC).</p> <p>46 LAP-B (X.25).</p> <p>4A HDLC NRM (SDLC).</p> <p>51 ISO 7776.</p> <p>70 Without IEEE 802.2 (ISO 8802/2) header.</p> <p>Byte 2</p> <p>80 Undefined.</p> <p>81 MAC address included (IEEE 802.2, ISO 8802/2) or HDLC address included (ISO 7776).</p>

Table 3. Format fields for the frame-relay protocol header (continued)

Field	Description	Values and notes
L3	Layer 3 protocol	<p>For System i platform using SNA direct connections, 7082 is placed in the L3 field.</p> <p>Byte 1</p> <p>66 ITU-T X.25.</p> <p>67 ISO 8208 (X.25 PLC).</p> <p>70 User-specified.</p> <p>Byte 2</p> <p>81 SNA subarea (FID4).</p> <p>82 SNA peripheral (FID2).</p> <p>83 APPN (FID2).</p> <p>85 HPR Network Layer Protocol (FID5).</p>
Information field	Information field	<p>System i support for SNA direct frame-relay connections requires Protocol Data Unit (PDU) to contain the type of FID2 in the Format Identification Field.</p> <p>Information fields sent over bridged connections can contain FID2 PDUs or IP packets.</p>

Abbreviations used:

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.

Related concepts

“SNA direct connections” on page 5

The System i platform supports frame-relay connections to remote systems that support the Systems Network Architecture (SNA) direct format. In this format, the frame-relay packets encapsulate the SNA data.

“IP direct connections” on page 6

The System i platform supports frame-relay connections to remote systems that support the IP direct format. In this format, the frame-relay packets encapsulate the TCP/IP data.

“Bridged connections for frame relay” on page 6

The System i platform supports frame-relay connections to remote local area networks (LANs) that support the bridged frame-relay formats defined by the Frame-Relay Forum IA 3.1. Most bridges, routers, and communication controllers support these formats.

Maximum frame-size parameter requirements for frame relay

The frame-relay network provider defines and typically establishes a tariff for the frame information field size provided. This size is referred to as *N203*. Use the *N203* value to determine the value specified for the System i maximum frame size (MAXFRAME parameter).

The MAXFRAME parameter specifies the maximum protocol data unit (PDU) that the system transmits or receives. The System i platform supports MAXFRAME values from 262 to 8192 bytes. The common *N203* frame size that all networks and attached equipment support is 1600 bytes.

When configuring the MAXFRAME value, you 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 Systems Network Architecture (SNA) direct because these headers must include source and destination adapter addresses. Distributed data interface (DDI) and token-ring connections also include up to 18 bytes of routing information.

The following table shows the number of bytes required for the various frame-relay header types.

Table 4. 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/AF	Type/Length	DA/SA	C/NLPID	OUI/PID	L2/L3	
SNA direct	4					2		4	10
IP direct						2			2
HPR						2		4	6
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

Table 4. Lengths for 802.2, remote LAN, and frame-relay headers (continued)

Connection type and protocol	802.2 LLC header	Remote LAN headers				Frame-relay headers			Total bytes
		RI	AC/AF	Type/Length	DA/SA	C/NLPID	OUI/PID	L2/L3	
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.									
HPR High-Performance Routing.									

Additional MAXFRAME parameter considerations

You need to base the maximum frame size on your System i platform on these values.

- N203.
- Maximum frame size supported by the protocol or connection type.
- Maximum frame size supported by the remote station.

Use the minimum of these values, minus the adjustment for the protocol header, to configure the MAXFRAME parameter for frame-relay connections. The following table shows the maximum frame size limits for supported connection types.

Table 5. Maximum frame size limits for connection types

Connection type	Maximum frame size (MAXFRAME parameter) limits
Systems Network Architecture (SNA) direct	8182
IP direct	8190
HPR	8186
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)
Note: At this time, the largest value allowed for the MAXFRAME parameter on the CRTLINFR command is 8182.	

You can configure the maximum frame size used for a connection at several levels of the System i configuration:

Line description MAXFRAME parameter

Specify the maximum frame size used for an individual permanent virtual circuit (PVC) on the MAXFRAME parameter of the frame-relay, token-ring, or distributed data interface (DDI) line description.

You cannot configure the MAXFRAME parameter on Ethernet line descriptions. Ethernet local area networks (LANs) normally use a frame size of 1500 bytes. A N203 value of 1600 for Ethernet connections to accommodate the standard 1500-byte frame size is recommended. For a N203 value less than 1600, you need to configure the maximum frame size on either the line description source service access point (SSAP) parameter or the controller description.

Line description SSAP parameter

You can specify the maximum frame size for an individual SSAP for the maximum frame size element of the line description SSAP parameter.

Controller description MAXFRAME parameter

You can specify the maximum frame size for connections to individual remote stations on the controller description MAXFRAME parameter.

The System i platform uses the smallest of the above values when it selects the maximum frame size used for connection to the remote station. For SNA connections, the system might also negotiate the frame size that is downward, based on the exchange identification (XID) that is exchanged with the remote station.

Tuning frame-relay performance

The frame-relay networks operate at slower speeds than LANs, so it might be necessary to adjust some parameters when you use the controller description for frame-relay connections for greater network performance.

Advanced Program-to-Program Communication (APPC) and Systems Network Architecture (SNA) host controller descriptions support the specification of a group of LANxxxxxx parameters to provide performance-tuning capabilities for both local area network (LAN) and frame-relay connections.

If you specify the default value, *CALC, for the LANxxxxxx parameters, then the System i platform automatically uses the recommended values for frame-relay connections. The system adjusts these values to allow for network delays. For example, the system might reduce them when using a high-speed network running at J1, T1, or E1 speeds. Reducing these values allows quicker error detection, but it also reduces the time allowed for error recovery.

You might receive better performance with a larger frame size. In a mixed LAN and wide area network (WAN) environment, it might help to put control program (CP) session support on the faster LAN controllers rather than the WAN controllers. The more data link connection identifiers (DLCIs) you have per network interface (NWI), the poorer the performance you might have per DLCI.

Local management interface

The System i platform uses the local management interface (LMI) to exchange status information between the frame-relay network (or the frame handler system) and systems that are attached to the network (terminal equipment).

The LMI uses data link connection identifier 0 (DLCI 0) to provide verification of the physical connection and status for logical connections.

LMIMODE parameter

Use the LMIMODE parameter on the network interface description to specify the type of LMI exchange done by the System i platform. You can configure the system as terminal equipment (*TE), or you can configure the system as terminal equipment (*ANNEXA). When you specify *TE, you use ANNEX D, and when you specify *ANNEXA, you use ANNEX A.

You can also configure the system to exchange no LMI information (*NONE).

Your LMI type must match the values of the network provider. If ANNEX D or ANNEX A are unavailable, ask the network provider to turn LMI off and set the system to *NONE.

When you make a connection without a network (using a modem eliminator or nonswitched line), you can configure the system as a frame handler (LMIMODE(*FH)). In this configuration, the system responds to LMI messages as an frame handler.

Parameters that control exchanges of information over local management interface

The polling interval (POLLITV) and full inquiry interval (FULLINQITV) parameters are used to control the exchange of information over the local management interface (LMI).

- The POLLITV parameter represents the frame-relay T391 timer. It sets the interval at which the terminal equipment (TE) sends a status inquiry message to the frame handler. You can set the POLLITV parameter 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 frame handler. You can set the FULLINQITV parameter to any value between 1 and 255 cycles. The default value is 6 cycles.

Local management interface exchanges

To maintain the exchanged status information between the frame-relay network and the systems attached to it, use the keep-alive exchange and permanent virtual circuit (PVC) status change.

Keep-alive exchange

Use the keep-alive exchange to maintain contact between the terminal equipment (TE) and the frame handler. It consists of an exchange of sequence messages.

At intervals specified by the POLLITV parameter, the TE sends status inquiry messages to the frame handler. The frame handler responds with a status message that includes the correct sequence number (both status inquiry and status messages include sequence numbers).

PVC status change

After the number of status inquiry messages specified by the FULLINQITV parameter is completed, the TE requests a full status from the frame handler. The frame handler responds with a status message that includes a list of the PVCs 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.

Scenarios: Frame-relay configuration

These scenarios show how to configure frame-relay connections.

Scenarios: SNA direct connection for frame relay

These scenarios show how to configure a direct Systems Network Architecture (SNA) connection.

Scenario: SNA direct connection of two System i platforms

This example shows a direct Systems Network Architecture (SNA) connection between two System i platforms.

The following figure shows a connection between a System i platform in Minneapolis and a System i platform in Madison over a frame-relay network.

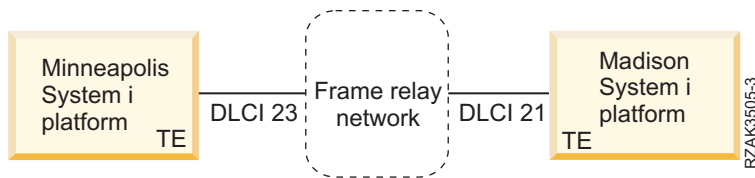


Figure 17. SNA direct connection between Minneapolis and Madison systems

The two systems have an Advanced Peer-to-Peer Networking (APPN) connection that is configured on the frame-relay data link connection identifier (DLCI). Note that the frame-relay link in Minneapolis has much more traffic and it operates at 1 536 000 bps. The link in Madison operates at 64 000 bps. The frame-relay network allows for this difference in subscriptions at the two sites.

The Minneapolis connection to the network uses DLCI 23. In Madison, the DLCI number is 21. If the connection uses a frame-relay network, the DLCI numbers have only local (terminal end to frame handler) significance and might be different on the two interfaces. The network is responsible for setting up the connection between the DLCIs at administration time.

If you require more than one Advanced Program-to-Program Communication (APPC) connection between the two sites, you must define additional source service access point (SSAP) values and destination service access point (DSAP) values on the lines, and the additional controllers need different SSAP and DSAP combinations.

Scenario details: Configuration for the System i platform in Minneapolis:

To configure the System i platform in Minneapolis, you must create the frame-relay line description and the Advanced Program-to-Program Communication (APPC) controller description on the Minneapolis system.

Use the Create Line Description (Frame-Relay Network) (CRTLINFR) command to create the frame-relay line description on the Minneapolis system. The DLCI that you specify for the line must match the network subscription. Because frame-relay Systems Network Architecture (SNA) direct addressing requires 10 bytes of overhead, a frame size of 1590 is configured for the MAXFRAME parameter. In other words, you need to use a frame size that is at least 10 bytes less than the network subscription. You also need to know the frame size at the other side of the network. For example, if one side is 1600 and the other is 2100, then both sides need to be set to 1600.

Use the Create Controller Description (APPC) (CRTCTLAPPC) command to create the APPC controller description on the Minneapolis system. You must specify LINKTYPE(*FR) for SNA direct connections.

Note: The default values for both the source service access point (SSAP) and destination service access point (DSAP) are 04. These values must match the values specified for the remote system. If you create more controllers using the same line description (DLCI), you must specify a unique SSAP and DSAP pair. This requires you to configure more service access points on the frame-relay line description.

Scenario details: Configuration for the System i platform in Madison:

To configure the System i platform in Madison, use these commands.

```

CRTNWIFR  NWID(FRMADISON) RSRNAME(LIN121) NRZI(*NO) INTERFACE(*RS449V36) +
          CLOCK(*MODEM) LINESPEED(64000) LMIMODE(*TE) +
          TEXT('Frame-relay NWI in Madison')

CRTLINFR  LIND(FRMINNEAP) NWI(FRMADISON) NWIDLCI(21) 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 System i platform in Minneapolis')

```

Scenario: SNA direct connection using a modem eliminator

The example shows a direct Systems Network Architecture (SNA) connection that uses a modem eliminator.

The following figure shows the configuration of two System i platforms (SYSTEM1 and SYSTEM2) for direct SNA communications without a frame-relay network.

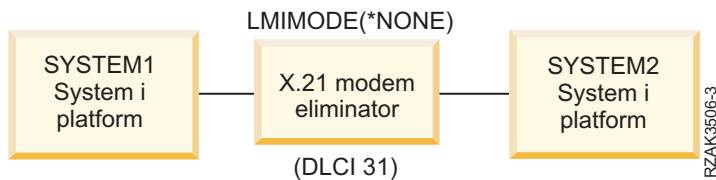


Figure 18. SNA direct connection using a modem eliminator

In this scenario, SYSTEM1 connects to SYSTEM2 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 SYSTEM1 and SYSTEM2 are defined as Advanced Peer-to-Peer Networking (APPN) end nodes. You must create the Advanced Program-to-Program Communication (APPC) controller descriptions, but the device descriptions are created automatically.

Scenario details: Configuration for SYSTEM1:

To configure SYSTEM1, use these commands.

```

CRTNWIFR  NWID(SYSTEM1) RSRNAME(LIN301) INTERFACE(*X21)1 +
  LINESPEED(1536000)1 LMIMODE(*NONE)2 +
  TEXT('Frame-relay connection through modem eliminator')

CRTLINFR  LIND(SYSTEM2FR) NWI(SYSTEM1) NWIDLCI(31)3 MAXCTL(40) +
  MAXFRAME(8182)4 EXCHID(05610441) LINKSPEED(1536000)5 +
  TEXT('Frame-relay direct line to SYSTEM1')

CRTCTLAPPC CTLD(SYSTEM2FR) LINKTYPE(*FR)6 APPN(*YES) +
  SWTLINLST(SYSTEM1FR) RMTNETID(*NETATR)+
  RMTCPNAME(SYSTEM1) EXCHID(5600033) DSAP(04)7 SSAP(04) +
  TEXT('FR direct controller for SYSTEM1')

```

Notes:

1. The INTERFACE and LINESPEED parameters must match the modem eliminator.
2. LMIMODE is *NONE, which means the systems do not exchange LMI data. You do not need the LMI for attachments without a network.
3. The data link connection identifier (DLCI) for the line must match the DLCI configured on the remote system for this connection. If you configure multiple lines, all DLCIs must match the remote system.
4. There is no maximum frame size in a system-to-system configuration, but both values must match. In this example, a value of 8182 gives the best performance.
5. Set the APPN link speed (LINKSPEED parameter) according to the speed specified on the NWI.
6. Specify LINKTYPE(*FR) for Systems Network Architecture (SNA) direct connections.

7. The default values for source service access point (SSAP) and destination service access point (DSAP) are both 04. These values must match the values specified for the remote system. If you create more controllers using the same line description, you must specify a unique SSAP and DSAP pair. This might require you to configure more service access points (SAPs) on the frame-relay line description.

Scenario details: Configuration for SYSTEM2:

To configure SYSTEM2, use these commands.

```
CRTNWIFR  NWID(SYSTEM2) RSRNAME(LIN291) INTERFACE(*X21) +  
          LINESPEED(1536000) LMIMODE(*NONE) +  
          TEXT('Frame-relay Interconnect through modem eliminator')  
  
CRTLINFR  LIND(SYSTEM1FR) NWI(SYSTEM2) NWIDLCI(31) MAXCTL(40) +  
          MAXFRAME(8182) EXCHID(05600033) LINKSPEED(1536000) +  
          TEXT('Frame-relay direct line to SYSTEM1')  
  
CRTCTLAPPC CTLD(SYSTEM1FR) LINKTYPE(*FR) APPN(*YES) +  
          SWTLINLST(SYSTEM1FR) RMTNETID(*NETATR)+  
          RMTCPNAME(SYSTEM2) EXCHID(05610441) DSAP(04) SSAP(04) +  
          TEXT('FR direct controller for SYSTEM2')
```

Scenario: SNA direct connection to a host system

This scenario shows a Systems Network Architecture (SNA) direct connection to a host system.

The following figure shows the configuration of a System i platform for frame-relay communications with a 3745 host controller.

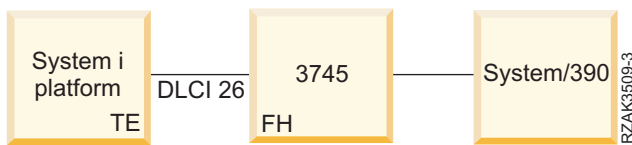


Figure 19. SNA direct connection to 3745 host controller

The 3745 host controller provides the frame-relay network function, and the System i platform is configured as a terminal equipment (TE).

A 64000 bps V.35 line exists between the System i platform and the 3745 host controller. The System i platform might also have data link connection identifier (DLCI) connections to multiple 3745 host controllers, 6611 Network Processor, and RouteXpanders through the 3745 host controller. However, these configurations are not shown as part of this scenario.

A single permanent virtual circuit (PVC) connection exists between the System i platform and the host system. This connection supports a 3270 emulation device that is used to access applications on the host. It also includes a distributed host command facility (DHCF) session.

Configuration for the System i platform

Use the following commands to configure the System i platform using an SNA direct connection with the 3745 host controller and the host system:

```
CRTNWIFR  NWID(FR3745) RSRNAME(LIN121) +  
          INTERFACE(*V35)1 LINESPEED(64000)1 +  
          LMIMODE(*TE)2 TEXT('Frame relay connection to 3745')  
  
CRTLINFR  LIND(FR3745) NWI(FR3745) NWIDLCI(26) +  
          EXCHID(05636759) TEXT('DLCI connection to the host')
```

```

CRCTCLHOST CTLD(FRHOST) LINKTYPE(*FR) APPN(*NO) +
  SWTLINLST(FR3745) MAXFRAME(8182) +
  SSCPID(050000000001) SWTDSC(*YES) +
  TEXT('Remote host system')

CRTDEV DSP  DEVD(FRDHCF) DEVCLS(*RMT) TYPE(3277) +
  (*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')

```

Notes:

1. The INTERFACE and LINESPEED parameters must match the characteristics of the line to the 3745 host controller.
2. The local management interface (LMI) mode is the default value of *TE, which means the System i platform acts as the terminal equipment. You must configure the 3745 as the frame handler by using American National Standards Institute (ANSI) Annex D (DLCI 0).
3. By creating a frame-relay line description, you indicate that the DLCI is connected to another device. The device supports the frame-relay SNA direct frame format of RFC 1490, such as the 3745 host controller.
4. The DLCI for the line must match the DLCI that you assigned in the configuration of the 3745 host controller.

Scenarios: Bridged configuration for frame relay

These scenarios illustrate the bridged configuration for frame relay. Some general considerations for configuring the 6611 Network Processor and the RouteXpander/2 are also provided.

Scenario: Bridged connections to remote token-ring networks

This scenario shows how to connect a System i platform on a frame-relay network to systems on two remote token-ring networks.

The following figure shows the configuration of a System i platform for frame-relay communications with devices on two different token-ring networks.

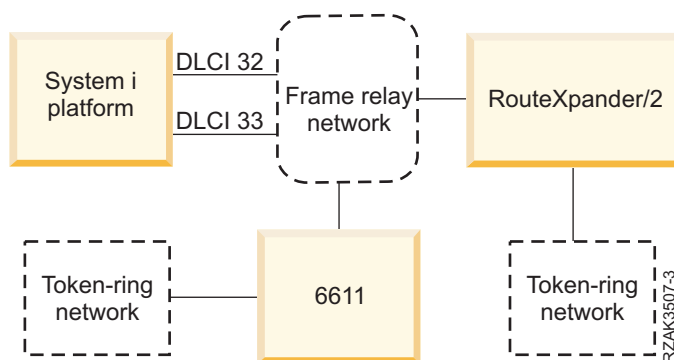


Figure 20. Bridged connections to remote token-ring networks

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 by using two data link connection identifiers (DLCIs), with each providing a link to one of the bridges. DLCI 32 defines a permanent virtual circuit (PVC) to the RouteXpander, and DLCI 33 defines a PVC to the 6611.

The source route bridging protocol is carried out on both bridges in this configuration. Both Systems Network Architecture (SNA) Advanced Program-to-Program Communication (APPC)/Advanced Peer-to-Peer Networking (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 System i platform.

Scenario details: Creating the frame-relay network interface description:

This scenario shows how to use the Create Network Interface (Frame-Relay Network) command to create the frame-relay network interface description.

```
CRTNWIFRN NWID(FRMRLY) RSRNAME(LIN031) INTERFACE(*RS449V36)1 +
  LINESPEED(1536000)1 LMIMODE(*TE)2 +
  TEXT('T1 link to frame-relay network')
```

Notes:

1. Values that you specify for the INTERFACE and LINESPEED parameters must match the frame-relay services that the network provider supplies.
2. Local management interface (LMI) mode is *TE, which means the System i platform exchanges information with the network on data link connection identifier 0 (DLCI 0). If the network does not support the LMI on DLCI 0, then you must configure the LMIMODE parameter to *NONE. The network provider must then configure the frame-relay switch not to perform LMI functions on the line.

Scenario details: Configuring the System i connection to a remote token-ring network through the 6611 Network Processor:

To configure the System i connection to a remote token-ring network through the 6611 Network Processor, use these commands.

```
CRTLINTRN1 LIND(ROUTE6611) RSRNAME(*NWID) NWI(FRMRLY) +
  NWIDLCI(33)2 LINESPEED(*NWI) MAXFRAME(8148)3 +
  ADPTADR(400000036760)4 EXCHID(05636760) +
  AUTOCTRL(*YES)5 TEXT('DLCI to the 6611')

ADDTCPIC6 INTNETADR('59.1.2.222') LIND(ROUTE6611)

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(SYS320) 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(SYS320) CTL(PC4) +
  TEXT('PC4 on 6611 Token-ring Network')
```

Notes:

1. By creating a token-ring line (CRTLINTRN), you indicate that the data link connection identifier (DLCI) for which you are configuring connects to a token-ring bridge. The bridge provides RFC 1490 bridging and performs source-route bridging.
2. The DLCI configured for the line must match the DLCI that is supplied by the network provider. At administration time, the network provider must establish a permanent virtual circuit (PVC) connection to the location of the bridge. If you connect more than one bridge, you need to configure multiple DLCIs and token-ring line descriptions.

3. The MAXFRAME values for each line might be different. When selecting values, you must take into account the maximum sizes that the network and bridge support. To determine a frame size to configure in your line descriptions, refer to the information about maximum frame-size parameter requirements for frame relay.
4. You must generate an adapter address (ADPTADR) for each line description that you configure for bridging over frame relay. The frame-relay adapter does not have a preset address.
5. Configure AUTOCRTCTL so that any devices that dial in to the System i platform have controller and device descriptions automatically created.
6. Use the ADDTCPIFC command to define a new interface to the TCP/IP configuration.

This configuration allows you to communicate by using either Systems Network Architecture (SNA) or TCP/IP data.

Note: If the 6611 Network Processor passes TCP/IP data from a frame-relay network to a token-ring or Ethernet network, you must ensure that the 6611 Network Processor does not filter data for service access point (SAP) AA. You must turn off filtering for SAP AA on both the frame-relay port and the token-ring or Ethernet port.

Related concepts

“Maximum frame-size parameter requirements for frame relay” on page 16

The frame-relay network provider defines and typically establishes a tariff for the frame information field size provided. This size is referred to as N203. Use the N203 value to determine the value specified for the System i maximum frame size (MAXFRAME parameter).

Scenario details: Configuring the System i connection to a remote token-ring network through a RouteXpander/2:

To configure the System i connection to a remote token-ring network through a RouteXpander/2, use these commands.

```
CRTLINTRTN LIND(ROUTEEX) RSRNAME(*NWID) NWI(FRMRLY) NWIDLCI(32) +
  LINESPEED(*NWI) MAXFRAME(4052) ADPTADR(400000036759) +
  EXCHID(05636759) AUTOCRTCTL(*YES) +
  TEXT('DLCI to RouteXpander/2')

ADDTCPIFC INTNETADR('59.1.2.211') LIND(ROUTEEX)

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(SYS320) 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(SYS320) CTL(PC2) +
  TEXT('PC2 on RouteXpander/2 Token-ring Network')
```

With this configuration, you can communicate by using either Systems Network Architecture (SNA) or TCP/IP data.

Scenario: Bridged connection to an Ethernet network

This scenario involves connecting a System i platform to an Ethernet local area network (LAN) using a 6611 Network Processor. The 6611 Network Processor is used as both the frame-relay frame handler and a bridge.

The following figure shows the configuration of a System i platform for frame-relay communications with devices on an Ethernet network.

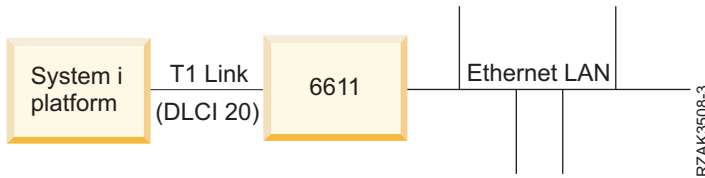


Figure 21. Bridged configuration to the Ethernet network

The Ethernet LAN is connected by using a 6611 Network Processor bridge and transparent bridging. The bridge is connected to the System i platform by using a T1 link.

As seen in the figure, there is no frame-relay network in the connection between the System i platform and the 6611 Network Processor. In this scenario, the System i platform provides the frame handler or DCE function, and the 6611 Network Processor 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 System i platform.

Use the following commands to configure the System i platform connection to the Ethernet network through a 6611 Network Processor.

```
CRTNWIFR  NWID(FT1) RSRNAME(LIN231) NRZI(*YES)1
          INTERFACE(*RS449V36)2 LINESPEED(1536000)2 +
          LMIMODE(*FH)3 +
          TEXT('Network Interface for T1 link to Ethernet Bridge')

CRTLINETH4 LIND(ETHER6611) RSRNAME(*NWID) NWI(FRT1)
          NWIDLCI(20)5 ADPTADR(020000036759)6 +
          EXCHID(05636759) LINKSPEED(1536000) AUTOCRTCTL(*YES)7 +
          TEXT('DLCI to the 6611 Ethernet LAN')

ADDTCPICF8 INTNETADR('59.1.2.222') LIND(ETHER6611)

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(SYS320) CTL(PC5) +
          TEXT('PC5 on 6611 Ethernet Network')

CRTCTLAPPC CTLD(PC6) LINKTYPE(*LAN) SWTLINLST(ETHERNET6611) +
          RMTNETID(RPC) RMTCPNAME(PC6) ADPTADR(400000455405) +
          TEXT('PC6 on 6611 Ethernet Network')

CRTDEVAPPC DEVD(PC6) RMTLOCNAME(PC6) LCLLOCNAME(SYS320) CTL(PC6) +
          TEXT('PC6 on 6611 Ethernet Network')
```

Notes:

1. You must configure NRZI(*YES) when communicating directly with a 6611 Network Processor without a frame-relay network, such as on a T1 link. You must also configure the 6611 Network Processor to use NRZI.
2. The INTERFACE and LINESPEED parameters must match the characteristics of the T1 line that you use.
3. The local management interface (LMI) mode is *FH, which means that the System i platform acts as the frame handler and the 6611 Network Processor acts as the terminal equipment (TE). LMI is exchanged on data link connection identifier 0 (DLCI 0).

4. By creating an Ethernet line (CRTLINETH), you are indicating that the DLCI connects to an Ethernet bridge. The Ethernet bridge carries out RFC 1490 bridging and performs transparent bridging.
5. The System i platform communicates with the 6611 bridge on DLCI 20.

Note: If the 6611 Network Processor passes TCP/IP data from a frame-relay network to a token-ring or Ethernet network, you must ensure that the 6611 Network Processor does not filter data for service access point (SAP) AA. You must turn off filtering for SAP AA on both the frame-relay port and the token-ring or Ethernet port.

6. You must generate an adapter address (ADPTADR) for each line description that you configure for bridging over frame relay. The frame-relay adapter does not have a preset address.
7. Configure the Automatically Create Controller Description (AUTOCRTCTL) command so that any devices that dial in to the System i platform have controller and device descriptions automatically created.
8. Use the Add TCP/IP Interface (ADDTCPIFC) command to define a new interface to the TCP/IP configuration.

Use this configuration to communicate by using either SNA or TCP/IP data.

Appendix. Notices

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