IBM i
Version 7.2

Networking
Ethernet

IBM

Contents

Ethernet

Ethernet on the IBM® i platform supports TCP/IP, Advanced Peer-to-Peer Networking (APPN), Advanced Program-to-Program Communication (APPC), retail, finance, host, and remote workstation.

You can use this information to configure and manage TCP/IP or Systems Network Architecture (SNA) over Ethernet on your IBM i platform.

What's new for IBM i 7.2

Read about new or significantly changed information for the Ethernet topic collection.

What's new as of October 2015

In IBM i 7.2 Technology Refresh 3 (TR3), there is new support for two new Ethernet adapters. For more information, see:

- "Hardware requirements for Ethernet" on page 7
- "Gigabit and 10 Gigabit Ethernet " on page 3

Link Aggregation Control Protocol

- Added support for the Link Aggregation Control Protocol. For more information, see "Ethernet Link Aggregation" on page 34.

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Ethernet support

Many different factors influence the capabilities of Ethernet. Some of these influences can come from the cabling and adapter type you use.

Limiting factors can be the capabilities of the hub or switch that you connect to, the frame size you are able to transmit and receive, and the type of connection you use.

Ethernet terminology

These terms are often used in reference to Ethernet networking.

Some of the terms defined can be used to represent multiple meanings. The terms and definitions used here are meant to specifically represent Ethernet networking technology, related information, and devices.

Link partner
A device that the Ethernet adapter is connected to in an Ethernet connection. A link partner can be a switch, hub, router, or some other device that the adapter is connected to.

Hub
A half-duplex device that sums all of its input and then broadcasts that sum on all output to the connected adapters. A hub has a large collision domain and shared media.

Switch
A half-duplex or full-duplex device that detects which devices are attached at each port and passes only frames addressed to those devices on that port. A switch has a small collision domain.

Ethernet capabilities

Ethernet capabilities, such as line speed and duplex mode, can enhance your system's performance.

IBM i products are capable of transmitting and receiving data at speeds from 10 megabits per second (10 Mbps) to 10 gigabits per second (10 Gbps or 10 000 Mbps). Functions such as full duplex also enhance the communication speeds and the overall performance of Ethernet.

Line speed
The speed of data transfer is limited by the connection type, cabling, and maximum speeds that your system and link partner support.

The supported speeds can be 10 Mbps, 100 Mbps, 1000 Mbps (1 Gbps), or 10 000 Mbps (10 Gbps).

The cable type you use will directly limit what speed you can transmit and receive data. For more information about cabling types and their capabilities, see the Establishment of a physical connection to your network topic.

The maximum line speed of your system is also affected by the type of input/output adapter (IOA) that you are using. For more specific information about each supported IOA, see the Hardware requirements for Ethernet topic.

Related concepts
Gigabit and 10 Gigabit Ethernet
IBM i products support Gigabit and 10 Gbps Ethernet, which requires the use of a 1 Gbps or 10 Gbps input/output adapter (IOA). The support for 10 Gbps Ethernet is limited to some models.

Related reference
Establishment of a physical connection to your network
The first step to use Ethernet for IBM i is establishing a physical connection to your network. Having the correct settings and configurations for your system helps to ensure a successful connection.

Hardware requirements for Ethernet

IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

Duplex mode
Depending on your system's capabilities and the duplex mode of the link partner you are attaching to, you can use either full or half duplex.

Half duplex mode restricts the system to one-way communication; it cannot transmit and receive data at the same time. Full duplex allows your system to send and receive data simultaneously. You must match your system's duplex mode to that of your link partner. If you do not, a duplex mismatch occurs.

Related concepts
Auto-sensing
If auto-negotiation fails, your system can match the line speed of its link partner.

Gigabit and 10 Gigabit Ethernet
IBM i products support Gigabit and 10 Gbps Ethernet, which requires the use of a 1 Gbps or 10 Gbps input/output adapter (IOA). The support for 10 Gbps Ethernet is limited to some models.

IBM i supports several different Ethernet input/output adapters (IOAs). Each IOA has ports that can transmit and receive Ethernet traffic at 1 gigabit per second (Gbps), 10 Gbps, or both. Some also support traffic at 10 or 100 megabits per second (Mbps). All of the adapters support Transmission Control Protocol and Internet Protocol (TCP/IP) and 9000-byte jumbo frames. The IBM i operating system does not have integrated support for SNA over Ethernet: Enterprise Extender or AnyNet(^R) is required to use SNA over Ethernet. The following table summarizes IBM i support for the gigabit and 10-gigabit Ethernet physical interconnects.

Table 1. Summary of IOA support by physical interconnect, speed, and cable type.

Physical interconnect	Speed	Cable	Adapter types
10BASE-T/100BASE-TX	10/100 Mbps	CAT 5e+	5701, 5706, 5767, 576F, 181A, 181C, 1818, 1819, 266D, 2BC4, 2B93[1], 2CC1[1], 2CC0[1]
1GBASE-T	1 Gbps	CAT 5e+	5701, 5706, 5767, 576F, 181A, 181C, 1818, 1819, 266D, 2BC4, 2B93[1], 2CC1[1], 2CC0[1], 2C4C[1], 2C4D[1]
10GBASE-T	10 Gbps	CAT 6e+	2C4C[1], 2C4D[1]
1000BASE-SX	1 Gbps	MMF	5700, 5707, 5768
10GBASE-SR	10 Gbps	MMF	573A, 181B, 1820, 1830, 1831, 266E, 266F, 2BC6, 2B93[1], 2C4D[1], 2CE3
10GBASE-LR	10 Gbps	SMF	576A, 576E, 2CC0[1]
SFP+ Direct Attach	10 Gbps	SFP Twinax Cu	2BDC, 2CC1[1], 2C4C[1], 2CE4

Footnote:

1. This IOA has more than one type of port, and each type supports different physical interconnections.

The 10BASE-T, 100BASE-TX, 1GBASE-T, and 10GBASE-T physical interconnects all use copper Universal Twisted Pair (UTP) cables with RJ45 connectors. They require CAT 5e or higher standard of cable, which is wired to the TIA/EIA 568-B standard; crossover cables are not supported.

The 1000BASE-SX, 10GBASE-SR (short range), and 10GBASE-LR (long reach) physical interconnects use fiber-optic cabling. 1000BASE-SX and 10GBASE-SR use 50-micron or 62.5-micron multi-mode fiber (MMF) cables, and 10GBASE-LR uses 9-micron single-mode fiber (SMF) cables. The 576A adapter port uses duplex SC connectors, and all other supported fiber-optic ports use duplex LC connectors.

The SFP+ Direct Attach physical interconnect is also referred to by several other names, including DA, SFP +, 10GSFP+Cu, 10GBASE-CX1, and 10GBASE-CR. These resources use twin-axial copper (Cu) cables with ends that connect directly into the SFP+ port. The hardware documentation for each IOA specifies which cables work with which adapter ports.

Table 2. Summary of IOA support by release	
IOA	**Earliest IBM i release supported**
5700	V5R2
5701	V5R2
5706	V5R3
5707	V5R3
573A	V5R4
576A	V5R4
5767	V5R4
5768	V5R4
181A	V5R4
181C	V5R4
1818	V6R1M0
1819	V6R1M0
181B	V6R1M0
1820	V6R1M0
1830	V6R1M0
576E	V6R1M0
576F	i 7.1 TR4
2B93	i 7.1 TR7
2CC1	i 7.1 TR7
2C4D	i 7.1 TR7
2C4C	i 7.1 TR7
2CC0	i 7.1 TR8
2CE3	i 7.1 TR10 and i 7.2 TR2
2CE4	i 7.1 TR10 and i 7.2 TR2

Ethernet frames can contain anywhere from 64 to 9000 bytes of information. All of these cards support the largest, 9000-byte jumbo frame size. The amount of work for the adapter to process each frame, regardless of size, is nearly the same. Therefore, you want to pack the most information possible into each

frame. The final result will be to decrease processor utilization, leaving it more available for other application usage.

Note: Your system is limited by the switches, hubs, and devices that it connects to. Gigabit Ethernet, 10 Gigabit Ethernet, and jumbo frames can only be used if all devices support them.

Related concepts

Line speed
The speed of data transfer is limited by the connection type, cabling, and maximum speeds that your system and link partner support.

Related reference

Establishment of a physical connection to your network
The first step to use Ethernet for IBM i is establishing a physical connection to your network. Having the correct settings and configurations for your system helps to ensure a successful connection.

Hardware requirements for Ethernet
IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

Auto-negotiation
Auto-negotiation is the preferred method of configuring your system's Ethernet connections.

Auto-negotiation should always be tried first. In auto-negotiation, your system sends out Ethernet link pulses seeking to transfer configuration data between your system and its link partner. Each link partner shares its supported values for line speed and duplex mode, and then finds the highest common value for each. The highest values common to both partners are selected, in the following order:

- 10 Gbps full duplex[1]
- 1 Gbps full duplex[2]
- 1 Gbps half duplex[2]
- 100 Mbps full duplex
- 100 Mbps half duplex
- 10 Mbps full duplex
- 10 Mbps half duplex

Notes:

1. The fiber optic 10 Gigabit Ethernet adapter can only run either 10 GBASE-LR (long range) or 10 GBASE-SR (short range), and full duplex. The fiber optic 10 Gigabit Ethernet adapter does allow auto-negotiation, but the only acceptable outcome is 10 Gbps, full duplex.

2. For Gigabit Ethernet, the line speed is negotiable only when using the UTP card, since this card has 10/100/1000BASE-T and full or half duplex capabilities. The fiber optic Gigabit Ethernet adapter can only run 1000BASE-SX and full duplex. The fiber optic Gigabit Ethernet adapter does allow auto-negotiation, but the only acceptable outcome from the auto-negotiation is 1000 Mbps, full duplex.

Auto-negotiation allows your system and its link partner to quickly establish a connection. However, both systems must support auto-negotiation. If the link partner is not configured to negotiate automatically, the system automatically senses a workable line speed, but not the duplex mode. The system uses the default setting of half-duplex. If this is not the correct duplex mode, a duplex mismatch occurs, at which point you must manually configure your system's duplex mode to match that of its link partner.

Related concepts

Auto-sensing
If auto-negotiation fails, your system can match the line speed of its link partner.

Auto-sensing
If auto-negotiation fails, your system can match the line speed of its link partner.

However, the adapter cannot sense the duplex mode. The system will use the default setting of half duplex, which can result in a duplex mismatch.

Duplex mismatch

Here is an example of duplex mismatch.

Your IBM i platform, configured for full duplex, is connecting to a hub configured for half duplex. Your system begins sending information to the hub, which is waiting to receive. When the receive line is clear, the hub then begins transmission back to your system. During this transmission, your system receives the incoming data and (if it has data ready) begins transmitting to the hub. Because the hub is half duplex, it sees this unexpected receipt of data and cancels the transmission in progress. This is called a *collision*. A duplex mismatch problem might be reported as a failure-to-connect error, or it might cause a more subtle performance problem due to intermittent canceled frames.

Related concepts

Duplex mode
Depending on your system's capabilities and the duplex mode of the link partner you are attaching to, you can use either full or half duplex.

Auto-negotiation
Auto-negotiation is the preferred method of configuring your system's Ethernet connections.

Establishment of a physical connection to your network

The first step to use Ethernet for IBM i is establishing a physical connection to your network. Having the correct settings and configurations for your system helps to ensure a successful connection.

The physical link includes using the correct cabling and configuring the correct line speed and duplex mode to match the capabilities of the link partner you are connecting to.

UTP cable specifications

The cabling that you use to connect to your link partner must be wired to the TIA/EIA 568–B standard (straight through, no cross-over). There are different categories of UTP cables and each one supports different speeds.

- Category 3: supports 10 Mbps
- Category 5: supports 10/100/1000 Mbps
- Category 5e: supports 10/100/1000 Mbps
- Category 6 or higher: supports 10/100/1000 Mbps

Note: Category 5e or higher is suitable if you are running Gigabit Ethernet. These cable types have tighter specifications that will help you achieve better quality connections.

Connecting your cables can be tedious work. The following list contains the pairs of wires inside the UTP cable and shows what order they are wired in the RJ-45 connector. It is crucial that the connector pins be in this order, or you will not be able to connect to your link partner. You will notice that the wires are different colors; some are solid colors and some are half solid and half white. Each half solid and half white wire is paired with the corresponding solid color wire, even though they might not sit adjacent to one another in the connector.

The pairs of wires are as follows:

- White/green, solid green
- White/orange, solid orange
- White/blue, solid blue
- White/brown, solid brown

The pins are numbered from left to right. (Hold the connector latch down and point the contacts away from you, so that pin 1 (White/Green) is on the left.) The following table shows how the wires appear in the connector and what pins they are set into.

Connector pin	Wire color
1 2	White/Green Green
3 4	White/Orange Blue
5 6	White/Blue Orange
7 8	White/Brown Brown

Line speed and duplex mode configuration

If your link partner is capable of auto-negotiation, you can use *AUTO for both line speed and duplex mode, to negotiate automatically. If you are unsure of the link partner's capabilities, find out what line speed and duplex mode it is set to, so you can configure your system to match.

Here is an example where *AUTO cannot be used. If the hub or switch port is set to 100 Mbps and half duplex (not capable of auto-negotiation), in the Create Line Desc (Ethernet) (CRTLINETH) command, set your system's parameters to LINESPEED equals 100M and DUPLEX equals *HALF. Do not use *AUTO for either of these parameters, in this case.

Do not use any of the following line speed and duplex mode configurations:

- 10/*AUTO
- 100/*AUTO
- *AUTO/Half
- *AUTO/Full

These configurations might work, but you will have frequently unsuccessful and incorrect connections.

Related concepts

Gigabit and 10 Gigabit Ethernet
IBM i products support Gigabit and 10 Gbps Ethernet, which requires the use of a 1 Gbps or 10 Gbps input/output adapter (IOA). The support for 10 Gbps Ethernet is limited to some models.

Line speed
The speed of data transfer is limited by the connection type, cabling, and maximum speeds that your system and link partner support.

Related reference

Establishment of a physical connection to your network
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Hardware requirements for Ethernet
IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

Hardware requirements for Ethernet

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The following tables show the relevant data for each type of Ethernet resource.

Only the resources indicated support half-duplex connections.

PhysCtl: Does the IBM i operating system line description configuration affect the line speed and duplex of the port? If not, those types are configured with the management console.

Table 3. PCI-x-attached resources				
Type	**Line Speeds**	**Physical Interface**	**Half Duplex**	**PhysCtl**
5701, 5706	10/100/1000 Mbps	UTP	Yes	Yes
5700, 5707	1 Gbps	Opt-SR	No	Yes
573A	10 Gbps	Opt-SR	No	Yes
576A	10 Gbps	Opt-LR	No	Yes

Table 4. PCI-e-attached resources				
Type	**Line Speeds**	**Physical Interface**	**Half Duplex**	**PhysCtl**
5767, 576F	10/100/1000 Mbps	UTP	Yes	Yes
5768	1 Gbps	Opt-SR	No	Yes
576E	10 Gbps	Opt-LR	No	Yes
2CE3	10 Gbps	Opt-SR	No	Yes
2CE4	10 Gbps	Cu-SFP	No	Yes

Table 5. Host Ethernet Adapter (HEA) resources				
Type	**Line Speeds**	**Physical Interface**	**Half Duplex**	**PhysCtl**
181A, 181C, 1818, 1819, 266D, 2BC4	10/100/1000 Mbps	UTP	No	No
181B, 1820, 1830, 1831, 266E, 266F, 2BC6	10 Gbps	Opt-SR	No	No
2BDC	10 Gbps	Cu-SFP	No	No

Table 6. Native SR-IOV resources				
Type	**Line Speeds**	**Physical Interface**	**Half Duplex**	**PhysCtl**
2B93[4], 2CC1[4], 2CC0[4]	10/100/1000 Mbps	UTP	No	No
2B93[2], 2C4D[2], 2CE3[2]	10 Gbps	Opt-SR	No	No

Table 6. Native SR-IOV resources (continued)				
Type	**Line Speeds**	**Physical Interface**	**Half Duplex**	**PhysCtl**
2CC1[2], 2C4C[2], 2CE4[2]	10 Gbps	Cu-SFP	No	No
2C4C[4], 2C4D[4]	1/10Gbps	UTP	No	No
2CC0[2]	10 Gbps	Opt-LR	No	No
Notes:				
1. Any marked with [2] are Model 002, and any with [4] are Model 004.				

Related concepts

Gigabit and 10 Gigabit Ethernet
IBM i products support Gigabit and 10 Gbps Ethernet, which requires the use of a 1 Gbps or 10 Gbps input/output adapter (IOA). The support for 10 Gbps Ethernet is limited to some models.

Related tasks

Changing your line description
To make changes to an existing line description, follow these steps.

Assigning your line description to a TCP/IP interface
To use your line description with TCP/IP, you must associate the line description with a new or existing TCP/IP interface.

Configuring TCP/IP over Ethernet
IBM Navigator for i provides a configuration wizard for you to set up Ethernet support for TCP/IP.

Related reference

Establishment of a physical connection to your network
The first step to use Ethernet for IBM i is establishing a physical connection to your network. Having the correct settings and configurations for your system helps to ensure a successful connection.

LAN IOA addresses

The input/output adapter (IOA) has a preset address (also known as the burned-in address or the manufacturer-assigned address). You have the option of setting the address for each IOA to an address of your choice.

If you are using SNA, it is preferred that you use an address of your choice. For example, if you use the burned-in address of the adapter, you must configure this address into every device that communicates with the adapter. If, at a later point in time you replace the adapter, you must go back to each device and reconfigure them with the burned-in address of the new adapter. You cannot assign the burned-in address of the old adapter to the new adapter.

However, you can avoid the excess reconfiguration work by associating a locally administered address with the adapter. Because the other devices will already have the locally administered address configured, you will not need to reconfigure them when you replace the IOA. Instead, you can associate the existing locally administered address with the new adapter.

Note: No two adapters in the same network can have the same address.

Ethernet frame format

While tracing LAN communications, you might need to look at the transmitted frames. To understand the data that is contained in the frame, you must know how it is formatted.

The following figures show the frame format of two Ethernet standards: IEEE 802.3 and Ethernet version 2.

The Frame Check Sequence (FCS) is a part of the frame put in place to verify that the information each frame contains is not damaged during transmission. If a frame is corrupted during transmission, the FCS on the frame will not match with the recipient's calculated FCS. Any frames that do not match the calculated FCS will be discarded.

IEEE 802.3 frame format

Starting Delimiter (1 byte)	Destination Address (6 bytes)	Source Address (6 bytes)	Length (2 bytes)	LLC header and Information field (46 - 1500 bytes)	Frame Check Sequence (4 bytes)

Ethernet version 2 frame format

Starting Delimiter (1 byte)	Destination Address (6 bytes)	Source Address (6 bytes)	Type (2 bytes)	Information field (46 - 1500 bytes)	Frame Check Sequence (4 bytes)

Ethernet version 2 supports SNA by placing the IEEE 802.2 LLC header and data into the information field. It also puts value X'80D5' into the Type field. This shows the frame format.

Starting Delimiter	Destination Address	Source Address	Type (80D5)	Information field (Length, Padding, LLC header, Data)	Frame Check Sequence

Note: The IBM i operating system does not have integrated support for SNA over Gigabit Ethernet or 10 Gbps Ethernet. Enterprise Extender or AnyNet® is required to run SNA over 1 Gpbs or 10 Gbps Ethernet.

Related information
APPC, APPN, and HPR

Types of Ethernet frames sent

The Ethernet frame that your system receives and the Ethernet standard that you select in the line description govern the type of frame that your system sends.

In the line description, you select the standard through the Ethernet standard (ETHSTD) field. In an SNA environment, if you have the option to use Ethernet standard IEEE 802.3 or Ethernet version 2, use *ALL.

The following table shows what Ethernet frame your system sends according to the frame type the system receives and the value of the ETHSTD field. As noted, your system will not send a frame in some cases.

Frame type received	ETHSTD value	Frame type sent
IEEE 802.3 with SNA or non-SNA data	*IEEE8023[1]	IEEE 802.3
	*ETHV2[2]	No frame sent
	*ALL[3]	IEEE 802.3
Ethernet version 2 with non-SNA data	*IEEE8023	No frame
	*ETHV2	Ethernet version 2
	*ALL	Ethernet version 2
Ethernet version 2 with SNA data	*IEEE8023	IEEE 802.3
	*ETHV2	Ethernet version 2, encapsulated SNA[4]
	*ALL	IEEE 802.3

Frame type received	ETHSTD value	Frame type sent

Notes:

1. The network uses Ethernet standard IEEE 802.3.
2. The network uses Ethernet version 2. In an SNA environment, you use this protocol for only IBM i to IBM i communications.
3. The network uses both Ethernet standards (IEEE 802.3 and Ethernet version 2). All TCP/IP multicast packets are sent as 802.3 and Ethernet version 2 frames.
4. The type field of the Ethernet version 2 frame to indicate the information field contains the SNA data.

Maximum Ethernet frame sizes

The largest frame size used during the connection process is controlled by the maximum frame size configurations of multiple items.

The maximum frame size for the connection is also influenced by exchange identifier negotiations and bridge considerations. Note that TCP/IP and SNA connections are limited by slightly different sets of items.

TCP/IP connections

The maximum frame size is associated with:

- the Ethernet standard that you select
- the line description (Gigabit Ethernet only)
- each service access point (SAP)
- the TCP/IP interface

SNA connections

The maximum frame size is associated with:

- the controller
- the Ethernet standard that you select
- each service access point (SAP)

During the connection process, your system selects the smallest common value of the maximum frame values. As previously stated, the actual maximum frame size used can become even smaller if the bridge cannot support the value selected by the system.

The following table shows the maximum frame sizes that are associated with the Ethernet standard that you select through the Ethernet standard (ETHSTD) field.

ETHSTD parameter value	Frame type used	Maximum frame size in bytes	
		SNA[4]	TCP/IP
*IEEE8023 [1]	IEEE 802.3	1496	8992 (1 Gbps/10 Gbps Ethernet) 1492 (all others)
*ETHV2[2]	Ethernet version 2	1493	9000 8992 (1 Gbps/10 Gbps Ethernet) 1500 (all others)

ETHSTD parameter value	Frame type used	Maximum frame size in bytes	
		SNA[4]	TCP/IP
*ALL[3]	IEEE 802.3	1496	8992 (1 Gbps/10 Gbps Ethernet) 1492 (all others)
	Ethernet version 2	1493	9000 8992 (1 Gbps/10 Gbps Ethernet) 1500 (all others)

Notes:

1. IEEE 802.3 standard.

2. Ethernet version 2 standard.

3. Network uses both Ethernet standards (IEEE 802.3 and Ethernet version 2).

4. For 1 Gbps and 10 Gbps cards, Enterprise Extender or AnyNet is required to use SNA. For more information, see the APPC, APPN, and HPR topic collection.

Related reference

SNA service access points

Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Remote bridges dropping frames

A remote bridge discards your frame if it does not support your frame size. The network can also discard your frame if it does not support your frame size.

Improvement of Gigabit and 10 Gigabit Ethernet performance

These tips show how to improve the performance of your system.

Maximum LAN frame sizes

The larger your frame size, the more data your system can put into it. Hence, you can increase your data throughput.

Typically, you set the maximum frame size to the largest size that is supported by your input/output adapter (IOA). However, a device along the way will drop the frame if it cannot support the larger size. For example, if frames are being sent to a remote system on a different LAN, the frame must go through a bridge to be retransmitted to the remote LAN. If the bridge cannot support the frame size that your LAN is using, the frame will be dropped or discarded. In the Ethernet environment, no indication of the smaller frame size of the bridge is received. The problem will be detected when a connection with the remote system is established and a CPA57A1 message is sent to the configured message queue.

If you cannot configure the device to support your frame size, you must decrease your maximum frame size to a size that the device can support. You can change one or more of the following maximum frame size fields (location of the field in parentheses):

• SSAP maximum frame parameter (line description)

• Maximum frame size (line descriptions for token ring, Gigabit and 10 Gigabit Ethernet networks)

• Maximum frame size (controller description)

If any adjustments are made, it is preferred that the MAXFRAME value on the controller description be adjusted as well.

LAN device connection

The correct line and controller descriptions help you achieve successful connections.

If you use SNA with a LAN protocol, this information can help you to successfully connect to a remote system. The correct relationship between a line description and a controller description helps to ensure connection establishment. A controller description determines which line descriptions your system uses. Therefore, you must ensure that the controller description refers to the correct line description.

A line description also governs the number of active controllers that can access it. By setting the MAXACT parameter number too small, you might prevent the controller from accessing the system over the specific line description. Therefore, you should set a large enough value to ensure the controller access to the line.

The descriptions must also contain the correct information to ensure connection establishment.

Related tasks
Creating the SNA controller description
The controller description identifies the remote devices to which the system connects.

Related reference
Connection failure and controller descriptions
Sometimes an incorrectly configured controller description can cause a connection failure. The problem source might involve the incorrect configuration of the adapter address, source service access point (SSAP), or destination service access point (DSAP) parameters.

LAN device identification
Different types of verification are used during the LAN connection process.

To begin a connection, your system sends information to the remote device you are connecting to. The device identifies the system using this information. The device then sends information back to the system, which the system uses to identify the device. The system compares that information against the information that is contained in the line and controller descriptions. If a match occurs and other connection values are correct, the connection process continues. In the meantime, the remote device performs a similar process.

Your system and the remote device use two types of verification during the connection process. The first type (required) matches the line and controller description information with the connection information that the remote device sent. After the information has been verified, your system continues the process.

The remote device sends the following information:

- The MAC address associated with the input/output adapter (IOA) on the remote device (either preset or locally administered)
- The source service access point (SSAP) on the remote device
- The destination service access point (DSAP)

The other type of verification matches the SNA exchange identifier values. SNA hosts that use parallel connections require this verification. This verification is optional for Advanced Program-to-Program Communications (APPC).

Related reference
SNA service access points
Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Connection failure and controller descriptions

Sometimes an incorrectly configured controller description can cause a connection failure. The problem source might involve the incorrect configuration of the adapter address, source service access point (SSAP), or destination service access point (DSAP) parameters.

SNA exchange identifiers
To establish a connection, your system and the remote device both send an SNA exchange identifier (XID).

The exchange identifier is defined in the controller description for your system. SNA hosts that use parallel connections require the XIDs. Your system conducts an initial poll with NULL XIDs during the connection process to determine whether the remote device is active. If the device responds to the poll, your system and the remote device exchange XIDs and establish the connection.

The controller description for an SNA host names the XID value as the local exchange identifier. The APPC controller description names the XID value as the exchange identifier. Other controller types, such as CTRL, FNC, and RWS, also use the exchange identifier.

LAN device connection initiation
In an SNA environment, you can determine which system initiates the connection request and which system waits for an incoming connection request.

To have your system initiate the connection, you can configure the controller description to dial the destination. If no connection is established, your controller description automatically switches to answer mode.

To have your system wait for incoming calls, you can configure the controller description to answer the incoming calls. You can specify the mode through the Initial connection (INLCNN) field of the controller description.

Dial mode (SNA)

SNA controller descriptions use dial mode to send a connection request to a remote device.

Dial mode typically starts when varying on the controller description. However, if the DIALINIT parameter is set to *DELAY, dial mode will not begin until an application opens a file that uses the connection. During the dialing process, the system polls the remote device to determine if the device is available. If the remote device is available, the connection process continues. Successful connection is still possible even if the local and remote devices dial each other simultaneously.

The following controller description fields set the frequency and duration of the poll:

- LAN connection retry (LANCNNRTY) determines the number of times your system polls the remote device.
- LAN connection timer (LANCNNTMR) determines the length of time between each poll.

If the remote device answers the poll within the time specified by the parameters, your system proceeds with establishing the connection. If not, your system sends an inquiry message (CPA58E0 or CPA57EF) to the configured message queue. This message indicates that a connection attempt failed and that the controller description is now in answer mode.

Answer mode (SNA)

If you specify answer mode, the input/output adapter (IOA) does not originate connection requests, but responds to incoming connection requests. Systems with controller descriptions that are configured with dial mode initiate and accept connection requests. However, APPC controllers that are user owned (CTLOWN = *USER) must be varied on before the system can respond to connection requests.

Related reference
LANCNNTMR and LANCNNRTY

The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

Connection failure and controller descriptions
Sometimes an incorrectly configured controller description can cause a connection failure. The problem source might involve the incorrect configuration of the adapter address, source service access point (SSAP), or destination service access point (DSAP) parameters.

SNA connections to LAN protocols

The system can connect SNA to a LAN protocol by using service access points (SAPs). Multiple SAPs enable you to have multiple connections between SNA and a LAN protocol, thus permitting multiple communication paths between independent applications.

You or the system specifies which SAPs to use in the line and controller descriptions. For SNA, the system can automatically create one SAP value (the default value). You might want to change this value or have additional SAPs if any of the following conditions apply:

- The remote system does not use the default source service access point (SSAP)
- You want parallel station-to-station connections between adapters (This might be desirable if you link two applications that require different controller descriptions.)
- You want station-to-station connections to the same adapters (You might want to do this to configure multiple SAPs to test an application on a single system.)

Related tasks
Creating the SNA controller description
The controller description identifies the remote devices to which the system connects.

SNA service access points
Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

If you decide to change the default service access points (SAPs) or add more SAPs, you must define them in the line and controller descriptions.

You can specify up to 24 SSAPs per line description when you define the SAPs. The SSAPs that your controller description uses must also be defined in the line description associated with the controller description. Your controller description also specifies the destination service access point (DSAP).

The following figure portrays the physical connection between the source service access points of your system and the destination service access points of the remote system. For example, on your system, the SSAP 08 will have a DSAP of 12. On the remote system, the SSAP is 12 and the DSAP is 08.

Example of SSAP and DSAP Pairs

System i #1 (LAN)				System i #2		
APPC Applications	SSAP*	DSAP**		SSAP	DSAP	APPC Applications
Application #1	04	04		04	04	Application #1
Application #2	08	12		08	12	Application #3
Application #3	12	08		12	08	Application #2

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

For SNA, you must use certain SSAP values. You can find the help for selecting these values by pressing F1 (Help) while your cursor is on the SSAP list field of the line description.

Related concepts

LAN device identification
Different types of verification are used during the LAN connection process.

Related tasks

Creating the SNA controller description
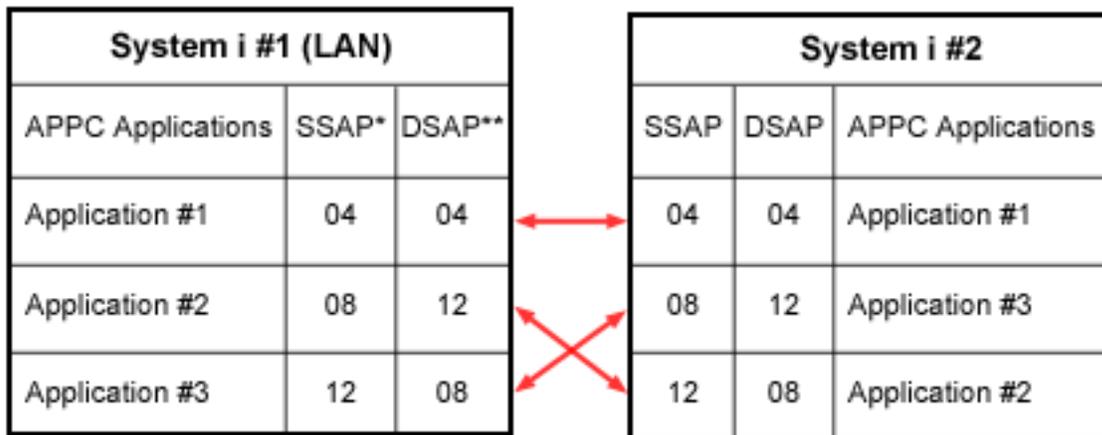The controller description identifies the remote devices to which the system connects.

Changing your line description
To make changes to an existing line description, follow these steps.

Assigning your line description to a TCP/IP interface
To use your line description with TCP/IP, you must associate the line description with a new or existing TCP/IP interface.

Configuring TCP/IP over Ethernet
IBM Navigator for i provides a configuration wizard for you to set up Ethernet support for TCP/IP.

Related reference

Maximum Ethernet frame sizes
The largest frame size used during the connection process is controlled by the maximum frame size configurations of multiple items.

Related information

Match iSeries system line description parameters for a remote iSeries system

Configuring Ethernet support

The IBM i operating system supports Ethernet connections with TCP/IP and SNA.

Configuring TCP/IP over Ethernet

IBM Navigator for i provides a configuration wizard for you to set up Ethernet support for TCP/IP.

To configure a new TCP/IP interface that is used with Ethernet, follow these steps:

1. In IBM Navigator for i , expand **IBM i Management** > **Network** > **TCP/IP Configuration** > **IPv4** or **IPv6** and click **IPv4 Interfaces** or **IPv6 Interfaces**.
2. Click **Actions** and select **New Interface** > **Local Area Network**. This takes you to the New Interface Wizard.

   Remember: You can choose to use an existing line description or have a new one created by IBM Navigator for i.
3. If you did not choose to turn on the TCP/IP interface, you can do so now. Follow the instructions in "Starting the TCP/IP interface" on page 22 .

Related tasks
Changing your line description
To make changes to an existing line description, follow these steps.

Related reference
Hardware requirements for Ethernet
IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

SNA service access points
Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Related information
TCP/IP setup

Configuring SNA over Ethernet

To configure Ethernet support for SNA, complete the following tasks from an interactive job.

Selecting a LAN IOA and creating the Ethernet line description
To configure SNA over Ethernet, you need to select a LAN input/output adapter (IOA) and create the Ethernet line description using an interactive job .

Note: The following steps describe only the fields that require additional information. If you need help with the fields that are not discussed here, press F1 (Help) when your cursor is on the field in question.

1. Type `WRKHDWRSC  *CMN` and press Enter. A list will appear that shows the attached IBM i communications resources, and their type numbers, operational statuses, and descriptive text.
2. Locate an IOA by looking in the descriptive text column for a phrase that describes the port for your LAN type. For example, if you use Ethernet, look for "Ethernet Port."
3. After you find an IOA, move your cursor to its **Opt** field.
4. Type 5 (Work with configuration descriptions) and press Enter.
5. Type 1 (Create) and press Enter.

   You are now in the Create Line Description (Ethernet) (CRTLINETH) screen.

   Note: The system enters the IOA you selected into the **Resource** name field.

   To move from field to field, move your cursor or press the tab key. Do not press Enter while you are in this screen unless instructed to do so; otherwise you will exit the command.
6. Type a name for your line description into the **Line description** field.

7. Indicate the address to use with the IOA in the **Local adapter** address field.

   You can use either the preset address or a locally administered address. If you are unsure which address to use, see the LAN IOA addresses topic.

   To use the preset address, accept the default value of ***ADPT**. To specify a locally administered address, enter a valid address into the field. For guidelines on creating a valid address, move your cursor to the address field and press F1 (Help).

8. If the system uses this line description to communicate with an SNA host through a parallel connection, specify a value other than *LIND in the **SNA Exchange identifier** field.

9. In the **Ethernet standard** field, specify the standard to use.

   If you can use SNA over IEEE 802.3 or Ethernet version 2, use the *ALL value on the **ETHSTD** parameter.

   For information about how the selected standard influences the type of Ethernet frame your system sends, see the Types of Ethernet frames sent topic.

   Note: You cannot change this field after exiting the command.

10. In the **Line speed** field, indicate the line speed to use.

    If you do not know the capabilities of the IOA, see the Hardware requirements for Ethernet topic.

    Note: Line speed automatic negotiation occurs when you specify *AUTO.

11. Select the duplex mode to use with your IOA.

    If you do not know the capabilities of the IOA, see the Hardware requirements for Ethernet topic.

    Note: Duplex mode automatic negotiation occurs when you specify *AUTO. Remember that your Ethernet switch or hub must support automatic negotiation before you can successfully use this function. If the device does not support it, a duplex mismatch can occur, causing connection problems. For more information see the Auto-sensing topic.

12. Specify the serviceability option. The default value for this parameter is ***NONE**, which indicates that no serviceability option is provided. If you need to specify another character value, do it under the guidance of your service provider.

13. Press F10 (Additional fields).

14. List all the source service access points (SSAP) that your controller description can use in the **SSAP** field. Accept the default value *SYSGEN or specify your SSAPs. To define the SSAP values, move your cursor to the field and press F1 (Help) for help to determine what values to use.

    For more information about whether you or the system should define the service access points (SAPs), see SNA connections to LAN protocols.

15. Leave the **SSAP maximum frame** field blank.

16. Optional: In the **Autocreate controller** field, specify *YES if you use APPN and want the system to create a controller description. (The system will create the description when a call comes in.) If you specified *YES, you do not need to create a device description.

17. Press Enter to create the line description. Your line description will appear at the bottom of the list.

18. Press Enter twice.

Related concepts

LAN IOA addresses
The input/output adapter (IOA) has a preset address (also known as the burned-in address or the manufacturer-assigned address). You have the option of setting the address for each IOA to an address of your choice.

SNA connections to LAN protocols
The system can connect SNA to a LAN protocol by using service access points (SAPs). Multiple SAPs enable you to have multiple connections between SNA and a LAN protocol, thus permitting multiple communication paths between independent applications.

Auto-sensing

If auto-negotiation fails, your system can match the line speed of its link partner.

Related reference

SNA service access points
Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Types of Ethernet frames sent
The Ethernet frame that your system receives and the Ethernet standard that you select in the line description govern the type of frame that your system sends.

Hardware requirements for Ethernet
IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

Creating the SNA controller description
The controller description identifies the remote devices to which the system connects.

Note: If you are running Advanced Peer-to-Peer Networking (APPN), your system can automatically create the controller description (this is the suggested method) or you can create it manually. Autocreate cannot be used with Advanced Program-to-Program Communication (APPC).

To create a controller description to use with your LAN adapter, complete the following steps:

1. Optional: Type GO CMDCTL to find a list of controller creation commands.
2. Type the name of the command to use and press F4 (Prompt).
3. Type the name of the controller description into the **Controller description** field.
4. Specify *LAN in the **Link Type** field.
5. Press Enter three times.
   The system displays more fields that might require the following information:

   - **Switched line list:** It specifies one or more line descriptions that your controller description can use. Enter the name of your Ethernet Line Description.
   - **Initial connection:** It determines whether the controller description initiates connection requests (*DIAL), or waits for incoming connection requests (*ANS).

     If you specify *DIAL and want to adjust the polling duration or frequency, you can change the **LAN connection retry** (LANCNNRTY) or **LAN connection timer** (LANCNNTMR) field.
   - **LAN remote adapter address:** It contains the address of the remote input/output adapter (IOA). To locate this address, see the Viewing the LAN IOA address topic. If you are using the preset address of the adapter, consider using your own LAN IOA addresses to minimize your reconfiguration work.
   - **LAN DSAP:** It contains the source service access point (SSAP) value from the controller description that is for the remote device.
   - **LAN SSAP:** It contains a value from the SSAP listing of the line description that is associated with this controller description.
6. Fill in all of the required fields. Press Enter until you reach a required field.
7. Press Enter again to create the description.

Related concepts

LAN device connection
The correct line and controller descriptions help you achieve successful connections.

SNA connections to LAN protocols
The system can connect SNA to a LAN protocol by using service access points (SAPs). Multiple SAPs enable you to have multiple connections between SNA and a LAN protocol, thus permitting multiple communication paths between independent applications.

Related tasks

Viewing the LAN IOA address

When configuring a controller description, you must specify the address of the remote input/output adapter (IOA).

Related reference

SNA service access points

Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

LANCNNTMR and LANCNNRTY

The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

Related information

Configure APPC, APPN, and HPR

Creating the SNA device description

The device description identifies the communications device that is used by the remote device.

There are no LAN-specific parameters in the device description. To create the SNA device description, complete the following steps:

1. Find the create command to use. Use the **GO CMDDEV** command to view of list of available commands.
2. Type the name of the command and press F4 (Prompt).
3. Type the name of the device description into the corresponding field.

   For detailed information about all the parameters and their dependencies, see the chapter about communications device descriptions in Communications Configuration.
4. Press Enter twice to create the description.

Varying on configuration objects for SNA

The Work with Configuration Status (WRKCFGSTS) command enables you to vary on the configuration objects.

1. Type WRKCFGSTS *LIN and press Enter.
2. Locate your line description.
3. Move your cursor to the **Opt** field of the line description, type 1 (Vary on), and press Enter.
4. If the line description does not vary on successfully, press F3 (Exit).
5. Press F3 (Exit).

If the line description varied on successfully, you should do the same for the controller description if you created one. Vary on the description by using the same instructions for varying on the line description. Instead of specifying *LIN for the **WRKCFGSTS** command, you must specify *CTL.

Managing Ethernet support

After configuring Ethernet support, you can change many things, such as line descriptions and Ethernet performance.

Using existing line descriptions with IBM Navigator for i

To use an existing Ethernet line description with IBM Navigator for i, you need to change the description with an interactive job.

However, you should ensure that all configuration objects (for example, TCP/IP interfaces) that currently use the line description are still able to work with it after you have changed it.

Use the **Change Line Description (Ethernet) (CHGLINETH)** command to change your line description. Then use IBM Navigator for i to assign your line description to a TCP/IP interface.

Changing your line description
To make changes to an existing line description, follow these steps.

1. Vary off the line description:

   a) Type **WRKLIND** and press Enter.

   b) Locate your line description, and place your cursor in its **Opt** field.

   c) Type 8 (Work with status) and press Enter.

   d) Type 2 (Vary off) and press Enter. If your line description does not vary off, place your cursor on the error message and press F1 (Help) to view more information about the error. If you need help with the error, see Troubleshooting.

   e) Press Enter.

2. Type CHGLINETH description_name (where **description_name** is the line description being changed) and press F4 (Prompt).

3. Specify the correct values for the **Line speed** field and the **Duplex** field. If you are not familiar with the input/output adapter (IOA), see Hardware requirements for Ethernet.

4. Specify the serviceability option. The default value for this parameter is ***NONE**. If you need to specify another character value, do it under the guidance of your service provider.

5. If you are using this line description with TCP/IP, ensure that source service access point (SSAP) X'AA' and its associated information are in the **SSAP list** field.

6. If you want to use the larger frame sizes of Gigabit or 10 Gigabit Ethernet, ensure that all the nodes along the communications path can support the frame sizes.

7. Press Enter to save your changes.

Related tasks
Assigning your line description to a TCP/IP interface
To use your line description with TCP/IP, you must associate the line description with a new or existing TCP/IP interface.

Configuring TCP/IP over Ethernet
IBM Navigator for i provides a configuration wizard for you to set up Ethernet support for TCP/IP.

Related reference
Hardware requirements for Ethernet
IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

SNA service access points
Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Assigning your line description to a TCP/IP interface
To use your line description with TCP/IP, you must associate the line description with a new or existing TCP/IP interface.

You can use the **Change TCP/IP Interface (CHGTCPIFC)** CL command to assign a line description to a TCP/IP interface. Use the Internet Address (INTNETADR) keyword to specify the internet address of the TCP/IP interface you want to configure. The internet address is specified in the form *nnn.nnn.nnn.nnn*, where *nnn* is a decimal number ranging from 0 through 255. Use the Line Description (LIND) keyword to specify the name of the line description to be associated with the TCP/IP interface. The following example illustrates how to assign the line description ETH0 to the TCP/IP interface 10.1.1.1 with the CHGTCPIFC command:

```
CHGTCPIFC INTNETADR('10.1.1.1') LIND(ETH0)
```

Related tasks
Changing your line description

To make changes to an existing line description, follow these steps.

Related reference

Hardware requirements for Ethernet

IBM i products support many input/output adapters (IOAs). Find out what IOAs are supported and what capabilities each one has.

SNA service access points

Local SAPs are known as source service access points (SSAP). The remote SAPs are known as destination service access points (DSAPs). Your system sends data from an SSAP to a DSAP.

Related information

TCP/IP setup

Change TCP/IP Interface (CHGTCPIFC) command

Enabling objects to accept connections

After configuring LAN support, you are ready to enable your configuration objects to accept connections. For SNA, vary on the line and controller descriptions. For TCP/IP, start the interface.

Varying on configuration objects for SNA

The Work with Configuration Status (WRKCFGSTS) command enables you to vary on the configuration objects.

1. Type `WRKCFGSTS *LIN` and press Enter.
2. Locate your line description.
3. Move your cursor to the **Opt** field of the line description, type 1 (Vary on), and press Enter.
4. If the line description does not vary on successfully, press F3 (Exit).
5. Press F3 (Exit).

If the line description varied on successfully, you should do the same for the controller description if you created one. Vary on the description by using the same instructions for varying on the line description. Instead of specifying *LIN for the **WRKCFGSTS** command, you must specify *CTL.

Starting the TCP/IP interface

You can use IBM Navigator for i to enable the TCP/IP interface.

1. In IBM Navigator for ion the system that contains the TCP/IP interface to start, expand **IBM i Mangement** > **Network** > **TCP/IP Configuration** > **IPv4** or **IPv6**.
2. Click **IPv4 Interfaces** or **IPv6 Interfaces**.
3. Start the interface now, or every time TCP/IP starts.

   To start the interface now, follow these steps:

   a) Right-click an inactive interface.

   b) Select **Start**.

   To start the interface every time TCP/IP starts, follow these steps:

   a) Right-click an interface and select **Properties**.

   b) On the **Advanced** tab, check **Start interface when TCP/IP is started**.

   c) Click **OK** to save the settings.

Related information

TCP/IP setup

Viewing the LAN IOA address

When configuring a controller description, you must specify the address of the remote input/output adapter (IOA).

Viewing the locally administered address

1. Type DSPLIND description_name (where **description_name** is the name of the description to be displayed) and press Enter.
2. Locate the **Local adapter address** field to view the address of the adapter.
3. Press F3 (Exit).

Viewing the preset address

1. Locate a line description that uses the IOA. This description must specify *ADPT in the **Adapter address** field. If you cannot find such a line description, create it, and then return here to continue the steps.
2. Use the **Work with Configuration Status (WRKCFGSTS)** command to vary on the line description:
   a) Type WRKCFGSTS *LIN and press Enter.
   b) Locate your line description and look for a status of varied on or active.
   c) If it is varied on or active, press F3 (Exit) and skip to step .
   d) If it is not varied on or active, place your cursor on the **Opt** field of the line description, type 1 (Vary on), and press Enter.
   e) If your line description does not vary on, place your cursor on the error message and press F1 (Help) to view more information about the error. If you need help to understand the error message or to resolve it, see Troubleshooting.
   f) Press F3 (Exit).
3. Type DSPLIND description_name (where **description_name** is the name of your line description), and press Enter.
4. Locate the **Local adapter address** field to view the preset address of the adapter.
5. Press Enter.

Configuration object commands

Configuration object commands are commands that affect your line, controller, or device descriptions. You can view and use these commands by using the **GO** command.

To view a subset of the commands, use the following **GO** commands:

- To view line description commands, type **GO CMDLIND** and press Enter.
- To view controller description commands, type **GO CMDCTLD** and press Enter.
- To view device description commands, type **GO CMDDEVD** and press Enter.

To view a more complete list of commands, use the following **GO** commands:

- To view line description commands, type **GO CMDLIN** and press Enter.
- To view controller description commands, type **GO CMDCTL** and press Enter.
- To view device description commands, type **GO CMDDEV** and press Enter.

The following list shows other related commands that you can use with your descriptions. To use one of these commands, type the name of the command (shown in parentheses) and press F4 (Prompt):

- Retrieve Configuration Status (RTVCFGSTS)
- Vary Configuration (VRYCFG)
- Save Configuration (SAVCFG)
- Restore Configuration (RSTCFG)

- Work with Configuration Status (WRKCFGSTS)

Tuning Ethernet performance

You can tune an Ethernet network's performance by adjusting the parameters that control its behavior.
Related information

Improve local area network performance

Adjusting your LAN-frame size
Changing the LAN-frame size influences the performance of Ethernet.

Ethernet networks break data up into many little chunks called frames. These frames are sent individually across the network and reconstructed by the receiving computer. Changing the size of the frames can alter the behavior of the network. Changing the frame size is possible for both TCP/IP over Ethernet networks and SNA over Ethernet networks.

Your frame size might need adjusting if the remote bridge drops your frames.

To change your frame size, follow these steps:

1. Determine the new frame size.

   If you do not know what your frame size should be, you might find that the frame size is contained within the QSYSOPR message queue in message CPF 5908.

2. Determine which configuration object and MAXFRAME parameter to change. See "Remote bridges dropping frames" on page 24 for information about which configuration object to change.

3. To change the parameter, perform one of the following tasks:

   - Change the line description using the CHGLINETH CL command.
   - Change the controller description. Type GO CMDCTL and press Enter to display a list of commands. Select the appropriate command for your controller type.

4. Press F9 to show all parameters.

5. Locate the MAXFRAME parameter that you chose in step "2" on page 24.

6. Specify the value that you found in step "1" on page 24.

7. Press Enter to save your changes and exit the command.

Related tasks

Viewing QSYSOPR or other message queues
The QSYSOPR and other message queues might contain messages that describe an error and might contain possible solutions for the error. These messages are typically a good place to begin troubleshooting with. You can use the Display Messages (DSPMSG) command to view these messages.

Related reference

Remote bridges dropping frames
A remote bridge discards your frame if it does not support your frame size. The network can also discard your frame if it does not support your frame size.

Remote bridges dropping frames
A remote bridge discards your frame if it does not support your frame size. The network can also discard your frame if it does not support your frame size.

If you cannot configure the bridge to support your frame size or a larger frame size, adjust the MAXFRAME parameter to a value that is acceptable to the bridge. The system has these MAXFRAME parameters that are shown in order of precedence:

1. The source service access point (SSAP) MAXFRAME parameter in the line description.
2. The MAXFRAME parameter in the line description (except Ethernet line descriptions).
3. The MAXFRAME parameter in the controller description.

The SSAP MAXFRAME parameter affects only one device. That is, only that device will use a frame size of SSAP MAXFRAME.

The MAXFRAME parameter that is in the line description affects all devices that use that description.

The MAXFRAME parameter that is in the controller description affects all lines and devices that use that description.

You set the precedence when specifying a MAXFRAME value. If you define a value for the first parameter (SSAP MAXFRAME) and then the second parameter, your system uses the value of the first parameter. To use the value of the second parameter, you should not specify a value for the first parameter.

Related tasks

Adjusting your LAN-frame size
Changing the LAN-frame size influences the performance of Ethernet.

Related reference

Maximum Ethernet frame sizes
The largest frame size used during the connection process is controlled by the maximum frame size configurations of multiple items.

Related information

Match iSeries system line description parameters for a remote iSeries system

Improvement of Gigabit and 10 Gigabit Ethernet performance
These tips show how to improve the performance of your system.

- Increase your maximum frame size. You must ensure that all devices along the communications path support the frame size. For more information about frame sizes, see Maximum Ethernet frame sizes.
- Monitor the performance of your LAN by using the monitors feature of System i® Navigator. See Track performance in the Performance topic collection for more information.

Related reference

Maximum Ethernet frame sizes
The largest frame size used during the connection process is controlled by the maximum frame size configurations of multiple items.

Related information

Tracking performance

SNA over Ethernet timing parameters
SNA over Ethernet networks have parameters that control timing. You can make the adjustments through the parameters of the SNA controller description.

SNA controller descriptions (Advanced Program-to-Program Communications (APPC), SNA host, remote workstation, finance, and retail) have parameters that describe the behavior of the station. The parameters can be used with all LAN protocols. The names of these parameters begin with the letters LAN.

See the following LAN parameters to find how they affect your connection's performance. You can view all parameter values with the Display Controller Description (DSPCTLD) command when the controller is varied on.

Note: Reducing a parameter's value gives you quicker error detection, but it also reduces the time for error recovery.

LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANCNNTMR specifies how long to wait before polling again. LANCNNRTY specifies how many times to poll. If the system receives no response from the remote station after polling LANCNNRTY times, the following situation occurs:

- The user is notified that contact with the station was unsuccessful.

- The system places the controller description in answer mode.
- If the remote station signals your system to do a retry of your connection inquiry, your system attempts to establish connection again.

The default *CALC value for LANCNNTMR is 7 seconds. The default *CALC value for LANCNNRTY is 10.

Performance considerations

The default values of the parameters are designed for a single LAN and might cause a connection failure when you access a remote station through a remote bridge. The bridge might slow data traffic enough that the connection timer expires before the remote station's response reaches you. If this is the case, you should increase the values of LANCNNTMR and LANCNNRTY.

Related concepts

LAN device connection initiation
In an SNA environment, you can determine which system initiates the connection request and which system waits for an incoming connection request.

Related tasks

Creating the SNA controller description
The controller description identifies the remote devices to which the system connects.

Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANRSPTMR defines how long to wait before retransmitting a frame to the remote station. LANFRMRTY specifies how many times to retransmit a frame. A system retransmits a frame when one of the following situation occurs:

- A frame was lost or damaged.
- The remote station does not respond because it is busy.
- The remote station is waiting to acknowledge the frame with an information frame of its own.

After your system retransmits a frame a number of times (based on the number that is indicated by the LANFRMRTY parameter), the system notifies the user that an error occurred and disconnects itself from the remote station.

The default *CALC value for LANRSPTMR is 1 second. The default *CALC value for LANFRMRTY is 10.

Performance considerations

The default values of the parameters are designed for a single LAN and can cause too many frame retransmissions when accessing a remote station through a remote bridge. The bridge might slow data traffic enough that your retransmit timer expires before the remote station's acknowledgment reaches you. Eventually, your system will automatically disconnect itself because it retransmitted a frame too many times. If this is the case, you should increase the values of LANRSPTMR and LANFRMRTY.

Note: If you make the parameter values too large, your connection failure notices can be delayed.

Related tasks
Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference
LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANACKTMR specifies how long the system waits before sending an acknowledgment for the frames that it received. LANACKFRQ specifies the maximum number of frames that your system receives before sending an acknowledgment to the remote station (independent of timers or having data to send). Your system has a greater chance of sending the acknowledgment in a data frame (rather than the acknowledgment by itself) if the LANACKFRQ value is large.

The default *CALC value for LANACKTMR is 0.1 second. The default *CALC value for LANACKFRQ is 1.

Performance issues

Large values for LANACKTMR and LANACKFRQ might be desirable because smaller values can cause unnecessary acknowledgments and contribute to heavier LAN traffic. If you are connected to a network with traffic problems, you can increase the values of either parameters or both parameters.

However, in most cases where LAN traffic is not a problem and data tends to flow one way, large parameter values can cause these to happen:

- Introduce unnecessary delays when sending acknowledgments.
- Slow response times.

LANACKTMR considerations

You should choose values for the LANACKTMR parameter by carefully considering the remote station's response timer (LANRSPTMR) and maximum outstanding frame count (LANMAXOUT).

For example, assume that your system cannot send an acknowledgment before the remote station's response timer expires. The remote station will retransmit its frame because it did not receive your acknowledgment. To solve this problem, you must either shorten your system's timer or lengthen the remote system's timer.

LANACKFRQ considerations

Similarly, you should choose values for LANACKFRQ by carefully considering the remote station's maximum outstanding frame count (LANMAXOUT). If you do not correctly adjust the counters, your system will wait for more frames. However, the remote station will not transmit them because it is waiting for an acknowledgment from your system.

Related tasks
Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference
LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

The default *CALC value for LANINACTMR is 10 seconds.

Performance considerations

Unnecessary traffic is created if the value that you specify for the LANINACTMR parameter is too small. This might lead to a performance throughput problem. If it is too large, your system might not find out as quickly that the remote station is inaccessible.

LANINACTMR is sensitive to whether the remote station is on the same LAN or not. If the station is across a bridge, you might need to increase this value. If the value is 0 (no time out), you will not be informed if the connection fails until your system attempts a data transfer.

Related tasks

Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference

LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANMAXOUT

The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

This parameter is highly sensitive to the remote station's speed to copy and acknowledge frames (speed is based on buffering capabilities and processing resource).

Note: The LAN window step (LANWDWSTP) parameter can influence the number of outstanding frames.

The default *CALC value for LANMAXOUT is 2.

Performance considerations

For optimal performance, you must choose appropriate values for the LANMAXOUT and LANACKFRQ parameters on both the sending and receiving stations.

These variables affect which LANMAXOUT and LANACKFRQ values provide the best performance:

- The characteristics of the application.
- The amount of data 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, the default value (*CALC) for LANACKFRQ and LANMAXOUT offer the best performance. However, for some environments, changing the values can improve performance significantly.

Related tasks

Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference

LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANWDWSTP

The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

Parameter LANMAXOUT determines the initial value for the number of outstanding frames.

The default *CALC value for LANWDWSTP is *NONE.

Performance considerations

If the value for LANWDWSTP parameter is too small or is *NONE, the network congestion takes longer to subside. For more information about network congestion, see the discussion of the dynamic window algorithm in book *Token-Ring Network Architecture Reference* (SC30–3374).

Related tasks

Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference

LANCNNTMR and LANCNNRTY

The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANINACTMR
The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANACCPTY
The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

LANACCPTY

The LAN access priority (LANACCPTY) parameter of your SNA controller description determines a token's priority.

The larger the number the higher the priority. (Used for token-ring only).

The default *CALC value for LANACCPTY is 0.

Performance considerations

The higher the priority, the greater the chances are that the remote station will quickly receive the token. The greater the access priority value, the more tokens the remote station receives. The greater value also increases your system's chances for sending its frame. These considerations are important if your system accesses a heavily used ring (not many free tokens available) and your application program needs priority treatment.

Related tasks
Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

Related reference
LANCNNTMR and LANCNNRTY
The LAN connection timer (LANCNNTMR) and LAN connection retry (LANCNNRTY) parameters of your controller description define the frequency and persistence of polling the remote station to establish a connection.

LANRSPTMR and LANFRMRTY
The LAN response timer (LANRSPTMR) and the LAN frame retry (LANFRMRTY) parameters in your controller description determine how soon and how often the system retransmits a frame.

LANACKTMR and LANACKFRQ
Your SNA controller description includes the LAN acknowledgment timer (LANACKTMR) and the LAN acknowledgment frequency (LANACKFRQ) parameters. They work together to determine how often to send an acknowledgment to the remote station.

LANINACTMR

The LAN inactivity timer (LANINACTMR) parameter of your SNA controller description determines how long your system waits before requesting a response from the remote station. Your system uses the request to test if the remote station is still accessible.

LANMAXOUT
The Maximum outstanding data frames (LANMAXOUT) parameter of your SNA controller description specifies how many frames your system sends before waiting to receive an acknowledgment.

LANWDWSTP
The LAN window step (LANWDWSTP) parameter of your SNA controller description determines whether the number of outstanding frames are reduced during network congestion.

Changing timing parameters
To change the LAN timing parameters in your controller description, follow these steps.

1. To view a list of commands that can change your controller description, type GO CMDCHG and press Enter.
2. From the displayed list of commands, choose a command to change your SNA controller description.
3. Type the command and press Enter.
4. Change the LAN parameters that you have chosen.
5. Press Enter to save your changes.

Troubleshooting Ethernet

This information might help you solve problems with your system and connections. You can find out why connections might fail, why frames are dropped, or why PCs cannot connect to your system.

Viewing QSYSOPR or other message queues

The QSYSOPR and other message queues might contain messages that describe an error and might contain possible solutions for the error. These messages are typically a good place to begin troubleshooting with. You can use the Display Messages (DSPMSG) command to view these messages.

To view the message queues, follow these steps:

1. Type DSPMSG MSGQ(message_queue) on the command line and press Enter.
   message_queue is QSYSOPR or the configured message queue name.
   For example, DSPMSG MSQ(QSYSOPR).
2. Locate the error messages created around the time the error occurred.
3. Move your cursor to the error message of interest and press F1.
   The system displays more information about the error.
4. Note the cause code, the error's description, and possible solutions. Also, record any message IDs, error codes, reference codes, or reason codes.

Related tasks
Adjusting your LAN-frame size
Changing the LAN-frame size influences the performance of Ethernet.

Related information
Display Messages (DSPMSG) command

Troubleshooting LANs

The IBM i tools can help you quickly find the problem and possible solutions.

For an overview of the tools of your system and instructions about how to use them, see IBM i troubleshooting.

Related information
Troubleshooting

Physical network problems

If your adapter cannot make a connection to the network, and the product activity log points to a physical network problem, check these problem areas.

Cabling problems

- Check that your cable type is appropriate for the line speed you are using. For example, category 3 cable cannot be used for 100 Mbps.
- Is the cable wired correctly?
- Do all cables, patch cables, and patch panels between the system and the network, switch, or hub support your line speed? For example, if the line speed is configured at 100 Mbps, the cable must be category 5 to support the speed.

Possible solutions

- If the cables have been excessively bent or stretched, the wiring inside the cable might have been untwisted, damaged, or even broken. Try reseating the cable or temporarily replacing it with a functional one.
- Make sure that you are not using crossover cable.
- Route the cable away from electrically noisy devices, such as fluorescent lights, printers, copiers, or electric motors. These items can cause interference with data transmissions.
- Try plugging the cable into a different switch or hub port.
- Check that the switch or hub has the latest software from the vendor.
- You might want to add lightning protection to your network cabling and switch or hub power lines, if you live in a lightning prone area. A direct strike can cause a large power surge, which can severely damage your networking equipment and cabling.

Configuration problem checks and solutions

- Check that the line speed and duplex mode chosen in CRTLINETH are the same as the parameters programmed into the switch or hub port. One frequent cause of problems is a duplex or line speed mismatch.

  Note: To use the *AUTO configuration for line speed or duplex mode, you must configure both of the parameters to *AUTO. Do not use line speed and duplex configurations of 10/AUTO, 100/AUTO, AUTO/Half, or AUTO/Full. These configurations might work, but you will have frequently unsuccessful and incorrect connections.
- Try varying the line off and then on again with *RESET. Do not use *RESET if an MFIOP is the IOP. This might shut down the entire machine because other devices that share the MFIOP will not be able to access the line.
- If you suspect the adapter might be faulty, run VFYCMN with an external wrap plug attached. If this test is passed, the adapter is not likely to be the problem.
- Connect a LAN analyzer to verify that the actual line speed and duplex mode being used on the link between the server and the hub, or between the server and the switch is accurate.

Connection failure and controller descriptions

Sometimes an incorrectly configured controller description can cause a connection failure. The problem source might involve the incorrect configuration of the adapter address, source service access point (SSAP), or destination service access point (DSAP) parameters.

For more information about how these parameters influence a successful connection, see LAN device identification. For other causes of a connection failure, see LAN device connection initiation.

The remote system does not connect

If your controller description uses dial mode, your system might receive message CPA58E0 (`Controller not replying`) or CPA57EF (`Contact not successful`). Remote systems or controller descriptions that do not vary on can cause one of these messages to appear.

Your system does not connect

If your controller description uses answer mode, you might receive the message CPI591A (`Controller is varied off or not recognized by local system`). The following situations can cause this message to appear:

- The connection requested by the remote system does not exist on the local system. The local system searches for this connection (that is indicated by combining the local adapter address, the DSAP, and the SSAP) in all varied on controller descriptions.
- The controller description does not refer to the line description that can answer the call.

Solutions

- On either side of the connection, verify that the controller description has the correct combination of adapter address, SSAP, and DSAP.
- In the **Switched line list** field of the controller description, enter the line description that can accept the incoming call.
- Vary on the correct controller description (use the Work with Configuration Status (WRKCFGSTS) command to vary on the controller).
- Verify that the local and remote adapters are wired into the network correctly.

Related concepts

LAN device identification
Different types of verification are used during the LAN connection process.

LAN device connection initiation
In an SNA environment, you can determine which system initiates the connection request and which system waits for an incoming connection request.

LAN device connection
The correct line and controller descriptions help you achieve successful connections.

Remote system connection failure

If a remote system cannot connect to your system, you need to check several areas.

If the remote device is polling your system, but the system operator message queue does not contain a message regarding your system being polled, check the Product Activity Log for messages regarding line descriptions and system reference code AF06.

A connection failure can occur if the remote system uses a destination service access point (DSAP) that your line description does not refer to. Another possible cause might be that the line description that contains the correct DSAP is not in the **Switched line list** field of the correct controller description. If the AF06 system reference code is absent, the error might still have occurred. Verify that the adapter address, SSAP, and DSAP values for both your system and the remote system are correct.
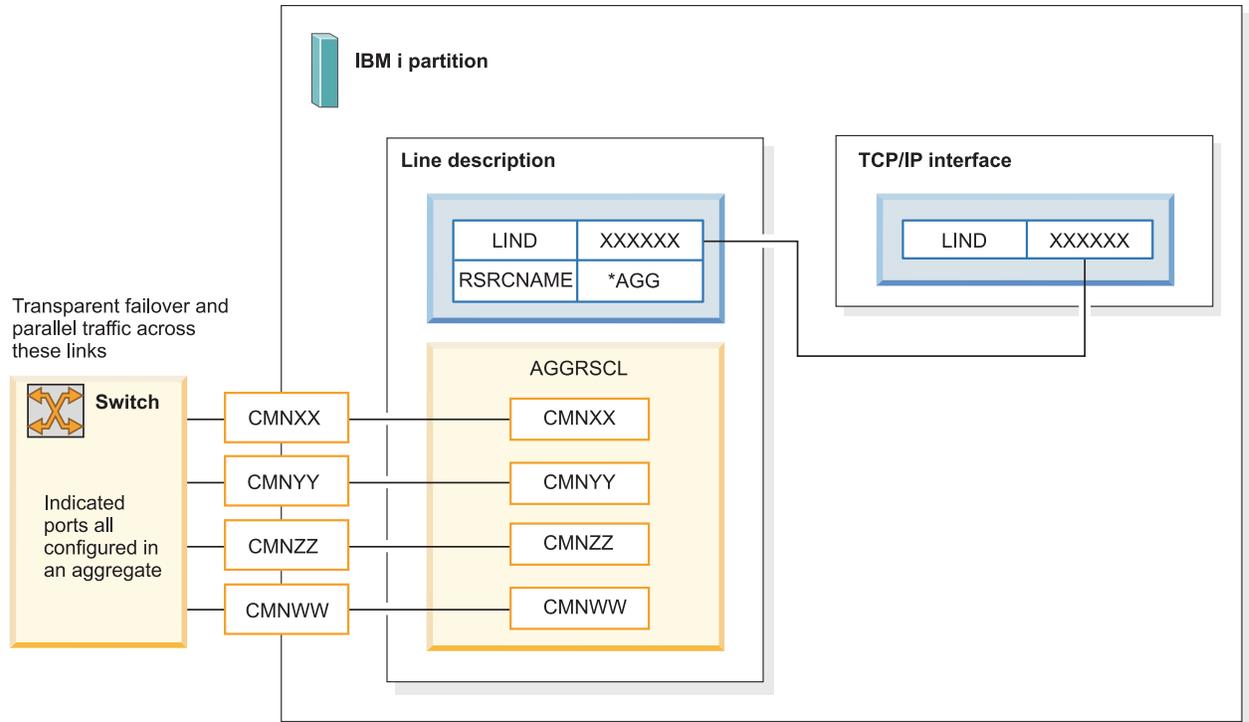
Ethernet Link Aggregation

Link Aggregation binds several full-duplex Ethernet links running at the same speed together into one logical link with a single Media Access Control (MAC) address.

The concept of Ethernet Link Aggregation is known by several different names:

- IEEE 802.3ad or 802.1ax
- Cisco supports this idea under the name EtherChannel

• Other vendors use the names "teaming" or "trunking"

Link Aggregation provides two main advantages: improved reliability through automatic failover and aggregated throughput.

If any of the links lose their connection, the IBM i support transmits outgoing frames on other active links. The link partner does the same for incoming frames. The automatic failover is provided on a per-frame basis, usually without affecting any running workloads. For example, if one link goes down on a four-port aggregate, the remaining three links handle the traffic that would have traveled on the down link. If any links are operational, the aggregate continues to function.

In addition, each operational aggregated link can run at the configured line speed, and outgoing traffic is spread according to a configured preference. Incoming traffic is spread across the links according to configuration at the link partner. Many workloads, especially workloads with multiple parallel TCP or UDP conversations, can take advantage of this configuration to scale their throughput over available ports.

Performance

Incoming and outgoing traffic through an aggregated link requires some more processing than traffic through an individual link. In addition, depending on what combination of resources are in the aggregate, some advanced performance features of the aggregated resources might be disabled. For example, if some aggregated resources support TCP large send offload over IPv6 and others do not, the aggregate does not support TCP large send offload over IPv6.

Configuring an Aggregate Line Description

Preparing to Create an Aggregate Line Description

Before you create an aggregate line description, select the Ethernet resources to be aggregated. Up to eight ports can be aggregated in one line description.

• None of the ports can be in use by another line description, LAN console, or remote support.

• Virtual Ethernet ports (type 268C) are not supported in an aggregate line description.

• A Host Ethernet Adapter (HEA) logical port, native SR-IOV logical port, or virtual NIC (VNIC) port is only supported if it is the only logical port on its corresponding physical port, and if the aggregate line uses the Link Aggregation Control Protocol (LACP) by specifying *LNKAGG in the Aggregate Policy (**AGGPCY**)

for the line description. Any other configuration can prevent the link partner from detecting faults, causing lost packets.

- All of the ports must support full duplex and the preferred line speed. Each port must support 1 Gbps or higher, even if that is not the preferred line speed.
- All of the ports must be connected to the same link partner (switch).
- If you use static aggregation (*ETHCHL), all of the corresponding ports on the link partner must be configured in a common static aggregation. If you use LACP (*LNKAGG), configure all of the corresponding ports on the link partner with LACP and share a common key.

IBM i Link Aggregation supports static aggregation (*ETHCHL) with any link partner, and supports LACP (*LNKAGG) with Cisco and IBM Networking switches. Other LACP-capable link partners might work, but are not officially supported.

No more than 255 aggregate line descriptions can exist in the partition. If more are wanted, delete existing aggregate line descriptions.

Create an Aggregate Line Description

An aggregated line description is created by using the Create Line Desc (Ethernet) (**CRTLINETH**) command.

The following parameters are relevant to aggregation:

- Resource Name (RSRCNAME): set to new special value *AGG to indicate aggregation
- Duplex (DUPLEX): Half duplex is not supported
- Aggregated Resource List (AGGRSCL): up to eight Ethernet port resource names (starting with CMN) with the restrictions laid out in "Preparing to Create an Aggregate Line Description" on page 35
- Aggregate Policy (AGGPCY): This parameter is split into two elements. The Standard controls any negotiation that is done with the link partner, and requires specific configuration with the link partner, as described under *ETHCHL and *LNKAGG. The Policy type describes the process for deciding what port is used for each outgoing Ethernet frame; this type can have performance implications.

  Choosing *ETHCHL as the Standard uses static aggregation, which performs no negotiation with the link partner. The link partner must also be configured for static aggregation. The Ethernet ports in the Aggregated Resource List (AGGRSCL) and the set of ports that are configured at the link partner should correspond exactly. If they do not, then some Ethernet packets might not get to the correct destination. There are several opportunities for error: having ports in AGGRSCL that are connected to a different link partner or to the wrong ports in the correct link partner, or having ports that are selected in the link partner's aggregate that are connected to ports not in AGGRSCL.

  Setting the Standard as *LNKAGG forces use of the Link Aggregation Control Protocol (LACP) as described in the IEEE 802.3ad standard. This negotiation detects the identity of the link partner for each Ethernet port in the Aggregated Resource List (AGGRSCL). This Standard requires that the link partner to enable LACP with common identification information on all ports that are connected to ports in AGGRSCL. In order for a port to aggregate and be used for Ethernet traffic, its partner port must respond to the LACP negotiation, and the response must match the identifying information to all other aggregated ports. The aggregation panel in Display Line Description (DSPLIND) shows the aggregation status of each port, and the status helps describe why any other ports are not aggregated.

  The round-robin (*RNDRBN) is only accepted if Standard is *ETHCHL, and it directly forces each batch of outgoing packets to use the next available port, ensuring that all ports are used in near-equal fashion. However, that creates risk that packets can be delivered out of order, and out-of-order delivery within a TCP connection causes retransmissions and large delays. Use this option only if that is not a concern.

  The remaining policy types could all be called hash modes, and they describe what data within a packet is used to determine which Ethernet port is used for each outgoing frame. All of the hash modes force a specific TCP connection to stay single-threaded on a specific Ethernet port to avoid the out-of-order delivery problem. They differ in how much packet data is used to decide which port to use. The best network usage comes from configurations that split outgoing traffic roughly equally among the ports in the Aggregated Resource List (AGGRSCL). As more packet data is used, the system can do more to

spread unrelated traffic among the ports. However, using more packet data also forces some additional processing and cache usage for each outgoing packet.

The *DFT hash mode uses the least amount of data, looking only at the destination IP address (or MAC for non-IP frames). This mode uses little processor, but spreads evenly only if traffic is running to many different IP addresses at the same time (as for a busy server).

The *SRCPORT, *DESTPORT, and *SRCDESTP hash modes also look at the source and destination TCP or UDP port numbers (if present) for each outgoing packet. This evaluation incurs more per-packet processing, but is better able to split unrelated traffic among multiple Ethernet ports, like parallel file transfers to the same remote host. If host processor is not known to be a constraint, *SRCDESTP is likely the best choice for most systems.

To create a static two-port aggregate that uses as much packet data as possible to spread outgoing traffic, use the following example:

```
CRTLINETH LIND(ETHAGG) RSRCNAME(*AGG) AGGPCY(*ETHCHL *SRCDESTP)
          AGGRSCL(CMN02 CMN03)
```

Managing an Aggregate Line Description

After an aggregate line description is created, it can be used the same way as a non-aggregate line description.

For example, the Add TCP/IP Interface (**ADDTCPIFC**) command can be used to create an IP interface to send traffic through the new line description.

A non-aggregate line description cannot be changed to an aggregate line description, nor can an aggregate be changed later into a non-aggregate. The **AGGPCY** and **AGGRSCL** parameters can be changed by the Change Line Desc (Ethernet) (**CHGLINETH**) command, but the line description must be varied off.

When the line description is varied on, the configuration is verified and all of the resources are activated and establish link with the partner. If the system detects any configuration errors, the line description does not vary on successfully. Any ports that fail to establish link when varying on are not aggregated until the line description is varied off and back on.

After the line description is varied on, the aggregation status of each resource can be viewed on a new panel from the Display Line Description (**DSPLIND**) command. The **DSPLIND** command can be used to monitor for any links that are not operational.
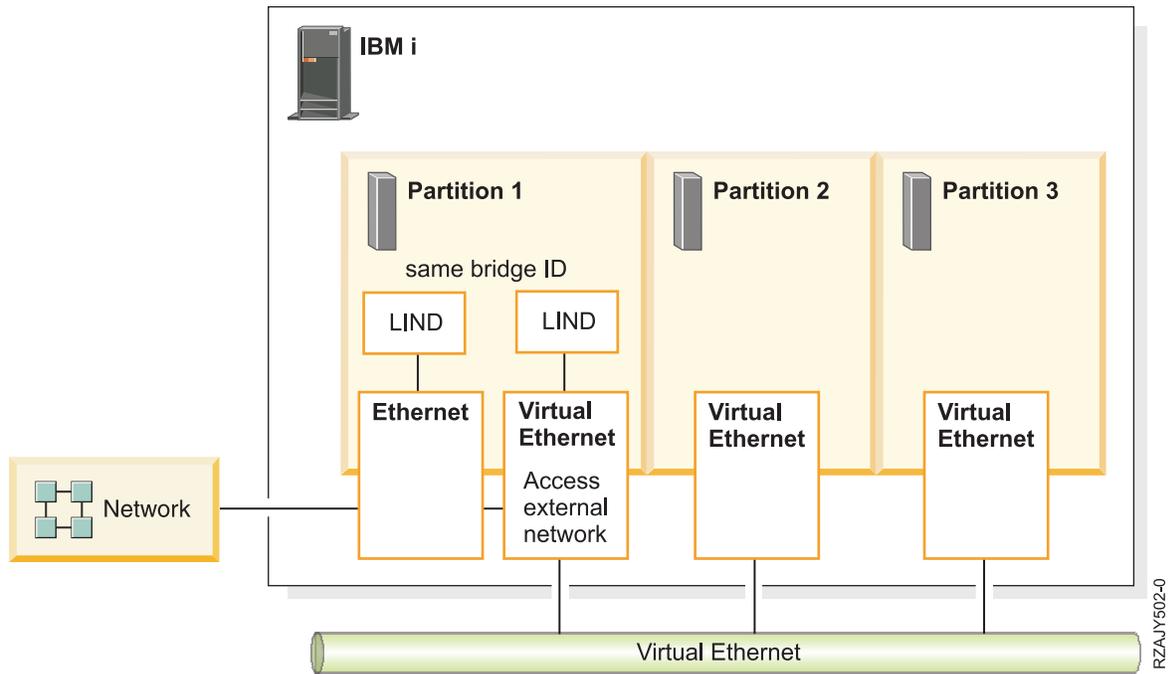
On systems with support for link aggregation, resources with type 6B26 are displayed on the Work with Communication Resources panel. This panel can be displayed by using the Work with Hardware Resources (**WRKHDWRSC**) command and the Type (**TYPE**) parameter of *CMN. When an aggregate line description is varied on for the first time, a new Comm Port resource with type 6B26 might be added. When an aggregate line description is deleted, one of the Comm Port resources might be removed. All resources with type 6B26 are invalid for configuration by line descriptions or for LAN console or remote support. When an aggregate line description is deleted, a resource with type 6B26 might no longer be displayed on the Work with Communication Resources panel.

Ethernet Layer-2 Bridging

Using layer-2 bridging, one Ethernet port in an IBM i partition can provide network access for other logical partitions on the same platform. Layer-2 bridging functions similar to the Shared Ethernet Adapter (SEA) support provided by a Power Systems Virtual I/O Server (VIOS) partition.

Layer-2 bridging works by putting one physical and one virtual Ethernet adapter into a mode where they can receive traffic that is not destined for their address. This traffic is selectively sent onto the other network according to the IEEE 802.1D standard, known as, "bridging" the frames. Frames transmitted by virtual Ethernet adapters on the same VLAN as the bridging virtual Ethernet adapter can be sent to the physical network. Frames sent from the physical network can be received by adapters on the virtual network.

IBM i

Partition 1

Partition 2

Partition 3

same bridge ID

LIND

LIND

Ethernet

Virtual
Ethernet

Access
external
network

Virtual
Ethernet

Virtual
Ethernet

Network

Virtual Ethernet

RZAJY502-0

Preparing for Ethernet Layer-2 Bridging

Take these steps to prepare for Ethernet Layer-2 Bridging configuration.

- Select a physical Ethernet resource to use for layer-2 bridging.

  - Any Ethernet resource that supports line speeds of 1 Gbps or greater is supported, except for Host Ethernet Adapter (HEA) resources. HEA already supports the ability for multiple partitions to use a single physical port by assigning each partition a logical port. For information about using a HEA resource, see the Configuring Host Ethernet Adapter topic collection in the IBM Power Systems Hardware Information Center.

  - The Ethernet resource must not be in use by any varied-on line description, LAN console, or remote support.

  - An aggregate line description can also be used to bridge traffic to the external network. See Ethernet Link Aggregation for details on creating an aggregate.

- Create a virtual Ethernet resource to use for layer-2 bridging and record its resource name.

  - If using a Hardware Management Console, create a virtual Ethernet adapter for the desired VLAN ID. Check the "Access external network" box to indicate that this virtual Ethernet adapter is used to bridge traffic to the physical network.

  - If using the IBM i Virtual Partition Manager, the virtual Ethernet adapter is automatically created with the ability to access the external network.

- Choose an alphanumeric name, a maximum of 10 characters, for the bridge itself. Make the name unique from any existing bridge names.

Suggested Practices for Ethernet Layer-2 Bridging

IBM suggests that the selected Ethernet resources be used for only layer-2 bridging and not for IBM i TCP/IP configuration. There is a significant increase in processor usage for any host traffic that uses bridged resources.

In addition, any line description that is used for bridging receives many frames that are not useful to the TCP/IP stack. These frames use unnecessary processing resources.

Configuring Ethernet Layer-2 Bridging

Ethernet layer-2 bridging is configured with the Create Line Desc (Ethernet) (CRTLINETH) command.

- Create an Ethernet line description for the physical Ethernet resource and set its Bridge identifier (**BRIDGE**) to your chosen bridge name.
- Create an Ethernet line description for the selected virtual Ethernet resource and set its Bridge identifier (**BRIDGE**) to the same bridge name.
- When both line descriptions are varied on, traffic is bridged between the two networks. Any other partitions with virtual Ethernet adapters on the same VLAN as the new virtual Ethernet resource are able to access the same network as the physical Ethernet resource.

For example, the following two commands are used if:

- The chosen physical Ethernet port is CMN01 (with line description name "PHYS")
- The chosen virtual Ethernet port is CMN02 (with line description name "VIRT")
- The chosen bridge name is "EXTBRIDGE":

CRTLINETH LIND(PHYS) RSRCNAME(CMN01) BRIDGE(EXTBRIDGE)

CRTLINETH LIND(VIRT) RSRCNAME(CMN02) BRIDGE(EXTBRIDGE)

Common Ethernet Layer-2 Bridging Errors

Use the following information to help resolve common errors encountered when using Ethernet layer-2 bridging.

The Change Line Desc (Ethernet) (**CHGLINETH**) command cannot be used to change the Bridge identifier of a line description that was created before Ethernet layer-2 bridging support was added. The following steps provide equivalent behavior:

- Use the "Copy" option on the Work with Line Descriptions (**WRKLIND**) command to make a temporary copy of the line description.
- Delete the existing line description by using the Delete Line Description (**DLTLIND**) command.
- Use the "Copy" option again on the **WRKLIND** command to replicate the original line description, specifying the Bridge identifier.
- Delete the temporary line description by using the **DLTLIND** command.

No more than one line description with a given Bridge identifier on a physical Ethernet adapter can be varied on at the same time. Likewise, no more than one line description with a given Bridge identifier on a virtual Ethernet adapter can be varied on at the same time. An error is returned when trying to vary on any more line descriptions with that Bridge identifier, indicating that the configuration is in error. For a given bridge, select one physical Ethernet line description and one virtual line description to be bridged. If more than one bridge is required, use a different Bridge identifier for each additional bridge.

The selected virtual Ethernet resource must be marked to allow access to the external network. If an incorrect virtual Ethernet resource is selected, an error is returned when trying to vary on its line description. The error indicates that the selected resource cannot use promiscuous mode. Create a virtual Ethernet resource that can be used to access the external network.

If either line description is not varied on, then no traffic is bridged between the networks.

Managing Ethernet Layer-2 Bridging

While an Ethernet line description is varied off, its Bridge identifier (**BRIDGE**) can be changed to a different name. To indicate the line description is not used for bridging, specify *NONE.

In IBM i 7.1, a bridge identifier for an Ethernet line description is not visible from **DSPLIND**. Use the **CHGLINETH** command and prompt to see the Bridge identifier for an Ethernet line description.

A communications trace (managed by the **STRCMNTRC**, **ENDCMNTRC**, **PRTCMNTRC**, and **DLTCMNTRC** commands) traces each incoming and outgoing frame for the selected line description. Each traced

incoming frame was bridged, handled by IBM i TCP/IP, or discarded. An outgoing frame was sent by the TCP/IP stack or bridged from the other network.

Related information for Ethernet

Other information center topic collections contain information that relates to the Ethernet on IBM i topic collection.

Other information

- Communications trace
- Configuring APPC, APPN, and HPR
- Troubleshooting
- Tracking performance

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