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iSeries

Networking

TCP/IP setup







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## Part 1. TCP/IP setup

Your iSeries™ server has arrived, and you are anxious to put it to use. This section provides tools and procedures for setting up a connection and for configuring TCP/IP on the iSeries server. After you complete these initial tasks, you are ready to expand TCP/IP with applications to meet your unique needs.

### **What's new for V5R2?**

Find out about new and changed TCP/IP function.

### **Print this topic**

Use this topic to print or download a Portable Document Format (PDF) version of the TCP/IP setup documentation.

### **Internet Protocol version 6 (IPv6)**

The new Internet Protocol, IPv6, plays a key role in the future of the Internet, and you can use IPv6 on the iSeries server. This topic provides general information about IPv6 and how it is being implemented on the iSeries server.

### **Plan TCP/IP setup**

This topic helps you prepare for installation and configuration of TCP/IP on the iSeries server. Basic requirements for the installation and configuration are provided so that you have all the necessary information at hand when you begin configuring TCP/IP. References to related terms and concepts are provided.

### **Install TCP/IP**

This topic guides you through the installation of products that prepare your iSeries server for operation.

### **Configure TCP/IP**

This topic shows you how to engage your iSeries and configure TCP/IP. In addition, see instructions for configuring IPv6.

### **Customize TCP/IP with iSeries Navigator**

This topic provides customizing options by using iSeries Navigator.

### **Troubleshoot TCP/IP**

If you encounter any problems with TCP/IP connections or traffic, see TCP/IP troubleshooting to help you find the solutions. This troubleshooting guide helps you solve problems related to both IPv4 and IPv6.

### **Related information for TCP/IP setup**

This topic answers the question, "What more can it do?" Find references to services and applications that enhance your server's performance.





## Chapter 1. What's new for V5R2?

New items in the TCP/IP setup topic for Version 5 Release 2 include:

- **Configure TCP/IP using the character-based interface**

Find TCP/IP setup instructions for customers who must use the character-based interface to configure their server. The preferred method for setting up TCP/IP is using the EZ-Setup wizard; however, if you want to use iSeries Navigator from a PC that requires basic TCP/IP configuration before iSeries Navigator can run, then you must use the character-based interface to perform the basic configuration.

- **Internet Protocol version 6 (IPv6)**

Introduce yourself to basic information about IPv6 and find out how it is being implemented on the iSeries server.

- **Configure IPv6**

Find setup requirements and instructions for configuring your server for IPv6.

- **Customize TCP/IP using iSeries Navigator**

This topic has been expanded. Find new ways to customize the TCP/IP configuration. Use new wizards in iSeries Navigator to configure IPv6 or to create new interfaces and routes.

To find other information about what's new or changed this release, see the Memo to Users .



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## Chapter 2. Print this topic

To view or download the PDF version, select TCP/IP setup (about 326KB or 41 pages).

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

1. Right-click the PDF in your browser (right-click the link above).
2. Click **Save Target As...**
3. Navigate to the directory in which you would like to save the PDF.
4. Click **Save**.

### Downloading Adobe Acrobat Reader

If you need Adobe Acrobat Reader to view or print these PDFs, you can download a copy from the Adobe Web site ([www.adobe.com/prodindex/acrobat/readstep.html](http://www.adobe.com/prodindex/acrobat/readstep.html))  .



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## Chapter 3. Internet Protocol version 6 (IPv6)

Internet Protocol version 6 (IPv6) is the updated version of Internet Protocol version 4 (IPv4) and is gradually replacing IPv4 as the Internet standard.

You may wonder how you can use IPv6 to improve your company's e-business, or you may be a programmer who wants to create IPv6 applications so your firm can benefit from this enhanced Internet Protocol. Read these topics to find basic information about IPv6 and how to use IPv6 on the iSeries server:

### **What is IPv6?**

Find out why IPv6 is replacing IPv4 as the Internet standard, and how you can use it to your advantage.

### **What IPv6 functions are available?**

Learn how IPv6 is currently being implemented on the iSeries server.

### **IPv6 scenarios**

See examples to help you understand situations in which you would use IPv6 for your business.

### **IPv6 concepts**

Learn basic IPv6 concepts. If you aren't sure what the differences are between IPv4 and IPv6, see detailed comparisons, such as how the IPv4 and IPv6 addresses compare to one another, or how IPv4 packet headers differ from IPv6 packet headers.

### **Configure IPv6**

Find hardware and software requirements and instructions for configuring IPv6 on the server.

### **Troubleshoot IPv6**

Find solutions to IPv6 problems.

### **Related information for IPv6**

Find links to resources that help you understand IPv6.

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## What is IPv6?

Internet Protocol version 6 (IPv6) is the next evolution in Internet Protocol. Most of the Internet currently uses IPv4, and this protocol has been reliable and resilient for over 20 years. However, IPv4 has severe limitations that are causing more problems as the Internet expands.

In particular, there is a growing shortage of IPv4 addresses, which are needed for all new devices added to the Internet. The key to IPv6 enhancement is the expansion of the IP address space from 32 bits to 128 bits, enabling virtually unlimited unique IP addresses. The new IPv6 address text format is:

```
xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx
```

where each x is a hexadecimal digit representing 4 bits.

The expanded addressing capability of IPv6 provides a solution to the address depletion problem. This is especially important as more people use mobile computers, such as mobile telephones and handheld computers. The increasing demands of wireless users contribute to the depletion of IPv4 addresses. The expanded IP address capability of IPv6 solves this problem by providing enough IP addresses for the growing number of wireless devices.

In addition to this addressing capability, IPv6 provides new functions that simplify the tasks of configuring and managing the addresses on the network. Configuring and maintaining networks is a labor intensive activity. IPv6 reduces some of the workload by automating several of the network administrator's tasks.

If you use IPv6, you will not have to renumber your device addresses when you change to a different Internet Service Provider (ISP). You can keep the same addresses because they are globally unique addresses.

The IPv6 autoconfiguration feature automatically configures interface and router addresses for you. In stateless autoconfiguration, IPv6 takes the machine's MAC address and a network prefix provided by a local node and combines these two addresses to create a new, unique IPv6 address. This feature eliminates the need for a DHCP server, which saves time for the administrator and saves money for your company.

For more information sources about IPv6, see [Related information for IPv6](#)

See [What IPv6 functions are available?](#) for IPv6 information related specifically to the iSeries server.

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## What IPv6 functions are available?

IBM® is implementing IPv6 for the iSeries server over several software releases. IPv6 is currently implemented in an application development platform for the purpose of developing and testing IPv6 applications. IPv6 functions are transparent to existing TCP/IP applications and coexist with IPv4 functions.

These are the main iSeries server functions that are affected by IPv6:

- **Configuration**

Be aware that the configuration process for IPv6 is different from the process for IPv4. To use the IPv6 function, you must change the server's TCP/IP configuration by configuring a line for IPv6. You may configure IPv6 on an Ethernet line or on a tunnel line.

If you configure an Ethernet line for IPv6 traffic, you are sending IPv6 packets over an IPv6 network. See [Create an IPv6 local area network \(LAN\)](#) for a scenario that describes a situation in which you would configure an Ethernet line for IPv6.

If you configure tunnel lines, you are sending IPv6 packets over an existing IPv4 network. See [Send IPv6 packets over an IPv4 local area network \(LAN\)](#) and [Send IPv6 packets over an IPv4 wide area network \(WAN\)](#) for scenarios that describe two situations in which you would create a configured tunnel line for IPv6.

See [Configure IPv6 to configure your network for IPv6](#).

- **Sockets**

Develop and test sockets applications using IPv6 APIs and tools. IPv6 enhances sockets so that applications can use IPv6 using a new address family: AF\_INET6. These enhancements do not affect existing IPv4 applications. You may create applications that support concurrent IPv4 and IPv6 traffic or IPv6-only traffic. See [Use AF\\_INET6 address family for more information on IPv6 for sockets](#).

- **DNS**

Domain Name System (DNS) supports AAAA addresses and a new domain for reverse lookups: IP6.ARPA. While it is true that DNS retrieves IPv6 information, the server must use IPv4 to communicate with the DNS.

- **Troubleshoot TCP/IP**

Use standard troubleshooting tools such as PING, netstat, trace route and communications trace for IPv6 networks and tunnels. These tools now support the IPv6 address format. See [TCP/IP troubleshooting to solve problems for both IPv4 and IPv6 networks](#).

See [Related information for IPv6](#) for resources on IPv6.

## Scenarios: IPv6

Review the following scenarios to understand why you would implement IPv6 and how to set up your network in each of these situations:

- Create an IPv6 local area network (LAN)
- Send IPv6 packets over an IPv4 local area network (LAN)
- Send IPv6 packets over an IPv4 wide area network (WAN)

**Note:** In the scenarios, the IP addresses 10.x.x.x represent public IP addresses. All addresses used in these scenarios are for example purposes only.

See Configure IPv6 to configure your server for IPv6.

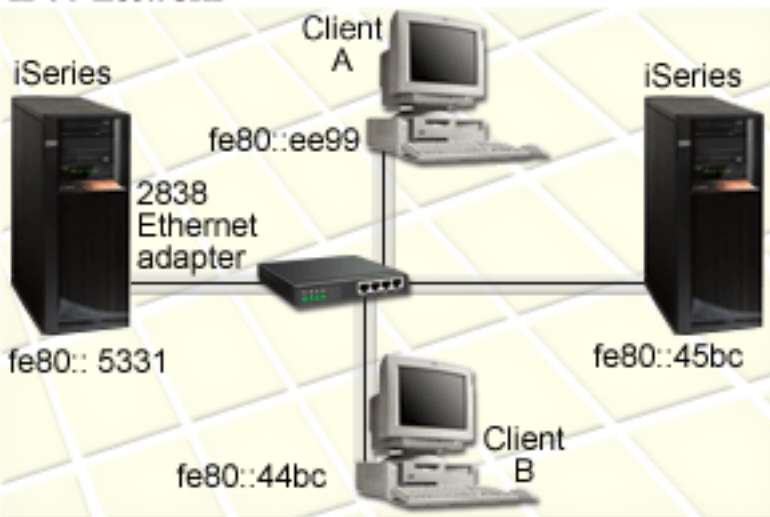
See IPv6 concepts for definitions of basic IPv6 concepts.

### Create an IPv6 local area network (LAN)

#### Situation

IPv6 will eventually replace IPv4 as the Internet standard. Consequently, your company decides to implement IPv6 for its financial operations and purchases a new accounting application that uses IPv6 for connectivity. The application needs to connect to another instance of the application that is located on a different server connected to the site Ethernet local area network (LAN). Your job is to configure your server for IPv6 so that your firm may start using the accounting application. The following figure illustrates the network setup in this scenario.

#### Accounting Department IPv6 network



#### Solution

To create an IPv6 LAN, you must configure an Ethernet line description for IPv6. IPv6 packets travel between iSeries servers and clients on the network as employees use the accounting application.

Setup requirements include:

- OS/400® Version 5 Release 2 or later
- 2838 or 2849 Ethernet adapters, as these are the only types of hardware resources currently supported for IPv6.
- iSeries Access for Windows® and iSeries Navigator (Network component of iSeries Navigator)
- The server must have a separate IPv4 physical interface configured before you configure the Ethernet line for IPv6 because TCP/IP must be running on your server. If you have not configured the server for IPv4, see Configure TCP/IP for the first time before configuring the line for IPv6.

### Configuration

To configure an Ethernet line description for IPv6, you must use the **IPv6 Configuration** wizard in iSeries Navigator. IPv6 may only be configured from iSeries Navigator, and may not be configured from the character-based interface.

The wizard requires the name of the hardware communications resource on the server on which you will configure IPv6; for example, CMN01. This must be either a 2838 or 2849 Ethernet adapter that is not currently configured for IPv4.

To use the **IPv6 Configuration** wizard, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration**.
2. Right-click **IPv6**, select **IPv6 Configuration**, and follow the wizard's instructions to configure an Ethernet line for IPv6.

## Send IPv6 packets over an IPv4 local area network (LAN)

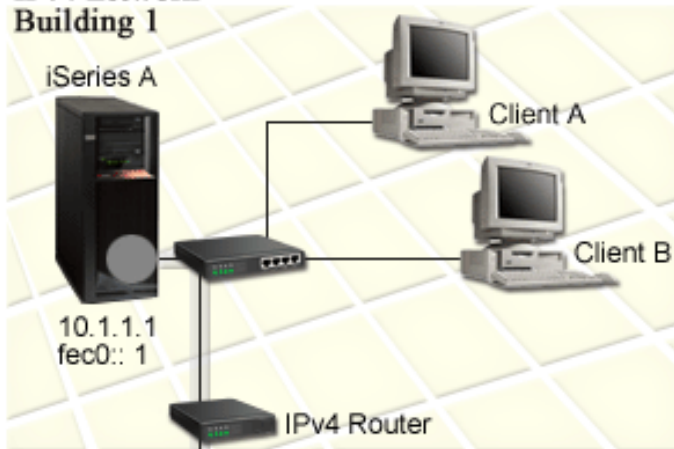
### Situation

Your firm has written a new IPv6 accounting application. This is a server-to-client application that you will use locally. The application communicates with other instances of itself that are located at the same site, but in other buildings and LANs. Although your firm wants to use IPv6 for this application, it is not ready to change its entire IPv4 infrastructure to IPv6. Your job is to configure IPv6 tunnel lines that allow IPv6 packets to run over the local IPv4 networks. The following figure illustrates the network setup in this



scenario.

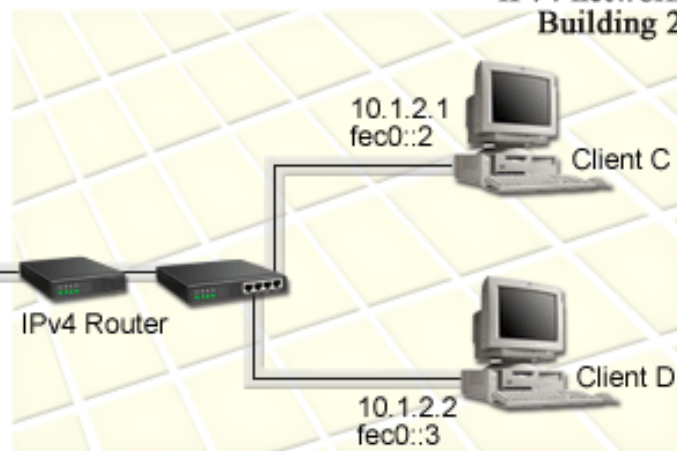
### Accounts Receivable IPv4 network Building 1



Red configured tunnel  
Local endpoint = 10.1.1.1  
Remote endpoint = 10.1.2.1  
Local IPv6 address = fec0::1

Blue configured tunnel  
Local endpoint = 10.1.1.1  
Remote endpoint = 10.1.2.2  
Local IPv6 address = fec0::1

### Accounts Payable IPv4 network Building 2



## Solution

To use IPv6 over these local IPv4 networks, you must create two configured tunnels and several associated routes. One tunnel is depicted in red and the other tunnel is depicted in blue, for example purposes.

First, consider the red tunnel:

- The red tunnel begins at iSeries A (local endpoint 10.1.1.1) in Building 1 and ends at Client C (remote endpoint 10.1.2.1) in Building 2.
- iSeries A encapsulates an IPv6 packet within an IPv4 packet and sends the IPv4 packet over the tunnel to Client C, which decapsulates the IPv6 packet so it may connect to another instance of the IPv6 application.

Next, consider the blue tunnel:

- The blue tunnel begins at iSeries A (local endpoint 10.1.1.1) in Building 1, like the red tunnel; however, the blue tunnel ends at Client D (remote endpoint 10.1.2.2) in Building 2.
- iSeries A encapsulates an IPv6 packet within an IPv4 packet and sends the IPv4 packet over the tunnel to Client D, which decapsulates the IPv6 packet so it may connect to another instance of the IPv6 application.

Each tunnel connection is point-to-point, so you must define a remote endpoint for each tunnel. This is accomplished by creating two routes. Each route is associated to the same tunnel line, but defines a different remote endpoint as the next hop. In other words, you define the remote endpoints of each tunnel as you create the routes.

In addition to creating the initial routes that define the tunnel endpoints and permit the packets to reach the clients in Building 2, you must create two more routes so the packets may return to the server in Building 1.

Setup requirements include:

- OS/400 Version 5 Release 2 or later
- iSeries Access for Windows and iSeries Navigator (Network component of iSeries Navigator)
- TCP/IP (using IPv4) must be configured on the server before you create the configured tunnel line. If you have not configured the server for IPv4, see Configure TCP/IP for the first time before configuring the tunnel line for IPv6.

### Configuration

To create a configured tunnel line, you must use the **IPv6 Configuration** wizard and the **New IPv6 Route** wizard in iSeries Navigator. IPv6 may only be configured from iSeries Navigator, and may not be configured from the character-based interface.

To use the **IPv6 Configuration** wizard to create the red tunnel line, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration**.
2. Right-click **IPv6**, select **IPv6 Configuration** wizard, and follow the wizard's instructions to configure a tunnel line for IPv6. After you complete the **IPv6 Configuration** wizard, it prompts you to create a new route for the configured tunnel line, and the **New IPv6 Route** wizard dialog will appear. You must create a new route to permit IPv6 packets to travel through the red tunnel.
3. From the **New IPv6 Route** wizard, create a route for the red tunnel. Specify the remote endpoint 10.1.2.1 as the next hop and specify fec0::2 as the destination address.

Use the **New IPv6 Route** wizard again to create a route for the blue tunnel. Note that it is not necessary to create the blue tunnel using the **IPv6 Configuration** wizard. The blue tunnel is created when you define its remote endpoint using the **New IPv6 Route** wizard. To use the **New IPv6 Route** wizard, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration** → **IPv6**.
2. Right-click **Routes**, select **New Route**, and follow the wizard's instructions to configure an IPv6 route for the blue tunnel. Specify the remote endpoint 10.1.2.2 as the next hop and specify fec0::3 as the destination address.

After you create the configured tunnel lines and the routes that define the tunnel endpoints, you must create a route on Client C and a route on Client D that permit the packets to travel back to the server in Building 1. For each of these routes, you should specify 10.1.1.1 as the next hop and specify fec0::1 as the destination address.

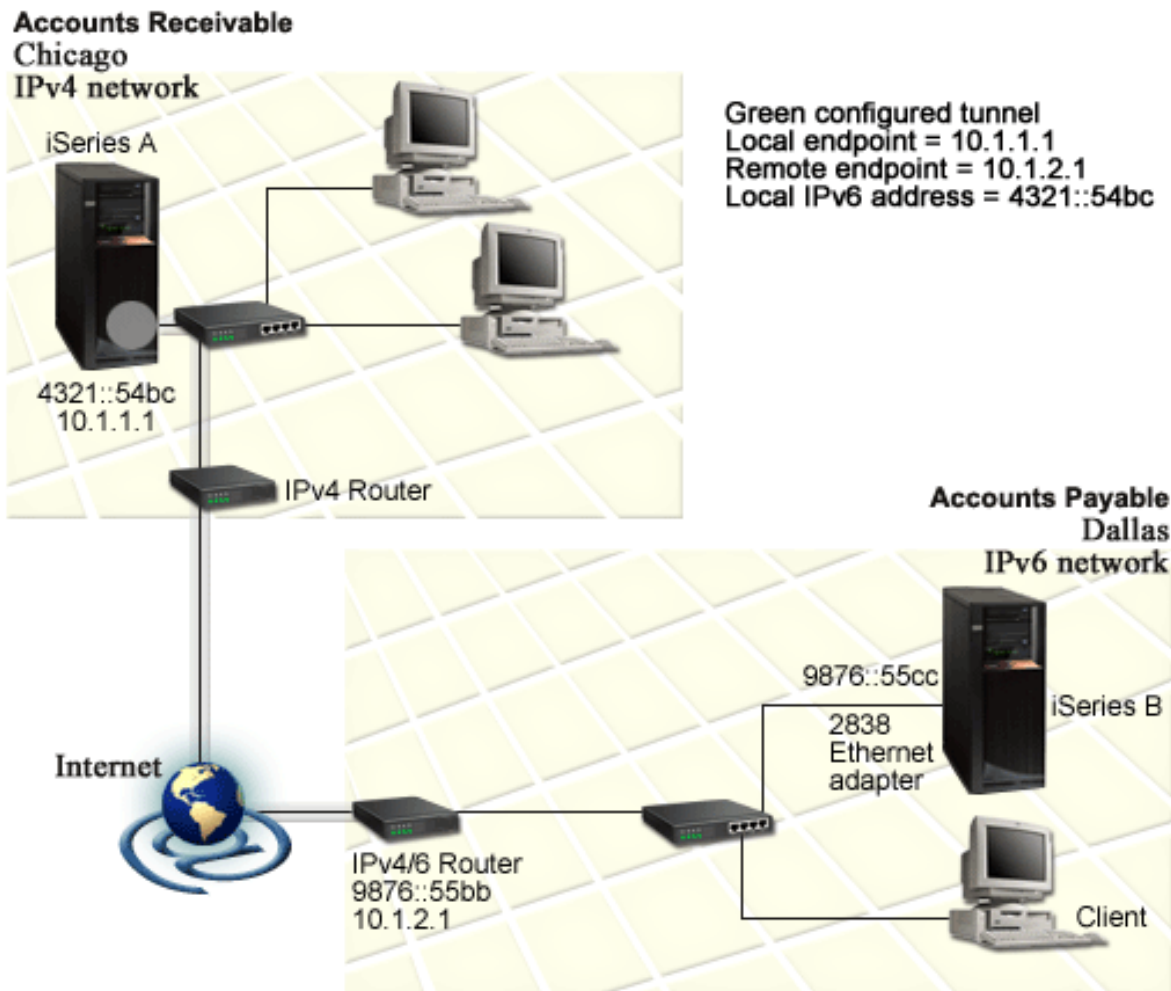
## Send IPv6 packets over an IPv4 wide area network (WAN)

### Situation

Your firm uses an accounting application for accounts receivable on the server in its Chicago office. You need to connect the application to a server in the Dallas office. This application uses IPv6 addressing on the servers in both cities. Because your ISP cannot provide IPv6 routers between your two sites, you need

to configure a tunnel between your two servers. The application packets travel through the tunnel, across the IPv4 wide area network between your two servers. The following figure illustrates the network setup in this scenario.

**Note:** In this scenario, the IP addresses 10.x.x.x represent public IP addresses that can be globally routed. All addresses used are for example purposes only.



## Solution

To use IPv6 across a wide area network that consists of an IPv4 infrastructure, you must create a configured tunnel line and several associated routes. This is how it works:

- The tunnel begins at iSeries A (local endpoint 10.1.1.1) in Chicago and ends at the IPv4/6 router (remote endpoint 10.1.2.1) in Dallas.
- The application that resides on iSeries A needs to connect to the application that resides on iSeries B. iSeries A encapsulates the IPv6 packet within an IPv4 packet and sends it over the tunnel to the IPv4/6 router, which decapsulates the IPv6 packet and forwards the IPv6 packet to iSeries B.
- The packet returns to Chicago by taking the reverse path.

The tunnel connection is point-to-point, so you must define the remote endpoint of the tunnel. This is accomplished by creating a route that is associated with this tunnel line. The route defines the remote

endpoint (10.1.2.1) as the next hop. In other words, you define the remote endpoint as you create the route. In addition, the route defines the destination address as 9876::55cc (the IPv6 address associated with iSeries B).

In addition to creating the initial route that defines the tunnel endpoint and permits the packet to travel to iSeries B in Dallas, you must create two more routes so the packet may return to iSeries A in Chicago.

Setup requirements include:

- OS/400 Version 5 Release 2 or later
- iSeries Access for Windows and iSeries Navigator (Network component of iSeries Navigator)
- TCP/IP (using IPv4) must be configured on the server before you create the configured tunnel line. If you have not configured the server for IPv4, see [Configure TCP/IP for the first time](#) before configuring the tunnel line for IPv6.

## Configuration

To create a configured tunnel line, you must use the **IPv6 Configuration** wizard and the **New IPv6 Route** wizard in iSeries Navigator. Configured tunnels may only be configured from iSeries Navigator, and may not be configured from the character-based interface.

To use the **IPv6 Configuration** wizard to create the tunnel line, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration**.
2. Right-click **IPv6**, select **IPv6 Configuration**, and follow the wizard's instructions to configure a tunnel line for IPv6. After you complete the **IPv6 Configuration** wizard, it prompts you to create a new route for the configured tunnel line, and the **New IPv6 Route** wizard dialog will appear. You must create a new route to allow IPv6 packets to travel through the tunnel.
3. From the **New IPv6 Route** wizard, create a host route for the tunnel. Specify the remote endpoint 10.1.2.1 as the next hop and specify 9876::55cc as the destination address.

After you create the configured tunnel line and the route that defines the tunnel endpoint, you must create routes on iSeries B and on the IPv4/6 router that permit the packets to travel back to Chicago. For the route on iSeries B, you should specify 9876::55bb as the next hop and 4321::54bc as the destination address. For the route on the IPv4/6 router, you should specify 10.1.1.1 as the next hop and 4321::54bc as the destination address.

**Note:** The IPv4/6 router in Dallas should have a direct route to 9876::55cc, but since this route is created automatically no manual configuration is necessary.

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## Concepts: IPv6

Read descriptions of these IPv6 concepts to better understand how IPv6 works:

### Compare IPv4 to IPv6

Find out how IPv4 attributes compare to IPv6 attributes. This table allows you to quickly look up specific functions and compare their usage in each Internet protocol.

### IPv6 address formats

Find out about the size and format of the IPv6 address.

### IPv6 address types

Find out about new types of addresses within the scope of IPv6.

### IPv6 tunneling

Find out how IPv6 tunneling allows IPv6 packets to travel over an IPv4 network.

## Neighbor discovery

Find out how neighbor discovery allows hosts and routers to communicate with one another.

## Stateless address autoconfiguration

Find out how stateless address autoconfiguration automates some of the network administrator's tasks.

## IPv6 address formats

The IPv6 address size is 128 bits. The preferred IPv6 address representation is:

xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx where each x is a hexadecimal digit representing 4 bits. IPv6 addresses range from 0000:0000:0000:0000:0000:0000:0000:0000 to ffff:ffff:ffff:ffff:ffff:ffff:ffff:ffff.

In addition to this preferred format, IPv6 addresses may be specified in two other shortened formats:

- **Omit leading zeros**

Specify IPv6 addresses by omitting leading zeros. For example, IPv6 address

1050:0000:0000:0000:0005:0600:300c:326b may be written as 1050:0:0:0:5:600:300c:326b.

- **Double colon**

Specify IPv6 addresses by using double colons (::) in place of a series of zeros. For example, IPv6

address ff06:0:0:0:0:0:c3 may be written as ff06::c3. Double colons may be used only once in an IP address.

An alternative format for IPv6 addresses combines the colon and dotted notation, so the IPv4 address may be embedded in the IPv6 address. Hexadecimal values are specified for the left-most 96 bits, and decimal values are specified for the right-most 32 bits indicating the embedded IPv4 address. This format ensures compatibility between IPv6 nodes and IPv4 nodes when you are working in a mixed network environment.

These two types of IPv6 addresses use this alternative format:

- **IPv4-mapped IPv6 address**

This type of address is used to represent IPv4 nodes as IPv6 addresses. It allows IPv6 applications to communicate directly with IPv4 applications. For example, 0:0:0:0:0:ffff:192.1.56.10 and ::ffff:192.1.56.10/96 (shortened format).

- **IPv4-compatible IPv6 address**

This type of address is used for tunneling. It allows IPv6 nodes to communicate across an IPv4 infrastructure. For example, 0:0:0:0:0:0:192.1.56.10 and ::192.1.56.10/96 (shortened format).

All of these formats are valid IPv6 address formats. Specify any one of these IPv6 address formats in iSeries Navigator.

## IPv6 address types

IPv6 addresses are categorized into three basic types:

### Unicast address

The unicast address specifies a single interface. A packet sent to a unicast address destination travels from one host to the destination host.

Three types of unicast addresses include:

#### Link-local address

Link-local addresses are designed for use on a single local link (local network). Link-local addresses are automatically configured on all interfaces. The prefix used for a link-local address is fe80::/10. Routers do not forward packets with a destination or source address containing a link-local address.

### **Site-local address**

Site-local addresses are designed for use in a specific site. The prefix used for a site-local address is `fec0::/10`. Routers do not forward packets with a source address containing a site-local address outside of a specific site.

### **Global address**

Global addresses are designed for use on any network. The prefix used for a global address begins with binary `001`.

Two special types of unicast addresses include:

### **Unspecified address**

The unspecified address is `0:0:0:0:0:0:0:0` or may be abbreviated with two colons (`::`). The unspecified address indicates the absence of an address, and it may never be assigned to a host. It may be used by an IPv6 host that does not yet have an address assigned to it. For example, when the host sends a packet to discover an address from another node, the host uses the unspecified address as its source address.

### **Loopback address**

The loopback address is `0:0:0:0:0:0:0:1` or may be abbreviated as `::1`. The loopback address is used by a node to send a packet to itself.

### **Anycast address**

The anycast address specifies a set of interfaces, possibly at different locations, that all share a single address. A packet sent to an anycast address goes only to the nearest member of the group. The iSeries server does not currently support anycast addressing.

### **Multicast address**

The multicast address specifies a set of interfaces, possibly at multiple locations. The prefix used for a multicast address is `ff`. If a packet is sent to a multicast address, one copy of the packet is delivered to each member of the group. The iSeries server currently provides basic support for multicast addressing. Multicast interface creation and application support are currently not supported.

## **IPv6 tunneling**

IPv6 tunneling enables the iSeries server to connect to IPv6 nodes (hosts and routers) across IPv4 domains. Tunneling permits isolated IPv6 nodes or networks to communicate without changing the underlying IPv4 infrastructure. Tunneling allows IPv4 and IPv6 protocols to cooperate, and thereby provides a transitional method of implementing IPv6 while retaining IPv4 connectivity.

A tunnel consists of two dual-stack (IPv4 and IPv6) nodes on an IPv4 network. These dual-stack nodes are capable of processing both IPv4 and IPv6 communications. One of the dual-stack nodes on the edge of the IPv6 infrastructure inserts an IPv4 header in front of (encapsulates) each IPv6 packet that arrives and sends it as though it were normal IPv4 traffic, through existing links. IPv4 routers continue to forward this traffic. On the other side of the tunnel, another dual-stack node removes the extra IP header from the IPv6 packet (decapsulates) and routes it to the ultimate destination using standard IPv6.

IPv6 tunneling for the iSeries server runs over configured tunnel lines, which are virtual lines. Configured tunnel lines provide IPv6 communications to any node with a routable IPv4 address that supports IPv6 tunnels. These nodes may exist anywhere, that is, within the local IPv4 domain or within a remote domain.

Configured tunnel connections are point-to-point. To configure this type of tunnel line, you must specify the local tunnel endpoint (IPv4 address), such as `124.10.10.150`, and the local IPv6 address, such as `1080:0:0:0:8:800:200c:417a`. You must also create an IPv6 route to enable traffic to travel through the tunnel. As you create the route, you will define one of the tunnel's remote endpoints (IPv4 address) as the route's next hop. You may configure an unlimited number of endpoints for an unlimited number of tunnels.



| See Send IPv6 packets over an IPv4 local area network (LAN) and Send IPv6 packets over an IPv4 wide area network (WAN) for scenarios and figures that demonstrate IPv6 tunneling.

## | Neighbor discovery

| Neighbor discovery functions are used by IPv6 nodes (hosts or routers) to discover the presence of other IPv6 nodes, to determine the link-layer addresses of nodes, to find routers that are capable of forwarding IPv6 packets, and to maintain a cache of active IPv6 neighbors. IPv6 nodes use these five Internet Control Message Protocol version 6 (ICMPv6) messages to communicate with other nodes:

### | Router solicitation

| Hosts send these messages to request routers to generate router advertisements. A host sends an initial router solicitation when the host first becomes available on the network.

### | Router advertisement

| Routers send these messages either periodically or in response to a router solicitation. The information provided by router advertisements are used by hosts to automatically create site-local interfaces, global interfaces, and associated routes. Router advertisements also contain other configuration information used by a host such as maximum transmission unit and hop limit.

### | Neighbor solicitation


| Nodes send these messages to determine the link-layer address of a neighbor, or to verify that a neighbor is still reachable.

### | Neighbor advertisement

| Nodes send these messages in response to a neighbor solicitation or as an unsolicited message to announce an address change.

### | Redirect

| Routers use these messages to inform hosts of a better first hop for a destination.

| See RFC 2461 for more information about neighbor discovery and router discovery. To view RFC 2461, see RFC Editor (<http://www.rfc-editor.org/rfcsearch.html>) .

## | Stateless address autoconfiguration

| Stateless address autoconfiguration is the process that IPv6 nodes (hosts or routers) use to automatically configure IPv6 addresses for interfaces. The node builds various IPv6 addresses by combining an address prefix with either the MAC address of the node or a user-specified interface identifier. The prefixes include the link-local prefix (fe80::/10) and prefixes of length 64 advertised by local IPv6 routers (if any exist). Stateless address autoconfiguration also creates appropriate multicast interfaces when the link-type is multicast-capable.

| The node performs duplicate address detection to verify the uniqueness of the address before assigning it to an interface. The node sends out a neighbor solicitation query to the new address and waits for a response. If the node does not receive a response, then the address is assumed to be unique. If the node receives a response in the form of a neighbor advertisement, the address is already in use. If a node determines that its tentative IPv6 address is not unique, then autoconfiguration stops and manual configuration of the interface is required.

## | Compare IPv4 to IPv6

| IBM is implementing IPv6 for the iSeries server over several software releases. IPv6 is currently implemented in an application development platform for the purpose of developing and testing IPv6 applications.

| You may be wondering how the details of IPv6 differ from IPv4. This table allows you to quickly glance at familiar attributes associated with IPv4 and compare them to similar attributes in IPv6. Select an attribute from this list to link to the comparison in the table.

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- | • “address allocation” on page 19

- | • “address lifetime” on page 19
- | • “address mask” on page 19
- | • “address prefix” on page 19
- | • “Address Resolution Protocol (ARP)” on page 20
- | • “address scope” on page 20
- | • “address types” on page 20
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- | • “IP header” on page 21
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- | • “loopback address” on page 22
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- | • “trace route” on page 25
- | • “transport layers” on page 26
- | • “unspecified address” on page 26
- | • “virtual private networking (VPN)” on page 26



	IPv4	IPv6
<b>address</b>	<p>32 bits long (4 bytes). Address is composed of a network and a host portion, which depend on address class. Various address classes are defined: A, B, C, D, or E depending on initial few bits. The total number of IPv4 addresses is 4 294 967 296.</p> <p>The text form of the IPv4 address is nnn.nnn.nnn.nnn, where <math>0 \leq n \leq 255</math>, and each n is a decimal digit. Leading zeros may be omitted. Maximum number of print characters is 15, not counting a mask.</p>	<p>128 bits long (16 bytes). Basic architecture is 64 bits for the network number and 64 bits for the host number. Often, the host portion of an IPv6 address (or part of it) will be a MAC address or other interface identifier.</p> <p>Depending on the subnet prefix, IPv6 has a more complicated architecture than IPv4.</p> <p>The number of IPv6 addresses is <math>10^{28}</math> (79 228 162 514 264 337 593 543 950 336) times larger than the number of IPv4 addresses.</p> <p>The text form of the IPv6 address is xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx:xxxx, where each x is a hexadecimal digit, representing 4 bits. Leading zeros may be omitted. The double colon (::) may be used once in the text form of an address, to designate any number of 0 bits. For example, ::ffff:10.120.78.40 is an IPv6 IPv4-mapped address. (See RFC 2373 for details. To view this RFC, see RFC Editor (<a href="http://www.rfc-editor.org/rfcsearch.html">http://www.rfc-editor.org/rfcsearch.html</a>)).</p>
<b>address allocation</b>	Originally, addresses were allocated by network class. As address space is depleted, smaller allocations using Classless Inter-Domain Routing (CIDR) are made. Allocation has not been balanced among institutions and nations.	Allocation is in the earliest stages. The Internet Engineering Task Force (IETF) and Internet Architecture Board (IAB) have recommended that essentially every organization, home, or entity be allocated a /48 subnet prefix length. This would leave 16 bits for the organization to do subnetting. The address space is large enough to give every person in the world their own /48 subnet prefix length.
<b>address lifetime</b>	Generally, not an applicable concept, except for addresses assigned using DHCP.	<p>IPv6 addresses have two lifetimes: preferred and valid, with the preferred lifetime always <math>\leq</math> valid.</p> <p>After the preferred lifetime expires, the address is not to be used as a source IP address. After the valid lifetime expires, the address is not used (recognized) as a valid destination IP address for incoming packets.</p> <p>Some IPv6 addresses have, by definition, infinite preferred and valid lifetimes; for example link-local (see “address scope” on page 20).</p>
<b>address mask</b>	Used to designate network from host portion.	Not used (see “address prefix”).
<b>address prefix</b>	Sometimes used to designate network from host portion. Sometimes written as /nn suffix on presentation form of address.	Used to designate the subnet prefix of an address. Written as /nnn (up to 3 decimal digits, $0 \leq n \leq 128$ ) suffix after the print form. An example is fe80::982:2a5c/10, where the first 10 bits comprise the subnet prefix.

	IPv4	IPv6
<b>Address Resolution Protocol (ARP)</b>	Address Resolution Protocol is used by IPv4 to find a physical address, such as the MAC or link address, associated with an IPv4 address.	IPv6 embeds these functions within IP itself as part of the algorithms for stateless autoconfiguration and neighbor discovery using Internet Control Message Protocol version 6 (ICMPv6). Hence, there is <u>no</u> such thing as ARP6.
<b>address scope</b>	For unicast addresses, the concept does not apply. There are designated private address ranges and loopback. Outside of that, addresses are assumed to be global.	In IPv6, address scope is part of the architecture. Unicast addresses have 3 defined scopes, including link-local, site-local and global; and multicast addresses have 14 scopes. Default address selection for both source and destination takes scope into account.  A scope zone is an instance of a scope in a particular network. As a consequence, IPv6 addresses sometimes have to be entered or associated with a zone ID. The syntax is %zid where zid is a number (usually small) or a name. The zone ID is written after the address and before the prefix. For example, 2ba::1:2:14e:9a9b:c%3/48.
<b>address types</b>	Unicast, multicast, and broadcast.	Unicast, multicast, and anycast. See IPv6 address types for descriptions.
<b>communications trace</b>	A tool to collect a detailed trace of TCP/IP (and other) packets that enter and leave an iSeries server.	Same for IPv6, and IPv6 is supported, including ICMPv6 and IPv6 packets tunneled in IPv4.
<b>configuration</b>	Configuration must be done on a newly installed system before it can communicate; that is, IP addresses and routes must be assigned.	Configuration is optional, depending on functions required. An appropriate Ethernet or tunnel interface must be designated as an IPv6 interface, using iSeries Navigator. Once that is done, IPv6 interfaces are self-configuring. So, the system will be able to communicate with other IPv6 systems that are local and remote, depending on the type of network and whether an IPv6 router exists.
<b>Domain Name System (DNS)</b>	Applications accept host names and then use DNS to get an IP address, using socket API <code>gethostbyname()</code> .  Applications also accept IP addresses and then use DNS to get host names using <code>gethostbyaddr()</code> .  For IPv4, the domain for reverse lookups is <code>in-addr.arpa</code> .	Same for IPv6. Support for IPv6 exists using AAAA (quad A) record type and reverse lookup (IP-to-name). An application may elect to accept IPv6 addresses from DNS (or not) and then use IPv6 to communicate (or not).  The socket API <code>gethostbyname()</code> is unchanged for IPv6 and the <code>getaddrinfo()</code> API can be used to obtain (at application choice) IPv6 only, or IPv4 and IPv6 addresses.  For IPv6, the domain used for reverse nibble lookups is <code>ip6.arpa</code> , and if not found then <code>ip6.int</code> (see API <code>getnameinfo()</code> ).
<b>Dynamic Host Configuration Protocol (DHCP)</b>	Used to dynamically obtain an IP address and other configuration information.	Currently, DHCP does not support IPv6.

	IPv4	IPv6
<b>File Transfer Protocol (FTP)</b>	File Transfer Protocol allows you to send and receive files across networks.	Currently, FTP does not support IPv6.
<b>fragments</b>	When a packet is too big for the next link over which it is to travel, it can be fragmented by the sender (host or router).	For IPv6, fragmentation can only occur at the source node, and reassembly is only done at the destination node. Currently, the fragmentation extension header is not supported.
<b>host table</b>	On iSeries Navigator, a configurable table that associates an Internet address with a host name; for example, 127.0.0.1, loopback. This table is used by the sockets name resolver, either before a DNS lookup or after a DNS lookup fails (determined by host name search priority).	Currently, this table does not support IPv6. Customers need to configure a AAAA record in a DNS for IPv6 domain resolution. You may run the DNS locally on the same system as the resolver, or you may run it on a different system.
<b>interface</b>	<p>The conceptual or logical entity used by TCP/IP to send and receive packets and always closely associated with an IPv4 address, if not named with an IPv4 address. Sometimes referred to as a logical interface.</p> <p>Can be started and stopped independently of each other and independently of TCP/IP using STRTCPIFC and ENDTCPIFC commands and using iSeries Navigator.</p>	<p>Same concept as IPv4.</p> <p>Can be started and stopped independently of each other and independently of TCP/IP using iSeries Navigator only.</p>
<b>Internet Control Message Protocol (ICMP)</b>	ICMP is used by IPv4 to communicate network information.	<p>Used similarly for IPv6; however, Internet Control Message Protocol version 6 (ICMPv6) provides some new attributes.</p> <p>Basic error types remain, such as destination unreachable, echo request and reply. New types and codes are added to support neighbor discovery and related functions.</p>
<b>Internet Group Management Protocol (IGMP)</b>	IGMP is used by IPv4 routers to find hosts that want traffic for a particular multicast group, and used by IPv4 hosts to inform IPv4 routers of existing multicast group listeners (on the host).	Replaced by MLD (multicast listener discovery) protocol for IPv6. Does essentially what IGMP does for IPv4, but uses ICMPv6 by adding a few MLD-specific ICMPv6 type values.
<b>IP header</b>	Variable length of 20-60 bytes, depending on IP options present.	Fixed length of 40 bytes. There are no IP header options. Generally, the IPv6 header is simpler than the IPv4 header.
<b>IP header options</b>	Various options that may accompany an IP header (before any transport header).	The IPv6 header has no options. Instead, IPv6 adds additional (optional) extension headers. The extension headers are AH and ESP (unchanged from IPv4), hop-by-hop, routing, fragment, and destination. Currently, IPv6 does not support any extension headers.

	<b>IPv4</b>	<b>IPv6</b>
<b>IP header protocol byte</b>	The protocol code of the transport layer or packet payload; for example, ICMP.	The type of header immediately following the IPv6 header. Uses the same values as the IPv4 protocol field. But the architectural effect is to allow a currently defined range of next headers, and is easily extended. The next header will be a transport header, an extension header, or ICMPv6.
<b>IP header Type of Service (TOS) byte</b>	Used by QoS and differentiated services to designate a traffic class.	Designates the IPv6 traffic class, similarly to IPv4. Uses different codes. Currently, IPv6 does not support TOS.
<b>iSeries Navigator support</b>	iSeries Navigator provides a full configuration function for TCP/IP.	The optional configuration for IPv6 is provided in full by iSeries Navigator, including the <b>IPv6 Configuration</b> wizard.
<b>LAN connection</b>	Used by an IP interface to get to the physical network. Many types exist; for example, token ring, Ethernet, and PPP. Sometimes referred to as the physical interface, link, or line.	IPv6 has the same concept. Currently, only the 2838 and 2849 Ethernet cards and tunnel lines are supported.
<b>Layer 2 Tunnel Protocol (L2TP)</b>	L2TP can be thought of as virtual PPP, and works over any supported line type.	Currently, L2TP does not support IPv6.
<b>loopback address</b>	An interface with address of 127.*.*.* (typically 127.0.0.1) that can only be used by a node to send packets to itself. The physical interface (line description) is named *LOOPBACK.	The concept is the same as in IPv4, and the single loopback address is 0000:0000:0000:0000:0000:0000:0000:0001 or ::1 (shortened version). The virtual physical interface is named *LOOPBACK6.
<b>Maximum Transmission Unit (MTU)</b>	Maximum transmission unit of a link is the maximum number of bytes that a particular link type, such as Ethernet or modem, supports. For IPv4, 576 is the typical minimum.	IPv6 has an architected lower bound on MTU of 1280 bytes. That is, IPv6 will not fragment packets below this limit. To send IPv6 over a link with less than 1280 MTU, the link-layer must transparently fragment and defragment the IPv6 packets.
<b>netstat</b>	A tool to look at status of TCP/IP connections, interfaces, or routes. Available using iSeries Navigator and 5250.	Same for IPv6, and IPv6 is supported for both 5250 and iSeries Navigator.
<b>Network Address Translation (NAT)</b>	Basic firewall functions integrated into TCP/IP, configured using iSeries Navigator.	Currently, NAT does not support IPv6. More generally, IPv6 does not require NAT. The expanded address space of IPv6 eliminates the address shortage problem and enables easier renumbering.
<b>network table</b>	On iSeries Navigator, a configurable table that associates a network name with an IP address without mask. For example, host Network14 and IP address 1.2.3.4.	Currently, no changes are made to this table for IPv6.
<b>node info query</b>	Does not exist.	A simple and convenient network tool that should work like ping, except with content: an IPv6 node may query another IPv6 node for the target's DNS name, IPv6 unicast address, or IPv4 address. Currently, not supported.

	IPv4	IPv6
<b>packet filtering</b>	Basic firewall functions integrated into TCP/IP, configured using iSeries Navigator.	Currently, packet filtering does not support IPv6. However, IPv4 filtering can be applied to tunneled IPv6 traffic.
<b>packet forwarding</b>	The iSeries server can be configured to forward IP packets it receives for nonlocal IP addresses. Typically, the inbound interface and outbound interface are connected to different LANs.	Currently, IPv6 packets are not forwarded.
<b>packet tunneling</b>	In IPv4, tunneling occurs in VPN for tunnel-mode VPN connections (IPv4 tunneled in IPv4) and in L2TP.	For IPv6, tunneling in IPv4 packets is expected to be a major part of its evolution. Currently, at least 5 different types of 6-in-4 tunneling are defined by IETF, each with different attributes and advantages.  A basic and flexible type of IPv6-in-IPv4 tunneling is supported to allow IPv6 nodes to communicate across the existing IPv4 Internet. Called <b>configured tunneling</b> , it provides a virtual point-to-point link between two IPv6 nodes and uses a new type of tunnel line called *TNLCFG64.
<b>PING</b>	Basic TCP/IP tool to test reachability. Available using iSeries Navigator and 5250.	Same for IPv6, and IPv6 is supported, for both 5250 and iSeries Navigator.
<b>Point-to-Point Protocol (PPP)</b>	PPP supports dial-up interfaces over various modem and line types.	Currently, PPP does not support IPv6.
<b>port restrictions</b>	These iSeries panels allow a customer to configure selected port number or port number ranges for TCP or UDP so that they are only available for a specific profile.	Not supported for IPv6. Configured restrictions apply only to IPv4.
<b>ports</b>	TCP and UDP have separate port spaces, each identified by port numbers in the range 1-65535.	For IPv6, ports work the same as IPv4. Because these are in a new address family, there are now four separate port spaces. For example, there are two TCP port 80 spaces to which an application can bind, one in AF_INET and one in AF_INET6.

	IPv4	IPv6
<b>private and public addresses</b>	All IPv4 addresses are public, except for three address ranges that have been designated as private by IETF RFC 1918: 10.*.*.* (10/8), 172.16.0.0 through 172.31.255.255 (172.16/12) , and 192.168.*.* (192.168/16). Private address domains are commonly used within organizations. Private addresses cannot be routed across the Internet.	IPv6 has an analogous concept, but with important differences.  Addresses are public or temporary, previously termed anonymous. See RFC 3041. Unlike IPv4 private addresses, temporary addresses can be globally routed. The motivation is also different; IPv6 temporary addresses are meant to shield the identity of a client when it initiates communication (a privacy concern). Temporary addresses have a limited lifetime, and do not contain an interface identifier that is a link (MAC) address. They are generally indistinguishable from public addresses.  IPv6 has the notion of limited address scope using its architected scope designations (see “address scope” on page 20).
<b>protocol table</b>	On iSeries Navigator, a configurable table that associates a protocol name with its assigned protocol number; for example, UDP, 17. The system is shipped with a small number of entries: IP, TCP, UDP, ICMP.	The table supports IPv6 without change.
<b>Quality of service (QoS)</b>	Quality of service allows you to request packet priority and bandwidth for TCP/IP applications.	Currently, QoS does not support IPv6. However, when IPv6 is tunneled in IPv4, existing iSeries QoS facilities can be applied to the IPv4 traffic, which will then transparently handle the IPv6 payloads.
<b>renumbering</b>	Done by manual reconfiguration, with the possible exception of DHCP. Generally, for a site or organization, a difficult and troublesome process to avoid if possible.	Is an important architectural element of IPv6, and is supposed to be largely automatic especially within the /48 prefix.
<b>route</b>	Logically, a mapping of a set of IP addresses (may contain only 1) to a physical interface and a single next hop IP address. IP packets whose destination address is defined as part of the set are forwarded to the next hop using the line. IPv4 routes are associated with an IPv4 interface, hence, an IPv4 address.  The default route is *DFTRROUTE.	Conceptually, the same as IPv4. One important difference: IPv6 routes are associated (bound) to a physical interface (a link, such as *TNLCFG64 or ETH03) rather than an interface. There are various reasons for this. One reason is that source address selection functions differently for IPv6 than for IPv4. See “source address selection” on page 25.  Duplicate routes are allowed to improve robustness, but they are ignored during route lookup.
<b>Routing Information Protocol (RIP)</b>	RIP is a routing protocol supported by the routed daemon.	Currently, RIP does not support IPv6. IPv6 routing uses static routes.

	IPv4	IPv6
<b>services table</b>	<p>On the iSeries server, a configurable table that associates a service name with a port and protocol; for example, service name FTP-control, port 21, TCP and UDP.</p> <p>A large number of well-known services are listed in the services table. Many applications use this table to determine which port to use.</p>	No changes are made to this table for IPv6.
<b>Simple Network Management Protocol (SNMP)</b>	SNMP is a protocol for system management.	Currently, SNMP does not support IPv6. IPv6 routing uses static routes.
<b>sockets API</b>	These APIs are the way applications use TCP/IP. Applications that do not need IPv6 are not affected by sockets changes to support IPv6.	<p>IPv6 enhances sockets so that applications can now use IPv6, using a new address family: AF_INET6.</p> <p>The enhancements have been designed so that existing IPv4 applications are completely unaffected by IPv6 and API changes. Applications that want to support concurrent IPv4 and IPv6 traffic, or IPv6-only traffic, are easily accommodated using IPv4-mapped IPv6 addresses of the form <code>::ffff:a.b.c.d</code>, where a.b.c.d is the IPv4 address of the client.</p> <p>The new APIs also include support for converting IPv6 addresses from text to binary and from binary to text.</p> <p>See Use AF_INET6 address family for more information on sockets enhancements for IPv6.</p>
<b>source address selection</b>	An application may designate a source IP (typically, using sockets <code>bind()</code> ). If it binds to INADDR_ANY, a source IP is chosen based on the route.	As with IPv4, an application may designate a source IPv6 address using <code>bind()</code> . Similarly to IPv4, it can let the system choose an IPv6 source address by using <code>in6addr_any</code> . But since IPv6 lines have many IPv6 addresses, the internal method of choosing a source IP is different.
<b>starting and stopping</b>	Use STRTCP and ENDTCP to start or end TCP/IP.	<p>Same as IPv4. IPv4 and IPv6 are not started or stopped independently of one another or independently of TCP/IP. That is, you start and stop all of TCP/IP, not just IPv4 or IPv6.</p> <p>Any IPv6 interfaces are automatically started if the AUTOSTART parameter = *YES (the default). IPv6 cannot be used or configured without IPv4, and IPv6 must have IPv6 loopback configured (<code>::1</code>).</p>
<b>Telnet</b>	Telnet allows you to log on and use a remote computer as though you were connected to it directly.	Currently, Telnet does not support IPv6.
<b>trace route</b>	Basic TCP/IP tool to do path determination. Available using iSeries Navigator and 5250.	Same for IPv6, and IPv6 is supported for both 5250 and iSeries Navigator.



	IPv4	IPv6
<b>transport layers</b>	TCP, UDP, RAW. A new transport, Stream Control Transmission Protocol (SCTP), aims to offer the best features of TCP and UDP, that is, guaranteed connectionless communication. SCTP is in the earliest stage of use, and is not supported on iSeries.	Same three transports exist and are functionally unchanged for IPv6.
<b>unspecified address</b>	Apparently, not defined, as such. Socket programming uses 0.0.0.0 as INADDR_ANY.	Defined as ::/128 (128 0 bits). It is used as the source IP in some neighbor discovery packets, and various other contexts, like sockets. Socket programming uses ::/128 as in6addr_any.
<b>virtual private networking (VPN)</b>	Virtual private networking (using IPsec) allows you to extend a secure, private network over an existing public network.	Currently, VPN does not support IPv6. However, when IPv6 is tunneled in IPv4, existing iSeries VPN facilities can be applied to the IPv4 traffic, which then transparently handles the IPv6 payloads.

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## Related information for IPv6

For more information on IPv6, see these sources of information:

**The Internet Engineering Task Force (IETF)** (<http://www.ietf.cnri.reston.va.us/>)   
Learn about the group of individuals that develops Internet protocol, including IPv6.

**IP Version 6 (IPv6)** (<http://playground.sun.com/pub/ipng/html/ipng-main.html>)   
Find current IPv6 specifications and references to several sources on IPv6.

**IPv6 Forum** (<http://www.ipv6forum.com/>)   
Find news articles and events that communicate the latest IPv6 developments.



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## Chapter 4. Plan TCP/IP setup

Before you begin to install and configure your iSeries server, take a few moments to plan the operation. See the topics below for planning guidelines. These planning guidelines pertain to basic TCP/IP setup using IPv4. If you intend to configure IPv6, see Configure IPv6 for setup requirements and configuration instructions.

### TCP/IP setup requirements

Gather and record basic configuration information that is required for TCP/IP setup.

### TCP/IP security considerations

Consider your security needs as a new member of a network.

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## TCP/IP setup requirements

Print this page and record the configuration information about your server and the TCP/IP network to which you are connecting. You will need to refer to this information later when you configure TCP/IP. Use the instructions following the table to help you determine the values for the first two rows. If you are unfamiliar with any of these terms, see IBM redbook TCP/IP for AS/400®: More Cool Things Than Ever



, and refer to Chapter Two, "TCP/IP: Basic Installation and Configuration." For your system

Required information	Example
Type of communications adapter installed in your system (see instructions below)	Ethernet
Resource name	CMN01
IP address for your iSeries server	199.5.83.158
Subnet mask for your iSeries server	255.255.255.0
Gateway address	199.5.83.129
Host name and domain name for your system	sys400.xyz.company.com
IP address for domain name server	199.4.191.76

To find your communications adapter information, follow these steps:

1. At the server command line, type go hardware, and press **Enter**.
2. To select Work with communication resources (Option 1), type 1, and press **Enter**.

Your communication resources will be listed by resource name. Follow the display instructions if you want to work with your resources or view more details.

### What to do next:

Install TCP/IP


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## TCP/IP security considerations

When planning your TCP/IP configuration, you should consider your security needs. These strategies can help limit your TCP/IP exposure:

- **Start only those TCP/IP applications that you need.**

Each TCP/IP application has its own unique security exposures. Do not depend on a router to reject requests for a particular application. As a secondary defense, set the autostart values of applications that are not required to NO.

- **Limit the hours during which TCP/IP applications run.**  
Limit your exposure by reducing the hours that your servers are running. If possible, stop TCP/IP servers such as FTP and Telnet during off-hours.
- **Control who can start and change your TCP/IP applications.**  
By default, \*IOSYSCFG authority is required to change TCP/IP configuration settings. A user without \*IOSYSCFG authority needs \*ALLOBJ authority or explicit authority to the TCP/IP start commands. Giving special authorities to users represents a security exposure. Evaluate the need for any special authorities for each user and keep special authorities to a minimum. Keep track of which users have special authorities and periodically review their requirement for the authority. This also limits the possibility of server access during off-hours.
- **Control your TCP/IP routing:**
  - Disallow IP forwarding so that hackers cannot use your Web server to attack other trusted systems.
  - Define only one route on your public Web server: the default route to your Internet Service Provider.
  - Do not configure host names and IP addresses of internal secure systems in your Web server's TCP/IP host table. Only put the name of other public servers that you need to reach in this table.
- **Control TCP/IP servers designed for remote, interactive sign-on.**  
Applications such as FTP and Telnet are more vulnerable to outside attack. For details on how to control your exposure, read the chapter on tips for controlling interactive sign-on in Tips and Tools for Securing Your iSeries  .

For more information about security and the options available to you, refer to IBM Secureway: iSeries and the Internet.

## Chapter 5. Install TCP/IP

Base TCP/IP support comes with OS/400 and allows you to connect an iSeries server to a network. However, if you want to use any TCP/IP applications such as Telnet, FTP, and SMTP, you also need to install TCP/IP Connectivity Utilities. This is a separately installable licensed program that is included with your operating system.

To install TCP/IP Connectivity Utilities on your iSeries server, follow these steps:

1. Insert your installation media for TCP/IP into your server. If your installation media is a CD-ROM, insert it into your optical device. If your installation media is a tape, insert it into your tape drive.
2. At the command line, type `GO LICPGM` and press **Enter** to access the Work with Licensed Programs display.
3. Select option **11** (Install licensed programs) on the Work with Licensed Programs display to see a list of licensed programs and optional parts of licensed programs.
4. Type **1** (Install) in the Option column next to 57xxTC1 (TCP/IP Connectivity Utilities for iSeries). Press **Enter**. The Confirm Licensed Programs to Install display shows the licensed program you selected to install. Press **Enter** to confirm.
5. Fill in the following choices on the Install Options display:

Installation device	Type Q0PT if installing from a CD-ROM device. Type TAP01 if installing from a tape drive.
Objects to install	This option allows you to install both programs and language objects, only programs, or only language objects.
Automatic restart	This option determines whether the system automatically starts when the installation process has completed successfully.

When TCP/IP Connectivity Utilities successfully installs, either the Work with Licensed Programs menu or the Sign On display appears.

6. Select option **50** (Display log for messages) to verify that you have installed the licensed program successfully.

If an error occurs, you will see the message `Work with licensed program function not complete` on the bottom of the Work with Licensed Programs display. Should a problem occur, try to re-install TCP/IP Connectivity Utilities. If the problem is not resolved, you may need to contact support.

### Note:

Other licensed programs that you may want to install include:

- iSeries Access for Windows 95/NT (5769–XD1 V3R1M3 or later) provides iSeries Navigator support that is used to configure some of the TCP/IP components.
- IBM HTTP Server for iSeries (57xx–DG1) provides Web server support.
- Some TCP/IP applications require installation of additional licensed programs. To find out which programs you need, review the setup instructions for the specific application you want.



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## Chapter 6. Configure TCP/IP

You may be configuring TCP/IP for the first time, or you may be changing an existing configuration to use the IPv6 function. This topic provides instructions for configuring TCP/IP in each of these situations. See the options below for instructions on how to configure TCP/IP on your server:

### Configure TCP/IP for the first time

Use these instructions if you are setting up a new server. You will establish a connection and configure TCP/IP for the first time.

### Configure IPv6

Use these instructions to configure your server for IPv6 function. You will benefit from the enhanced addressing capability and the robust features of this Internet Protocol. If you are unfamiliar with IPv6, see Internet Protocol version 6 (IPv6) for an overview. You must have TCP/IP configured on the server before you may configure IPv6.

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## Configure TCP/IP for the first time

Select one of the following methods for setting up TCP/IP on your new server:

### Configure TCP/IP using the EZ-Setup wizard

Use this preferred method if your PC is equipped to use the EZ-Setup wizard. The EZ-Setup wizard is packaged with your iSeries server.

### Configure TCP/IP using the character-based interface

Use this method if you are unable to use the EZ-Setup wizard. For example, if you want to use iSeries Navigator from a PC that requires basic TCP/IP configuration before iSeries Navigator will run, then you should use this method.

## Configure TCP/IP using the EZ-Setup wizard

iSeries Navigator is a graphical user interface that provides concise dialog boxes and wizards to configure TCP/IP. For initial setup, use the iSeries Navigator's EZ-Setup wizard to establish a connection and to configure TCP/IP for the first time. This is the preferred method for working with your server because the interface is easy to use. The CD-ROM containing the EZ-Setup wizard is packaged with your iSeries server.

To configure your server, follow these steps:


1. Use the EZ-Setup wizard. Access the wizard from the CD-ROM that is packaged with your server. Follow the wizard's instructions to configure TCP/IP.
2. Start TCP/IP
  - a. In iSeries Navigator, expand your **server** → **Network**.
  - b. Right-click **TCP/IP configuration** and select **Start**. All interfaces and servers that were set to start automatically when TCP/IP is started will be started at this time.

You have finished configuring TCP/IP on your server. Use iSeries Navigator to modify the configuration as your networking needs change. See *Customize TCP/IP with iSeries Navigator* to add routes and interfaces or *Configure IPv6* to use Internet Protocol version 6 on your network.

## Configure TCP/IP using the character-based interface

If you are unable to use the iSeries Navigator's EZ-Setup wizard, use the character-based interface instead. For example, if you want to use iSeries Navigator from a PC that requires basic TCP/IP configuration before iSeries Navigator will run, then you should use the character-based interface to perform the basic configuration.

| To perform the configuration steps discussed in this section, you need \*IOSYSCFG special authority in your user profile. For more information on this type of authority, see the chapter on user profiles in iSeries

| Security Reference  .

| To configure TCP/IP using the character-based interface, follow these steps:

- | 1. At the command line, type GO TCPADM to display the TCP/IP Administration menu, and press Enter.
- | 2. Specify option 1 (Configure TCP/IP) to display the Configure TCP/IP menu (CFGTCP), and press Enter. Use this menu to select configuration tasks. Take a few moments to review the menu before starting to configure your server.

| Perform the following steps to configure TCP/IP on your server.

- | 1. Configure a line description
- | 2. Configure an interface
- | 3. Configure a route
- | 4. Define local domain and host names
- | 5. Define a host table
- | 6. Start TCP/IP

### | **Configure a line description (Ethernet)**

| These instructions pertain to configuring TCP/IP over an Ethernet communications adapter. However, if you are using a different type of adapter, such as a token-ring, see TCP/IP Configuration and Reference, *Appendix A*, for a command specific to your adapter.

| To configure a line description, follow these steps:

- | 1. At the command line, type CRTLINETH to access the Create Line Desc (Ethernet) (CRTLINETH) menu, and press Enter.
- | 2. Specify your line name, and press Enter. (Use any name.)
- | 3. Specify your resource name, and press Enter.

#### | **What to do next:**

| Configure an interface

### | **Configure an interface**

| To configure an interface, follow these steps:

- | 1. At the command line, type CFGTCP to access the Configure TCP/IP menu, and press Enter.
- | 2. Select option 1 (Work with TCP/IP interfaces) on the Configure TCP/IP menu, and press Enter.
- | 3. Specify option 1 (Add) to show the Add TCP/IP Interface display, and press Enter.
- | 4. Specify the address value that you want to represent your iSeries server, the subnet mask address, and the line description name you previously defined, and then press Enter.

| To start the interface, specify option 9 (Start) for the interface you configured, and press Enter.

#### | **What to do next:**

| Configure a route

### | **Configure a route**

| To reach remote networks, at least one routing entry is required. If no routing entries are manually added, your server cannot reach systems that are not on the same network to which the server is attached. You must also add routing entries to allow TCP/IP clients that are attempting to reach your server from a remote network to function correctly.

| You should plan to have the routing table defined so that there is always an entry for at least one default route (\*DFTRROUTE). If there is no match on any other entry in the routing table, data is sent to the IP router specified by the first available default route entry.

| To configure a default route, follow these steps:

- | 1. Select option 2 (Work with TCP/IP Routes) on the Configure TCP/IP menu, and press Enter.
- | 2. Specify option 1 (Add) to go to the Add TCP/IP Route (ADDTCPRTE) display, and press Enter.
- | 3. Specify \*DFTRROUTE for the route destination, specify \*NONE for the subnet mask, specify the IP address for the next hop, and press Enter.

| **What to do next:**

| Define local domain and host names

| **Define local domain and host names**

| To define local domain and host names, follow these steps:

- | 1. Select option 12 (Change TCP/IP domain) from the Configure TCP/IP menu, and press Enter.
- | 2. Specify the names you selected to be your local host name and local domain name, leaving the other parameters at the default values, and press Enter.

| **What to do next:**

| Define a host table

| **Define a host table**

| To define a host table, follow these steps:

- | 1. Select option 10 (Work with TCP/IP Host Table Entries) from the Configure TCP/IP menu, and press Enter.
- | 2. Specify option 1 (Add) to go to the Add TCP/IP Host Table Entry display, and press Enter.
- | 3. Specify the IP address, the associated local host name and the fully qualified host name, and then press Enter.
- | 4. Specify a plus sign (+) to make space available for more than one host name, if necessary.
- | 5. Repeat these steps for each of the other hosts on the network to which you want to communicate with by name, and add an entry for each.

| **What to do next:**

| Start TCP/IP

| **Start TCP/IP**

| TCP/IP services are not available until you start TCP/IP.

| To start TCP/IP, type STRTCP at the command line.

| The Start TCP/IP (STRTCP) command initializes and activates TCP/IP processing, starts the TCP/IP interfaces, and starts the server jobs. Only TCP/IP interfaces and servers with AUTOSTART \*YES are started with the STRTCP command.

| You have finished configuring TCP/IP on your server. Use iSeries Navigator to modify the configuration as your networking needs change. See Customize TCP/IP with iSeries Navigator to add routes and interfaces or Configure IPv6 to use Internet Protocol version 6 on your network.

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## Configure IPv6

You are ready to take advantage of the next generation Internet by using IPv6 on your network. To use the IPv6 function, you need to change your TCP/IP configuration by configuring a line that is dedicated to IPv6. You must configure either a line on a 2838 or 2849 Ethernet adapter or on a configured tunnel line (virtual line). Read these topics for instructions on configuring IPv6:

### Setup requirements

This topic lists the hardware and software requirements for configuring the server for IPv6.

### Configure IPv6 using the IPv6 Configuration wizard

See instructions for using the **IPv6 Configuration** wizard to configure IPv6 on your server.

## Setup requirements

Determine which of these two types of IPv6 configurations is appropriate for your situation. If you are not sure which type to choose, see IPv6 scenarios for examples.

Meet these requirements to allow IPv6 to function on your server:

### For configuring an Ethernet line for IPv6:

- OS/400 Version 5 Release 2 or later
- iSeries Access for Windows and iSeries Navigator
  - Network component of iSeries Navigator
- 2838 or 2849 Ethernet adapter to be dedicated to IPv6.
- IPv6-capable router is required only if you want to send IPv6 traffic beyond the immediate LAN.
- TCP/IP (using IPv4) must be configured on a separate physical adapter because TCP/IP must be running on the server. If you have not configured your server for IPv4, see *Configure TCP/IP* for the first time before configuring the line for IPv4.

### For creating a configured tunnel line (TNLCFG64):

- OS/400 Version 5 Release 2 or later
- iSeries Access for Windows and iSeries Navigator
  - Network component of iSeries Navigator
- TCP/IP (using IPv4) must be configured on the server before you configure the tunnel line for IPv6. If you have not configured your server for IPv4, see *Configure TCP/IP* for the first time.

Go to *Configure IPv6* using the IPv6 Configuration wizard for directions on accessing the wizard.

## Configure IPv6 using the IPv6 Configuration wizard

To configure IPv6 on the server, you must change the server's configuration using the **IPv6 Configuration** wizard in iSeries Navigator. IPv6 may only be configured from iSeries Navigator, and may not be configured from the character-based interface.

**Note:** You may configure the IPv6 ethernet line description by using the Create Line Desc (Ethernet) CRTLINETH command in the character-based interface; however, you must specify the hexadecimal multicast group address 333300000001. Then, you must use the **IPv6 Configuration** wizard to finish configuring IPv6.

The wizard will require the following input:

### For configuring an Ethernet line for IPv6:

This configuration allows you to send IPv6 packets over an IPv6 local area network (LAN). The wizard requires the name of the hardware communications resource on the server on which you will configure



| IPv6; for example, CMN01. This must be either a 2838 or 2849 Ethernet adapter that is not currently  
| configured for IPv4. See *Create an IPv6 local area network (LAN)* for a scenario that shows a situation  
| in which you would configure an Ethernet line for IPv6.

| **For creating a configured tunnel line (TNLCFG64):**

| This type of configuration allows you to send IPv6 packets over IPv4 networks. The wizard requires the  
| IPv4 address for the local endpoint and the IPv6 address for the local interface associated with the  
| tunnel. See *Send IPv6 packets over an IPv4 local area network (LAN)* and *Send IPv6 packets over an*  
| *IPv4 wide area network (WAN)* for scenarios that show two situations in which you would create the  
| configured tunnel lines for IPv6.

| To use the **IPv6 Configuration** wizard, follow these steps:

- | 1. In iSeries Navigator, expand your **server** —> **Network** —> **TCP/IP Configuration**.
- | 2. Right-click **IPv6** and select **IPv6 Configuration**.
- | 3. Follow the wizard's instructions to configure IPv6 on your server.



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## Chapter 7. Customize TCP/IP with iSeries Navigator

Once you have configured TCP/IP, you may decide to customize your configuration. As your network grows, you may need to change properties, add interfaces, or add routes to your server. You may need to configure the server for IPv6 (Internet Protocol version 6) to use IPv6 applications. Use wizards in iSeries Navigator to quickly accomplish many of these tasks.

Choose any of the topics below to customize your configuration using iSeries Navigator. These topics provide a starting point for you to manage your TCP/IP configuration with iSeries Navigator.

- Change TCP/IP settings

- Configure IPv6

- Add IPv4 interfaces

- Add IPv6 interfaces

- Add IPv4 routes

- Add IPv6 routes

### Change TCP/IP settings

You can view and change your TCP/IP settings using iSeries Navigator. For instance, you may change properties for host or domain names, name server, host table entries, system attributes, port restrictions, servers, or client connections. You may change general properties or properties that are specific to either IPv4 or IPv6, such as transports.

To access the general TCP/IP property pages, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** .
2. Right-click **TCP/IP Configuration** and select **Properties** to open the **TCP/IP Properties** dialog.
3. Select the tabs at the top of the dialog to view and edit TCP/IP information.

To add and change host table entries, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** .
2. Right-click **TCP/IP Configuration** and select **Host Table** to open the **Host Table** dialog.
3. Use the **Host Table** dialog to add, edit, or remove host table entries.

To access property pages that are specific to IPv4, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** .
2. Right-click **IPv4** and select **Properties** to open the **IPv4 Properties** dialog.
3. Select the tabs at the top of the dialog to view and edit the IPv4 property settings.

To access property pages that are specific to IPv6, follow these steps:

1. In iSeries Navigator, select your **server** → **Network** .
2. Right-click **IPv6** and select **Properties** to open the **IPv6 Properties** dialog.
3. Select the tabs at the top of the dialog to view and edit the IPv6 property settings.

### Configure IPv6

If you are unfamiliar with IPv6, see Internet Protocol version 6 (IPv6) for an overview.

To configure IPv6, you must change the server's configuration by using the **IPv6 Configuration** wizard. Before using the wizard, see Configure IPv6 for instructions and special requirements.

## | **Add IPv4 interfaces**

| To create a new IPv4 interface, follow these steps:

- | 1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration** → **IPv4**.
- | 2. Right-click **Interfaces**, select **New Interface**, and select **Local Area Network**, **Wide Area Network**, or **Virtual IP** to create the appropriate type of IPv4 interface.
- | 3. Follow the wizard's instructions to create a new IPv4 interface.

## | **Add IPv6 interfaces**

| To create a new IPv6 interface, follow these steps:

- | 1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration** → **IPv6**.
- | 2. Right-click **Interfaces** and select **New Interface**.
- | 3. Follow the wizard's instructions to create a new IPv6 interface.

## | **Add IPv4 routes**

| Any changes that you make to the routing information take effect immediately.

| To configure a new IPv4 route, follow these steps:

- | 1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration** → **IPv4**.
- | 2. Right-click **Routes**, and select **New Route**.
- | 3. Follow the wizard's instructions to configure a new IPv4 route.

## | **Add IPv6 routes**

| Any changes that you make to the routing information take effect immediately.

| To configure a new IPv6 route, follow these steps:

- | 1. In iSeries Navigator, select your **server** → **Network** → **TCP/IP Configuration** → **IPv6**.
- | 2. Right-click **Routes**, and select **New Route**.
- | 3. Follow the wizard's instructions to configure a new IPv6 route.

## **Chapter 8. Troubleshoot IPv6**

- | If you have IPv6 configured on the server, you may use several of the same troubleshooting tools as you do for IPv4. For example, tools such as trace route and PING accept both the IPv4 and IPv6 address formats, so you may use them to test connections and routes for both types of networks. In addition, you may use the communications trace function to trace data on both IPv4 and IPv6 communications lines.
  
- | See TCP/IP troubleshooting for a general troubleshooting guide that provides techniques for solving problems related to IPv4 and IPv6.





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## Chapter 9. Related information for TCP/IP setup

Now that your server is up and running, you may ask yourself, "What more can I accomplish with my server?" Listed below are the manuals and IBM Redbooks™ (in PDF format) and Information Center topic that relate to the TCP/IP setup topic. You can view or print the PDFs. Use the following references to make the most of TCP/IP on your iSeries server:




### Manuals

- **TCP/IP Configuration and Reference**  (about 100 pages)  
This book provides information on configuring Transmission Control Protocol/Internet Protocol (TCP/IP) and operating and managing your network.
- **Tips and Tools for Securing your iSeries**  (about 254 pages)  
This book provides basic recommendations for using the security features of the iSeries to protect your server and its associated operations.

### Redbooks

- **TCP/IP Tutorial and Technical Overview**   
This redbook provides information on the basics of TCP/IP.
- **TCP/IP for AS/400: More Cool Things Than Ever**   
This redbook includes an extensive list of common TCP/IP applications and services.

### IPv6


- **The Internet Engineering Task Force (IETF)** (<http://www.ietf.cnri.reston.va.us/>)   
Learn about the group of individuals that develops Internet protocol, including IPv6.
- **IP Version 6 (IPv6)** (<http://playground.sun.com/pub/ipng/html/ipng-main.html>)   
Find current IPv6 specifications and references to several sources on IPv6.
- **IPv6 Forum** (<http://www.ipv6forum.com/>)   
Find news articles and events that communicate the latest IPv6 developments.

### Other information

- **TCP/IP**  
This topic contains information about TCP/IP applications and services beyond the scope of configuration.

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

1. Right-click the PDF in your browser (right-click the link above).
2. Click **Save Target As....**
3. Navigate to the directory in which you would like to save the PDF.
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