

# Configuring the Router

---

This chapter describes how to configure the routers and contains the following sections:

- Booting the Router for the First Time
- Configuring the Router for the First Time
- Cisco IOS Software Basics
- Configuring ISDN
- Verifying Network Connectivity
- Getting More Information

This chapter provides minimum software configuration information; it is not meant as comprehensive router configuration instructions. Detailed software configuration information is available in the Cisco IOS configuration guide and command reference publications. These publications are available on the documentation CD that came with your router or you can order printed copies. Refer to the section “Ordering Documentation” in the chapter “Overview of the Router” for ordering information.

# Booting the Router for the First Time

Each time you power on the router, it goes through the following boot sequence:

- 1 The router goes through power-on self-test diagnostics to verify basic operation of the CPU, memory, and interfaces.
- 2 The system bootstrap software (boot image) executes and searches for a valid Cisco IOS image (router operating system software). The source of the Cisco IOS image (Flash memory or a Trivial File Transfer Protocol [TFTP] server) is determined by the configuration register setting. The factory-default setting for the configuration register is 0x2102, which indicates that the router should attempt to load a Cisco IOS image from Flash memory.
- 3 If after five attempts a valid Cisco IOS image is not found in Flash memory, the router reverts to boot ROM mode (which is used to install or upgrade a Cisco IOS image).
- 4 If a valid Cisco IOS image is found, then the router searches for a valid configuration file.
- 5 If a valid configuration file is not found in NVRAM, the router runs the System Configuration Dialog so you can configure it manually. For normal router operation, there must be a valid Cisco IOS image in Flash memory and a configuration file in NVRAM.

The first time you boot your router, you will need to configure the router interfaces and then save the configuration to a file in NVRAM.

# Configuring the Router for the First Time

You can configure the router using one of the following procedures, which are described in this section:

- System Configuration Dialog—Recommended if you are not familiar with Cisco IOS commands.
- Configuration mode—Recommended if you are familiar with Cisco IOS commands.
- AutoInstall—Recommended for automatic installation if another router running Cisco IOS software is installed on the network. This configuration method must be set up by someone with experience using Cisco IOS software.



**Timesaver** Acquire the correct network addresses from your system administrator or consult your network plan to determine the correct addresses before you begin to configure the router.

Proceed with the procedure that best fits the needs of your network configuration and Cisco IOS software experience level. If you will be using configuration mode or AutoInstall to configure the router, and you would like a quick review of the Cisco IOS software, refer to the section “Cisco IOS Software Basics” later in this chapter. Otherwise, proceed with the next section “Using the System Configuration Dialog.”

## Using the System Configuration Dialog

If you do not plan to use AutoInstall, make sure all the WAN cables are disconnected from the router. This will prevent the router from attempting to run the AutoInstall process. The router will attempt to run AutoInstall whenever you power it ON if there is a WAN connection on both ends and the router does not have a configuration file stored in NVRAM. It can take several minutes for the router to determine that AutoInstall is not connected to a remote TCP/IP host.

If your router does not have a configuration (setup) file and you are not using AutoInstall, the router will automatically start the setup command facility. An interactive dialog called the System Configuration Dialog appears on the console screen. This dialog helps you navigate through the configuration process by prompting you for the configuration information necessary for the router to operate.

Many prompts in the System Configuration Dialog include default answers, which are included in square brackets following the question. To accept a default answer, press **Return**; otherwise, enter your response.

This section gives an example configuration using the System Configuration Dialog. When you are configuring your router, respond as appropriate for your network.

At any time during the System Configuration Dialog, you can request help by typing a question mark (?) at a prompt.

Before proceeding with the System Configuration Dialog, obtain from your system administrator the node addresses and the number of bits in the subnet field (if applicable) of the router ports.

## Configuring the Router for the First Time

---

Take the following steps to configure the router using the System Configuration Dialog:

- Step 1** Connect a console terminal to the console port on the rear panel of your router, and then power ON the router. (For more information, refer to the section “Connecting the Console Terminal and Modem” in the chapter “Installing the Router.”)

---

**Note** The default parameters for the console port are 9600 baud, 8 data bits, no parity, and 2 stop bits.

---

After about 30 seconds, information similar to the following is displayed on the console screen:

---

**Note** The messages displayed vary, depending on the interfaces on the rear panel of the router and the Cisco IOS release and feature set you selected. The screen displays in this section are for reference only and may not exactly reflect the screen displays on your console.

---

```
System Bootstrap, Version X.X(XXXX) [XXXXX XX], RELEASE SOFTWARE
Copyright (c) 1986-199X by Cisco Systems
2500 processor with 4096 Kbytes of main memory
```

```
Notice: NVRAM invalid, possibly due to write erase.
```

```
F3: 5797928+162396+258800 at 0x3000060
```

## Configuring the Router for the First Time

---

### Restricted Rights Legend

Use, duplication, or disclosure by the Government is subject to restrictions as set forth in subparagraph (c) of the Commercial Computer Software - Restricted Rights clause at FAR sec. 52.227-19 and subparagraph (c) (1) (ii) of the Rights in Technical Data and Computer Software clause at DFARS sec. 252.227-7013.

Cisco Systems, Inc.  
170 West Tasman Drive  
San Jose, California 95134-1706

Cisco Internetwork Operating System Software  
IOS (tm) X000 Software (XXX-X-X), Version XX.X(XXXX) [XXXXX XXX]  
Copyright (c) 1986-199X by Cisco Systems, Inc.  
Compiled Fri 20-Oct-9X 16:02 by XXXXX  
Image text-base: 0x03030FC0, data-base: 0x00001000  
Cisco 25XX (68030) processor (revision A) with 4092K/2048K bytes of  
memory.  
Processor board ID 00000000  
Bridging software.  
SuperLAT software copyright 1990 by Meridian Technology Corp).  
X.25 software, Version X.X, NET2, BFE and GOSIP compliant.  
TN3270 Emulation software (copyright 1994 by TGV Inc).  
Basic Rate ISDN software, Version X.X.  
X Ethernet/IEEE 802.3 interface.  
2 Serial network interfaces.  
1 ISDN Basic Rate interface.  
32K bytes of non-volatile configuration memory.  
8192K bytes of processor board System flash (Read ONLY)

Notice: NVRAM invalid, possibly due to write erase.  
--- System Configuration Dialog ---

At any point you may enter a question mark '?' for help.  
Refer to the 'Getting Started' Guide for additional help.  
Use ctrl-c to abort configuration dialog at any prompt.  
Default settings are in square brackets '['].  
Would you like to enter the initial configuration dialog? [yes]:

## Configuring the Router for the First Time

---

**Step 2** Press **Return** or enter **yes** to begin the configuration process.

**Step 3** When the System Configuration Dialog asks whether you want to view the current interface summary, press **Return** or enter **yes**:

```
First, would you like to see the current interface summary? [yes]:
```

```
Any interface listed with OK? value "NO" does not have a valid configuration
```

Interface	IP-Address	OK?	Method	Status	Protocol
Ethernet0	unassigned	NO	not set	up	down
BRI0	unassigned	NO	not set	up	up
Serial0	unassigned	NO	not set	down	down
Serial1	unassigned	NO	not set	down	down

**Step 4** Configure the global parameters. A typical configuration follows:

```
Configuring global parameters:
```

```
Enter host name [Router]:
```

Next, you are prompted to enter an enable secret password. There are two types of privileged-level passwords:

- Enable secret password (a very secure, encrypted password)
- Enable password (a less secure, nonencrypted password)

The enable password is used when the enable secret password does not exist.

For maximum security, be sure the passwords are different. If you enter the same password for both, the router will accept your entry, but will display a warning message indicating that you should enter a different password.

**Step 5** Enter an enable secret password:

```
The enable secret is a one-way cryptographic secret used instead of the enable password when it exists.
```

```
Enter enable secret: pail
```

```
The enable password is used when there is no enable secret and when using older software and some boot images.
```

**Step 6** Enter the enable and virtual terminal passwords:

```
Enter enable password: shovel  
Enter virtual terminal password: vterm1
```

**Step 7** Press **Return** to accept Simple Network Management Protocol (SNMP) management, or enter **no** to refuse it:

```
Configure SNMP Network Management? [yes]: no
```

**Step 8** In the following example, the router is configured for AppleTalk, Internet Protocol (IP), and Internetwork Packet Exchange (IPX). Configure the appropriate protocols for your router:

```
Configure Vines? [no]:  
Configure LAT? [no]:  
Configure AppleTalk? [no]: yes  
  Multizone networks? [no]: yes  
Configure DECnet? [no]:  
Configure IP? [yes]:  
  Configure IGRP routing? [yes]:  
    Your IGRP autonomous system number [1]: 15  
Configure CLNS? [no]:  
Configure bridging? [no]:  
Configure IPX? [no]: yes  
Configure XNS? [no]:  
Configure Apollo? [no]:
```

**Step 9** If your router includes an ISDN BRI port, enter the ISDN BRI switch type. The switch type appropriate for the router depends on the ISDN service provider's equipment. Table 4-1 lists the ISDN switch types.

```
Enter ISDN BRI Switch Type [none]: basic-5ess
```

## Configuring the Router for the First Time

---

**Table 4-1 ISDN Switch Types**

Country	ISDN Switch Type	Description
Australia	basic-ts013	Australian TS013 switches
Europe	basic-1tr6	German 1TR6 ISDN switches
	basic-nwnet3	Norwegian NET3 ISDN switches (phase 1)
	basic-net3	NET3 ISDN switches (UK and others)
	basic-net5	NET5 switches (UK and Europe)
	vn2	French VN2 ISDN switches
	vn3	French VN3 ISDN switches
Japan	ntt	Japanese NTT ISDN switches
New Zealand	basic-nznet3	New Zealand NET3 switches
North America	basic-5ess	AT&T basic rate switches
	basic-dms100	NT DMS-100 basic rate switches
	basic-ni1	National ISDN-1 switches

### Configuring the ISDN BRI Interface

This section describes how to configure the ISDN BRI interface. If your router does not include an ISDN BRI interface, proceed to the next section, “Configuring Ethernet or Token Ring Interfaces.”

The ISDN BRI interface is configured to allow connection to ISDN WANs. Determine which protocols to support on the ISDN BRI interface and enter the appropriate responses. In the following example, the system is configured for IP, AppleTalk, and IPX:

```
Configuring interface BRI0:
Is this interface in use? [yes]
Configure IP on this interface? [yes]
IP address for this interface: 172.16.71.1
Number of bits in subnet field [0]: 8
Class B network is 172.16.0.0, 8 subnet bits; mask is
255.255.255.0
```

```
Configure AppleTalk on this interface? [no]: yes
Extended AppleTalk network? [no]: yes
AppleTalk starting cable range [0]: 1
AppleTalk ending cable range [1]: 2
AppleTalk zone name [myzone]:
AppleTalk additional zone name: otherzone
AppleTalk additional zone name:
Configure IPX on this interface? [no]: yes
IPX network number [1]: B000
```

After you have completed the entire initial router configuration using the System Configuration Dialog, proceed to the section “Configuring ISDN,” later in this chapter, for additional ISDN configuration information.

### Configuring Ethernet or Token Ring Interfaces

The Ethernet and Token Ring interfaces are configured to allow connection to a LAN. To configure the interface parameters, you need to know your Ethernet or Token Ring interface network addresses.

Take the following steps to configure an Ethernet or Token Ring interface to allow communication over a LAN:

**Step 1** Press **Return** or enter **yes** to configure the LAN interface:

```
Configuring interface Ethernet0:
Is this interface in use? [yes]:
```

**Step 2** Determine which protocols you want to support on the LAN interface and enter the appropriate responses. In the following example, the system is configured for IP, AppleTalk, and IPX:

```
Configure IP on this interface? [yes]:
IP address for this interface: 172.16.72.1
Number of bits in subnet field [8]: 8
Class B network is 172.16.0.0, 8 subnet bits; mask is
255.255.255.0
```

## Configuring the Router for the First Time

---

```
Configure AppleTalk on this interface? [no]: yes
Extended AppleTalk network? [no]: yes
AppleTalk starting cable range [0]: 3
AppleTalk ending cable range [1]: 3
AppleTalk zone name [myzone]:
AppleTalk additional zone name: otherzone
AppleTalk additional zone name:
Configure IPX on this interface? [no]: yes
IPX network number [1]: B001
```

- Step 3** If there is more than one LAN interface on your router, repeat this procedure to configure the second LAN interface.

## Configuring the Synchronous Serial Interfaces

The synchronous serial interfaces are configured to allow connection to WANs. After the Ethernet or Token Ring port on your router has been configured, take the following steps to configure the synchronous serial interfaces:

- Step 1** Press **Return** or enter **yes** to configure serial port 0:

```
Configuring interface Serial0:
Is this interface in use? [yes]:
```

- Step 2** Determine which protocols you want on the synchronous serial interface and enter the appropriate responses. In the following example, the system is configured for IP, AppleTalk, and IPX:

```
Configure IP on this interface? [yes]:
Configure IP unnumbered on this interface? [no]:
IP address for this interface: 172.16.73.1
Number of bits in subnet field [8]:
Class B network is 172.16.0.0, 8 subnet bits; mask is
255.255.255.0
Configure AppleTalk on this interface? [no]: yes
Extended AppleTalk network? [yes]:
AppleTalk starting cable range [2]: 4
AppleTalk ending cable range [3]: 4
AppleTalk zone name [myzone]: ZZ Serial
AppleTalk additional zone name:
Configure IPX on this interface? [no]: yes
IPX network number [2]: B002
```

**Step 3** Configure the second synchronous serial interface, for example, as follows:

```
Configuring interface Serial1:
Is this interface in use? [yes]:
Configure IP on this interface? [yes]:
Configure IP unnumbered on this interface? [no]:
  IP address for this interface: 172.16.74.2
  Number of bits in subnet field [8]:
  Class B network is 172.16.0.0, 8 subnet bits; mask is
  255.255.255.0
Configure AppleTalk on this interface? [no]: yes
  AppleTalk starting cable range [3]: 5
  AppleTalk ending cable range [4]: 5
  AppleTalk zone name [myzone]: ZZ Serial
  AppleTalk additional zone name:
Configure IPX on this interface? [no]: yes
  IPX network number [3]: B003
```

**Step 4** The configuration you entered is now displayed and you are asked if you want to use the displayed configuration. If you enter **no**, you will lose the configuration information you just entered and you can begin the configuration again. If you enter **yes**, the configuration will be entered and saved in the startup configuration:

```
Use this configuration? [yes/no]: yes
Building configuration...
Use the enabled mode 'configure' command to modify this
configuration.
```

Press RETURN to get started!

Proceed to the section “Cisco IOS Software Basics” for more information about the Cisco IOS software.

### Using Configuration Mode

You can configure the router manually if you do not want to use AutoInstall or the prompt-driven System Configuration Dialog. Take the following steps to configure the router manually:

**Step 1** Connect a console terminal following the instructions in the section “Connecting the Console Terminal and Modem” in the chapter “Installing the Router,” and then power ON the router.

**Step 2** When you are prompted to enter the initial dialog, enter **no** to go into the normal operating mode of the router:

```
Would you like to enter the initial dialog? [yes]: no
```

**Step 3** After a few seconds you will see the user EXEC prompt (Router>). Enter the **enable** command to enter privileged EXEC mode. You can only make configuration changes in privileged EXEC mode:

```
Router> enable
```

The prompt changes to the privileged EXEC prompt:

```
Router#
```

**Step 4** Enter the **configure terminal** command at the privileged EXEC prompt to enter configuration mode:

```
Router# configure terminal
```

You can now enter any changes you want to the configuration. You will probably want to perform the following tasks:

- (a) Assign a host name for the router using the **hostname** command.
- (b) Enter an enable secret password using the **enable password** command.
- (c) Assign addresses to the interfaces using the *protocol* **address** command.
- (d) Specify which protocols to support on the interfaces.

Refer to the Cisco IOS configuration guide and command reference publications for more information about the commands you can use to configure the router.

**Step 5** When you are finished configuring the router, enter the **exit** command until you return to the privileged EXEC prompt (Router#).

**Step 6** To save the configuration changes to NVRAM, enter the **copy running-config startup-config** command at the privileged EXEC prompt.

```
Router# copy running-config startup-config
*****
```

The router will now boot with the configuration you entered.

## Using AutoInstall

The AutoInstall process is designed to configure the router automatically after connection to your WAN. In order for AutoInstall to work properly, a Transmission Control Protocol/Internet Protocol (TCP/IP) host on your network must be preconfigured to provide the required configuration files. The TCP/IP host may exist anywhere on the network as long as the following two conditions are maintained:

- 1 The host must be on the remote side of the router's synchronous serial connection to the WAN.
- 2 User Datagram Protocol (UDP) broadcasts to and from the router and the TCP/IP host must be enabled.

This functionality is coordinated by your system administrator at the site where the TCP/IP host is located. You should not attempt to use AutoInstall unless the required files have been provided on the TCP/IP host. For more information, refer to the Cisco IOS configuration guide and command reference publications.

Take the following steps to prepare your router for the AutoInstall process:

**Step 1** Attach the WAN cable to the router.

**Step 2** Power ON the router.

The router will load the operating system image from Flash memory. If the remote end of the WAN connection is connected and properly configured, the AutoInstall process will begin.

- Step 3** If AutoInstall completes successfully, enter the **copy running-config startup-config** command in privileged EXEC mode to write the configuration data to the router's NVRAM:

```
Router# copy running-config startup-config
```

Taking this step saves the configuration settings that the AutoInstall process created to the router's NVRAM. If you do not do this, the configuration will be lost the next time you reload the router.

## Cisco IOS Software Basics

This section provides you with some basic information about the Cisco IOS software and includes the following sections:

- Cisco IOS Modes of Operation
- Getting Context-Sensitive Help
- Saving Configuration Changes

### Cisco IOS Modes of Operation

The Cisco IOS software provides access to several different command modes. Each command mode provides a different group of related commands.

For security purposes, the Cisco IOS software provides two levels of access to commands: user and privileged. The unprivileged user mode is called user EXEC mode. The privileged mode is called privileged EXEC mode and requires a password. The commands available in user EXEC mode are a subset of the commands available in privileged EXEC mode.

Table 4-2 describes some of the most commonly used modes, how to enter the modes, and the resulting prompts. The prompt helps you identify which mode you are in and, therefore, which commands are available to you.

Table 4-2 Cisco IOS Operating Modes

Mode of Operation	Usage	How to Enter the Mode	Prompt
User EXEC	User EXEC commands allow you to connect to remote devices, change terminal settings on a temporary basis, perform basic tests, and list system information. The EXEC commands available at the user level are a subset of those available at the privileged level.	Log in.	Router>
Privileged EXEC	Privileged EXEC commands set operating parameters. The privileged command set includes those commands contained in user EXEC mode, and also the <b>configure</b> command through which you can access the remaining command modes. Privileged EXEC mode also includes high-level testing commands, such as <b>debug</b> .	From user EXEC mode, enter the <b>enable</b> EXEC command.	Router#
Global configuration	Global configuration commands apply to features that affect the system as a whole.	From global configuration mode, enter the <b>configure</b> privileged EXEC command.	Router(config)#

Table 4-2 Cisco IOS Operating Modes (Continued)

Mode of Operation	Usage	How to Enter the Mode	Prompt
Interface configuration	Interface configuration commands modify the operation of an interface such as an Ethernet, Token Ring, or serial port. Many features are enabled on a per-interface basis. Interface configuration commands always follow an interface global configuration command, which defines the interface type.	From global configuration mode, enter the <b>interface</b> <i>type number</i> command. For example, enter the <b>interface serial 0</b> command to configure the serial 0 interface.	Router(config-if)#
ROM monitor	ROM monitor commands are used to perform low-level diagnostics. You can also use the ROM monitor commands to recover from a system failure and stop the boot process in a specific operating environment. <sup>1</sup>	From privileged EXEC mode, enter the <b>reload</b> EXEC command. Press Break during the first 60 seconds while the system is booting.	>

1. You can modify the configuration register value using the **config-reg** configuration command. Refer to the Cisco IOS configuration guide for more information.

Almost every configuration command also has a no form. In general, use the no form to disable a feature or function. Use the command without the keyword **no** to reenable a disabled feature or to enable a feature that is disabled by default. For example, IP routing is enabled by default. To disable IP routing, enter the **no ip routing** command and enter **ip routing** to reenable it. The Cisco IOS software command reference publication provides the complete syntax for the configuration commands and describes what the no form of a command does.

## Getting Context-Sensitive Help

In any command mode, you can get a list of available commands by entering a question mark (?).

```
Router> ?
```

To obtain a list of commands that begin with a particular character sequence, type in those characters followed immediately by the question mark (?). Do not include a space. This form of help is called word help, because it completes a word for you.

```
Router# co?  
configure connect copy
```

To list keywords or arguments, enter a question mark in place of a keyword or argument. Include a space before the question mark. This form of help is called command syntax help because it reminds you which keywords or arguments are applicable based on the command, keywords, and arguments you have already entered.

```
Router# configure ?  
memory      Configure from NV memory  
network     Configure from a TFTP network host  
terminal    Configure from the terminal  
<cr>
```

You can also abbreviate commands and keywords by entering just enough characters to make the command unique from other commands. For example, you can abbreviate the **show** command to **sh**.

## Saving Configuration Changes

Any time you make changes to the router configuration, you must save the changes to memory because if you do not they will be lost if there is a system reload or power outage. There are two types of configuration files: the running (current operating) configuration and the startup configuration. The running configuration is stored in RAM; the startup configuration is stored in NVRAM.

## Configuring ISDN

---

To display the current running configuration, enter the **show running-config** command. Enter the **copy running-config startup-config** command to save the current running configuration to the startup configuration file in NVRAM.

```
Router> enable
Router# copy running-config startup-config
```

To display the startup configuration, enter the **show startup-config** command. Enter the **copy startup-config running-config** command to write the startup configuration to the running configuration:

```
Router> enable
Router# copy startup-config running-config
```

To erase both configuration files (and start over), enter the **write erase** and **reload** commands:

```
Router> enable
Router# write erase
Router# reload
```



**Caution** This command sequence will erase the entire router configuration in RAM and NVRAM and reload the router.

## Configuring ISDN

This section describes a typical ISDN configuration for one or two B channels. In the examples that follow, the BRI port is configured for IP routing, Challenge Handshake Authentication Protocol (CHAP), and Point-to-Point Protocol (PPP) encapsulation.

For your reference, an example configuration follows in the next section, “Example ISDN Configuration.” You may want to refer to it during this procedure.

Take the following steps to configure the router for a basic ISDN PPP connection on a single B channel or two B channels, substituting the correct addresses and host names as appropriate for your network:

**Step 1** Enter privileged EXEC mode:

```
Router> enable  
password: enablepassword
```

**Step 2** Enter the **configure terminal** command to enter global configuration mode. Then enter the host name of the current router, the user name of the target router (the router to which packets will be sent), and the password that the routers will use for CHAP caller identification. The user name and password are case sensitive and must match the host name and password of the target router (even if it is not a Cisco router):

```
Router# configure terminal  
Router (config)# hostname currentrouter  
Router (config)# username targetrouter password abc
```

**Step 3** Enter the **isdn switch-type** command to configure the ISDN switch type (such as basic-5ess, basic-dms100, or basic-ni1). Refer to Table 4-1, earlier in this chapter, for a list of ISDN switch types supported.

```
Router (config)# isdn switch-type switch-type
```

**Step 4** Configure the IP address and subnet mask for the LAN interface:

```
Router (config)# interface type port_number  
Router (config-if)# ip address ipaddress subnetmask
```

**Step 5** Configure the IP address and subnet mask for the BRI interface:

```
Router (config-if)# interface bri port_number  
Router (config-if)# ip address ipaddress subnetmask
```

## Configuring ISDN

---

- Step 6** If you are using an ISDN switch type (such as Basic NI1 or DMS-100) that requires a service profile identifier (SPID), enter the SPID and optional local directory number (LDN). The SPID and LDN are assigned by the ISDN service provider.

The SPID is a number that identifies the service to which you have subscribed. A SPID is not required for AT&T 5ESS service configured for a point-to-point connection.

The LDN is an optional seven-digit phone number for the channel.

```
Router (config-if)# isdn spid1 SPID_no [LDN]
Router (config-if)# isdn spid2 SPID_no [LDN]
```

- Step 7** Configure the router for PPP encapsulation and CHAP authentication:

```
Router (config-if)# encapsulation ppp
Router (config-if)# ppp authentication chap
```

- Step 8** Enter the **load-threshold** or **ppp multilink** command to set up a second B channel.

For bandwidth on demand, enter the **load-threshold** command to set the ISDN load threshold. The load threshold determines the percentage of network load at which the second ISDN B channel is activated. The value ranges from 1 to 255 (100 percent). In the following example, the value of 128 means that when the first B channel reaches 50 percent of its bandwidth capacity (128 equals 50 percent of 255), the second B channel will activate to assist with the bandwidth load:

```
Router (config-if)# dialer load-threshold 128
```

Alternatively, you can use Multilink PPP to activate a second ISDN line. For Multilink PPP to work, the router must be running Cisco IOS Release 11.0(3) or a later release, and both the current router and target router must support Multilink PPP:

```
Router (config-if)# ppp multilink
```

- Step 9** Enter the **dialer map** command to provide the information necessary to successfully route packets to the target router. Do not use periods or hyphens when entering the number to dial:
- ```
Router (config-if)# dialer map protocol targetBRIport_ipaddress
name targetrouter_number
```
- Step 10** Enter the **dialer-group** command to specify the number of the group permitted to access the router:
- ```
Router (config-if)# dialer-group groupnumber
```
- Step 11** Enter the **exit** command to exit interface configuration mode.
- Step 12** Enter the **dialer list** command to specify the groups and protocols permitted to access the router:
- ```
Router (config)# dialer-list groupnumber protocol protocol_type
permit
```
- Step 13** Configure a static route to allow connection to the target router's LAN. Enter the IP address and subnet mask of the target router's LAN interface, and the IP address of the target router's BRI port:
- ```
Router (config)# ip route targetrouter_ipnetwork subnetmask
targetBRIport_ipaddress
```
- Step 14** Enter the **exit** command to exit global configuration mode.
- Step 15** Enter the **copy running-config startup-config** command to save the configuration to NVRAM.

## Example ISDN Configuration

For your reference, Table 4-3 shows an example configuration for two Cisco routers using IP over ISDN. In the example, the current router (branch1) is at a remote site and the target router (main1) is at a central site.

## Configuring ISDN

---

Table 4-3 Example ISDN Configuration

Configuration for the Current Router	Configuration for the Target Router
<pre>Router&gt; enable password: pail1 Router# config term Router (config)# hostname branch1 branch1 (config)# username main1 password secret1 branch1 (config)# isdn switch-type basic-dms100 branch1 (config)# interface Ethernet 0 branch1 (config)# ip address 172.16.80.170 255.255.255.0 branch1 (config-if)# interface bri 0 branch1 (config-if)# ip address 172.16.71.1 255.255.255.0 branch1 (config-if)# isdn spid1 415988488501 9884885 branch1 (config-if)# isdn spid2 415988488602 9884886 branch1 (config-if)# dialer load-threshold 128 branch1 (config-if)# ppp multilink branch1 (config-if)# encapsulation ppp branch1 (config-if)# ppp authentication chap branch1 (config-if)# dialer map ip 172.16.71.2 name main1 9884883 branch1 (config-if)# dialer group 1 branch1 (config-if)# exit branch1 (config)# dialer-list 1 protocol ip permit branch1 (config-if)# ip route 172.16.0.0 255.255.0.0 172.16.71.2 branch1 (config-if)# ip route 0.0.0.0 172.16.71.2 branch1 (config)# exit branch1# copy running-config startup-config branch1#</pre>	<pre>Router&gt; enable password: pail2 Router# config term Router (config)# hostname main1 main1 (config)# username branch1 password secret1 main1 (config)# isdn switch-type basic-dms100 main1 (config)# interface Ethernet 0 main1 (config)# ip address 172.16.64.190 255.255.255.0 main1 (config-if)# interface bri 0 main1 (config-if)# ip address 172.16.71.2 255.255.255.0 main1 (config-if)# isdn spid1 415988488201 9884882 main1 (config-if)# isdn spid2 415988488302 9884883 main1 (config-if)# dialer load-threshold 128 main1 (config-if)# ppp multilink main1 (config-if)# encapsulation ppp main1 (config-if)# ppp authentication chap main1 (config-if)# dialer map ip 172.16.71.1 name branch1 9884885 main1 (config-if)# dialer group 1 main1 (config-if)# exit main1 (config)# dialer-list 1 protocol ip permit main1 (config-if)# ip route 172.16.80.0 255.255.0.0 172.16.71.1 main1 (config)# exit main1# copy running-config startup-config main1#</pre>

## Verifying Network Connectivity

After you have installed and configured the router, you can use the following commands in user EXEC mode to verify network connectivity:

- **telnet**—Logs in to a remote node
- **ping**—Sends a special datagram to the destination device, then waits for a reply datagram from that device
- **trace**—Discovers the routes that packets take when traveling from one router to another

If there is a problem with network connectivity, refer to the section “Reading the LEDs” in the appendix “Troubleshooting the Router” and check the cable connections. If there is still a problem, check the router configuration.

## Getting More Information

For more information about router software configuration, refer to the Cisco IOS configuration guide and command reference publications. These publications are available on the documentation CD that accompanied your router or you can order printed copies. Refer to the section “Ordering Documentation” in the “Overview of the Router” chapter for ordering information.

## Getting More Information

---