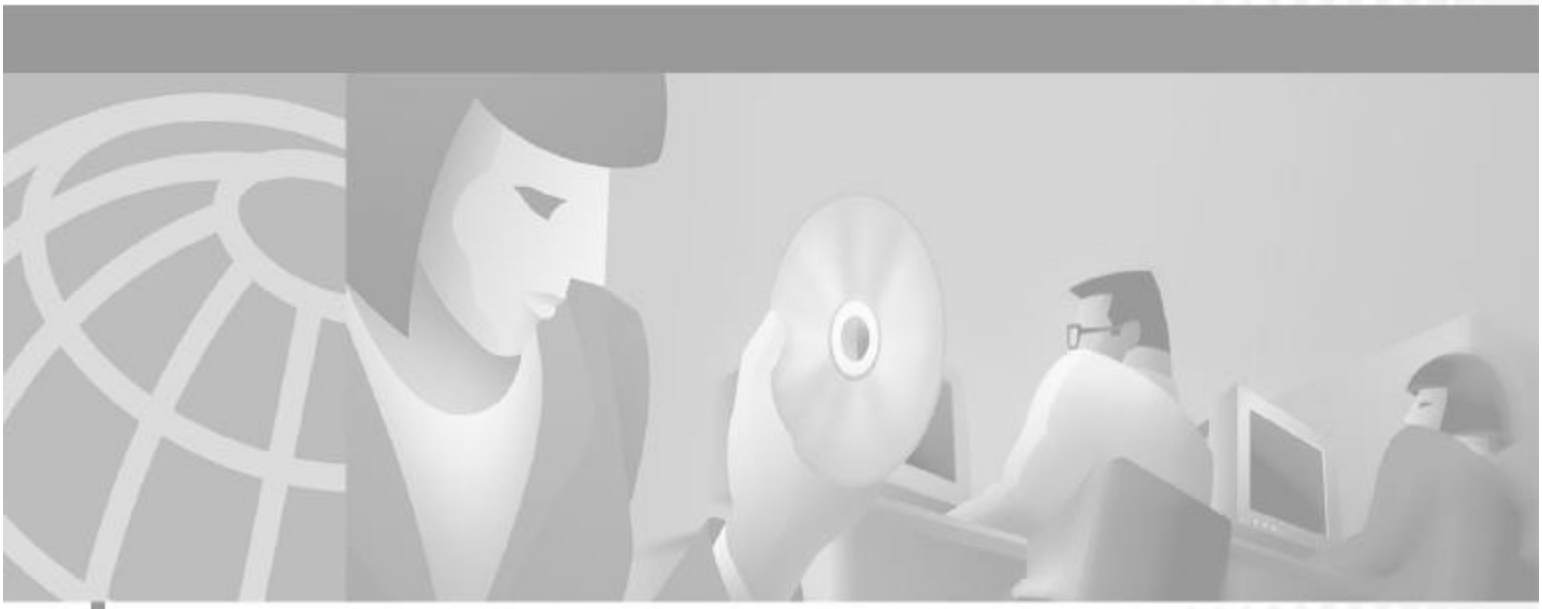


Software Configuration Guide

For Cisco 2600 Series, Cisco 3600 Series, and Cisco 3700 Series Routers

Corporate Headquarters
Cisco Systems, Inc.
170 West Tasman Drive
San Jose, CA 95134-1706
USA
http://www.cisco.com
Tel: 408 526-4000
800 553-NETS (6387)
Fax: 408 526-4100

Text Part Number: OL-1957-04

Preface

This preface discusses the objectives, audience, organization, and conventions of this software configuration guide, and where to get the latest version of this guide.

Objectives

After installing the router, use this guide to complete a basic router configuration using the **setup** command facility. It also contains information on using the Cisco IOS software to perform other configuration tasks, such as configuring a Voice-over-IP interface and other features.

This guide does not provide complete configuration instructions. Refer to the Cisco IOS configuration guides and command references for detailed configuration instructions. These publications are available on the Documentation CD-ROM that came with your router and on Cisco.com. See the "Obtaining Documentation" section on page xvi for more information.

Audience

This publication is designed for the person who will be responsible for configuring your router. This guide is intended primarily for the following audiences:

- Customers with technical networking background and experience
- System administrators who are familiar with the fundamentals of router-based internetworking, but who might not be familiar with Cisco IOS software
- System administrators who are responsible for installing and configuring internetworking equipment, and who are familiar with Cisco IOS software

Organization

The major sections of this software configuration guide include:

Chapter	Title	Description
Chapter 1	Understanding Interface Numbering and Cisco IOS Software Basics	Provides an overview of the interface numbering conventions for the Cisco routers. Also provides a basic understanding of the Cisco IOS software.
Chapter 2	Using the Setup Command Facility	Describes how to use the **setup** command facility to configure your router.
Chapter 3	Configuring with the Command-Line Interface	Describes how to use the Cisco IOS software command-line interface (CLI) to configure basic router functionality.
Chapter 4	Configuring Voice-over-IP	Describes how to configure voice network modules with recEive and transMit (E&M), Foreign Exchange Office (FXO), and Foreign Exchange Station (FXS) interfaces for your router.
Appendix A	Configuration Examples	Provides configuration examples of the Cisco 2600 series, Cisco 3600 series, and Cisco 3700 series routers.
Appendix B	Appendix B, "Formatting the Compact Flash Memory Cards"	Provides configuration information for the Cisco Flash memory.
Appendix C	Appendix C, "Using the ROM Monitor"	Describer how the ROM Monitor works in the Cisco 2600 series, Cisco 3600 series, and Cisco 3700 series routers.

Document Conventions

This publication uses the following conventions to convey instructions and information:

Convention	Description
boldface font	Commands and keywords.
italic font	Variables for which you supply values.
[ ]	Keywords or arguments that appear within square brackets are optional.
{*x* | *y* | *z*}	A choice of required keywords appears in braces separated by vertical bars. You must select one.
`screen font`	Examples of information displayed on the screen.
`boldface screen font`	Examples of information you must enter.
< >	Nonprinting characters, for example passwords, appear in angle brackets in contexts where italic font is not available.
[ ]	Default responses to system prompts appear in square brackets.

Note This symbol means *reader take note*. Notes contain helpful suggestions or references to additional information and material.

Timesaver This symbol means *the described action saves time*. You can save time by performing the action described in the paragraph.

Caution This symbol means *reader be careful*. In this situation, you might do something that could result in equipment damage or loss of data.

Tip This symbol means *the following information will help you solve a problem*. The tips information might not be troubleshooting or even an action, but could be useful information, similar to a Timesaver.

Additional Information

This guide does not contain the following:

- Network design information
- Application case studies
- Troubleshooting information
- A comprehensive reference to access services

For l information about any of the above topics, refer to the following resources:

- Cisco.com
- Documentation CD-ROM
- Cisco Technical Assistance Center (TAC)

Related and Referenced Documents

The documents described here are available online and on the documentation CD-ROM that you received with your router. To be sure of obtaining the latest information, you should access the online documentation.

To print a document in its original page format, access the online document, and click on the PDF icon.

You can also order printed copies of documents. See the Ordering Documentation.

To Access Online User Documentation (PDF and HTML Formats):

From Cisco.com at **http://www.cisco.com**, under **Service & Support**, select **Technical Documents** and select **Cisco Product Documentation**.

Access User Documentation on the Documentation CD-ROM (HTML format only):

On the Documentation CD-ROM, select **Cisco Product Documentation**.

Paths to specific documents are provided below, starting at **Cisco Product Documentation**.

Tip To navigate up to the next higher level in the documentation hierarchy, click on **CONTENTS** in the navigation bar at the top of each page.

Table 1 Related and Referenced Documents

Cisco Product	Document Title
Cisco 2600 series routers	• *Cisco 2600 Series Routers Hardware Installation Guide* • *Cisco 2600 Series Modular Routers Quick Access Guide* • *Cisco Network Modules Hardware Installation Guide* • *Cisco WAN Interface Cards Hardware Installation Guide* • *Regulatory Compliance and Safety Information*
Cisco 3600 series routers	• *Cisco 3600 Series Routers Hardware Installation Guide* • *Cisco 3620 and Cisco 3640 Modular Access Routers Quick Start Guide* • *Cisco 3660 Modular Access Router Quick Start Guide* • *Cisco Network Modules Hardware Installation Guide* • *Cisco WAN Interface Cards Hardware Installation Guide* • *Cisco RPS Hardware Installation Guide* • *Regulatory Compliance and Safety Information*

Table 1 Related and Referenced Documents (continued)

Cisco Product	Document Title
Cisco 3700 series routers	• *Cisco 3700 Series Routers Hardware Installation Guide* • *Cisco 3725 and Cisco 3745 Modular Access Routers Quick Start Guide* • *Cisco Network Modules Hardware Installation Guide* • *Cisco WAN Interface Cards Hardware Installation Guide* • *Regulatory Compliance and Safety Information*
Cisco IOS software **Note** Refer to the modular reference publication that corresponds to the Cisco IOS software release installed on your server.	• *Cisco IOS Configuration Fundamentals Configuration Guide* • *Cisco IOS Configuration Fundamentals Command Reference* • *Cisco IOS Dial Technologies Configuration Guide* • *Cisco IOS Wide-Area Networking Configuration Guide* • *Cisco IOS IP Configuration Guide* Release 12.2 • *Cisco IOS Wide-Area Networking Command Reference* • *Debug Command Reference* • *System Error Messages* • *Cisco IOS Software Command Summary* • *Cisco IOS Release notes* for your release

Table 1 Related and Referenced Documents (continued)

Cisco Product	Document Title
Other documents	• Information about TL1 commands can be found in the Telcordia Technology (formerly Bellcore) document *Network Maintenance: Network Element and Transport Surveillance Messages*, GR-833-CORE, Issue 5, November 1996. For a reference of security-related commands (ACT-USER and CANC-USER) refer to Telcordia Technology's *Operations Applications Messages-Network Element and Network System Security Admin Messages*, TR-NWT-000835, Issue 2, January 1993. • Information about the PRI network module, refer to the *1-Port and 2-Port ISDN-PRI Network Module Configuration Note*. For information on how to install an Ethernet module, refer to the *1-Port Ethernet Network Module Configuration Note* or the *4-Port Ethernet Network Module Configuration Note*. • For information on how to correctly install and configure the Digital Network module and the PRI module, refer to the *Digital Modem Network Module Configuration Note*. • To configure the router for voice traffic, refer to the *Voice over IP Configuration* document • To configure DLAMs, refer to the *Configuration Guide for DSLAs with NI-2*.

Obtaining Documentation

The following sections provide sources for obtaining documentation from Cisco Systems.

World Wide Web

You can access the most current Cisco documentation on the World Wide Web at the following sites:

- http://www.cisco.com
- http://www-china.cisco.com
- http://www-europe.cisco.com

Documentation CD-ROM

Cisco documentation and additional literature are available in a CD-ROM package, which ships with your product. The Documentation CD-ROM is updated monthly and may be more current than printed documentation. The CD-ROM package is available as a single unit or as an annual subscription.

Ordering Documentation

Cisco documentation is available in the following ways:

- Registered Cisco Direct Customers can order Cisco Product documentation from the Networking Products MarketPlace:

  http://www.cisco.com/cgi-bin/order/order_root.pl

- Registered Cisco.com users can order the Documentation CD-ROM through the online Subscription Store:

  http://www.cisco.com/go/subscription

- Nonregistered Cisco.com users can order documentation through a local account representative by calling Cisco corporate headquarters (California, USA) at 408 526-7208 or, in North America, by calling 800 553-NETS(6387).

Documentation Feedback

If you are reading Cisco product documentation on the World Wide Web, you can submit technical comments electronically. Click **Feedback** in the toolbar and select **Documentation**. After you complete the form, click **Submit** to send it to Cisco.

You can e-mail your comments to bug-doc@cisco.com.

To submit your comments by mail, for your convenience many documents contain a response card behind the front cover. Otherwise, you can mail your comments to the following address:

Cisco Systems, Inc.
Document Resource Connection
170 West Tasman Drive
San Jose, CA 95134-9883

We appreciate your comments.

Obtaining Technical Assistance

Cisco provides Cisco.com as a starting point for all technical assistance. Customers and partners can obtain documentation, troubleshooting tips, and sample configurations from online tools. For Cisco.com registered users, additional troubleshooting tools are available from the TAC website.

Cisco.com

Cisco.com is the foundation of a suite of interactive, networked services that provides immediate, open access to Cisco information and resources at anytime, from anywhere in the world. This highly integrated Internet application is a powerful, easy-to-use tool for doing business with Cisco.

Cisco.com provides a broad range of features and services to help customers and partners streamline business processes and improve productivity. Through Cisco.com, you can find information about Cisco and our networking solutions, services, and programs. In addition, you can resolve technical issues with online technical support, download and test software packages, and order Cisco learning materials and merchandise. Valuable online skill assessment, training, and certification programs are also available.

Customers and partners can self-register on Cisco.com to obtain additional personalized information and services. Registered users can order products, check on the status of an order, access technical support, and view benefits specific to their relationships with Cisco.

To access Cisco.com, go to the following website:

http://www.cisco.com

Technical Assistance Center

The Cisco TAC website is available to all customers who need technical assistance with a Cisco product or technology that is under warranty or covered by a maintenance contract.

Contacting TAC by Using the Cisco TAC Website

If you have a priority level 3 (P3) or priority level 4 (P4) problem, contact TAC by going to the TAC website:

http://www.cisco.com/tac

P3 and P4 level problems are defined as follows:

- P3—Your network performance is degraded. Network functionality is noticeably impaired, but most business operations continue.
- P4—You need information or assistance on Cisco product capabilities, product installation, or basic product configuration.

In each of the above cases, use the Cisco TAC website to quickly find answers to your questions.

To register for Cisco.com, go to the following website:

http://www.cisco.com/register/

If you cannot resolve your technical issue by using the TAC online resources, Cisco.com registered users can open a case online by using the TAC Case Open tool at the following website:

http://www.cisco.com/tac/caseopen

Contacting TAC by Telephone

If you have a priority level 1(P1) or priority level 2 (P2) problem, contact TAC by telephone and immediately open a case. To obtain a directory of toll-free numbers for your country, go to the following website:

http://www.cisco.com/warp/public/687/Directory/DirTAC.shtml

P1 and P2 level problems are defined as follows:

- P1—Your production network is down, causing a critical impact to business operations if service is not restored quickly. No workaround is available.
- P2—Your production network is severely degraded, affecting significant aspects of your business operations. No workaround is available.

Understanding Interface Numbering and Cisco IOS Software Basics

This chapter provides an overview of the interface numbering in the Cisco 2600 series, Cisco 3600 series, and Cisco 3700 series routers. It also describes how to use the Cisco IOS software commands.

Understanding Interface Numbering

This section contains information with which you should be familiar before you begin to configure your router for the first time, including interface numbering and what you should do before starting your router.

Cisco 2600 Series Interface Numbering

Each network interface on a Cisco 2600 series router is identified by a slot number and a unit number. Table 1-1 lists the router models and summarizes the interfaces supported on each model that are available in the Cisco 2600 series routers

Table 1-1 Router Models

Model	Ethernet (10BASE-T)	Token-Ring (RJ-45)	Fast Ethernet (10/100)	Network Module Slot	WAN Interface Card Slots	Advanced Integration Module Slots
Cisco 2610	1			1	2	1
Cisco 2610XM			1	1	2	1
Cisco 2611	2			1	2	1
Cisco 2611XM			2	1	2	1
Cisco 2612	1	1		1	2	1
Cisco 2613		1		1	2	1
Cisco 2620			1	1	2	1
Cisco 2620XM			1	1	2	1
Cisco 2621			2	1	2	1
Cisco 2621XM			2	1	2	1
Cisco 2650			1	1	2	1
Cisco 2650XM			1	1	2	1
Cisco 2651			2	1	2	1
Cisco 2651XM			2	1	2	1
Cisco 2691			2	1	3	2

Note The number and type of interfaces vary depending on the router.

WAN and LAN Interface Numbering

The Cisco 2600 series router chassis contains the following wide-area network (WAN) and local-area network (LAN) interface types:

- Built-in LAN interfaces: Ethernet, FastEthernet, Token Ring
- Two or three slots in which you can install WAN interface cards (WICs)
- One slot in which you can install a network module

The numbering format is *Interface-type Slot-number*/*Interface-number*. Two examples are:

```
Ethernet 0/0
Serial 1/2
```

The slot number is 0 for all built-in interfaces and 0 for all WIC interfaces; the slot number is 1 for network module interfaces.

Interface (port) numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top.

Figure 1-1 below shows a router of 1 RU height with:

- A WIC in each WIC slot (containing interface Serial 0/0 in physical slot W0, and interface Serial 0/1 in physical slot W1)
- A 4-serial-port network module in slot 1 (containing the following ports: Serial 1/0, Serial 1/1, Serial 1/2, and Serial 1/3)
- First built-in Ethernet interface—Ethernet 0/0
- Second built-in Ethernet interface—Ethernet 0/1, or optionally in Cisco 2612 and Cisco 2613 only: Token Ring interface 0/0

Figure 1-1 Example of 1RU Router

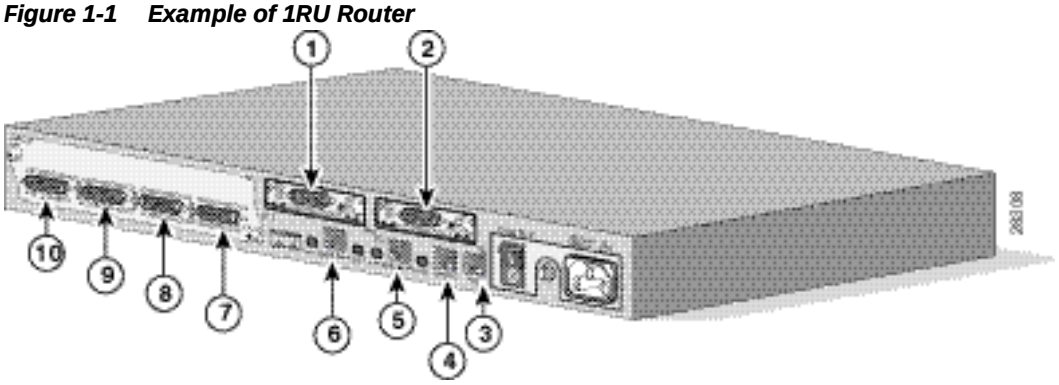
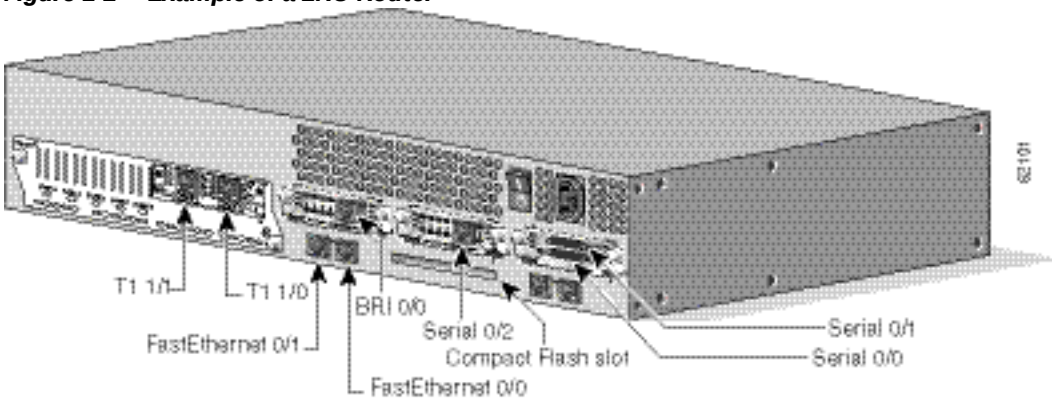


Figure 1-2 below shows a router of 2 RU height with:

- A WIC in each WIC slot (containing interfaces Serial 0/0 and Serial 0/1 in physical slot W0, interface Serial 0/2 in physical slot W1, and interface BRI 0/0 in physical slot W2)
- A 2-port T1 network module in slot 1 (containing the following ports: T1 1/0 and T1 1/1)
- Two built-in Ethernet 10/100 interfaces—FastEthernet 0/0 and FastEthernet 0/1

Figure 1-2 Example of a 2RU Router



Note The slot number for all WIC interfaces is always 0. (The W0 and W1 slot designations are for physical slot identification only.) Interfaces in the WICs are numbered from right to left, starting with 0/0 for each interface type, regardless of which physical slot the WICs are installed in. Some examples are:

- If physical slot W0 is empty and physical slot W1 contains a 1-port serial WIC, the interface number in the WIC is numbered Serial 0/0.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port serial WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered Serial 0/2.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port BRI WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered BRI 0/0.

Voice Interface Numbering in Cisco 2600 Series Routers

Voice interfaces are numbered differently from the WAN interfaces described in the previous section. Voice interfaces are numbered as follows:

chassis slot/voice module slot/voice interface

If a 4-channel voice network module is installed in chassis slot 1, the voice interfaces are:

- 1/0/0—Chassis slot 1/Voice module slot 0/Voice interface 0
- 1/0/1—Chassis slot 1/Voice module slot 0/Voice interface 1
- 1/1/0—Chassis slot 1/Voice module slot 1/Voice interface 0
- 1/1/1—Chassis slot 1/Voice module slot 1/Voice interface 1

Cisco 3600 Series Interface Numbering

Each individual network interface on a Cisco 3600 series router is identified by a slot number and a unit number.

Cisco 3600 Series Router Slot Numbering

A Cisco 3600 series router chassis includes up to six slots in which you can install modules. The Cisco 3600 series includes the Cisco 3660 (see Figure 1-3), Cisco 3640 (see Figure 1-4) and Cisco 3620 routers (see Figure 1-5). The Cisco 3660 has six network module slots, the Cisco 3640 has four slots, the Cisco 3620 has two slots, and the Cisco 3631 (see Figure 1-6) has four slots. You can install any module into any available slot in the chassis.

Figure 1-3 Cisco 3660 Router Rear View

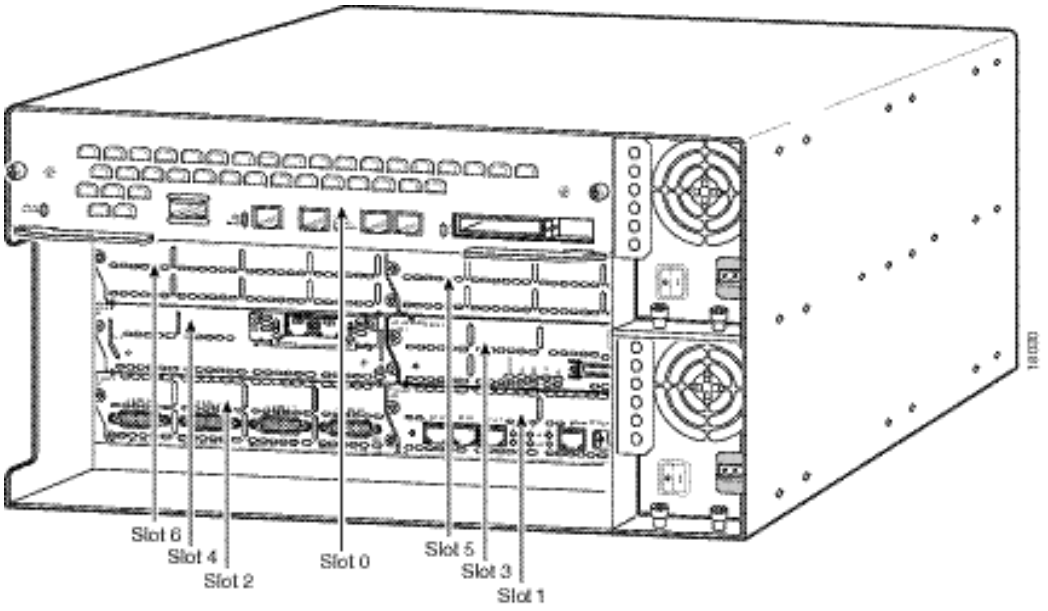


Figure 1-4 Cisco 3640 Router Rear View

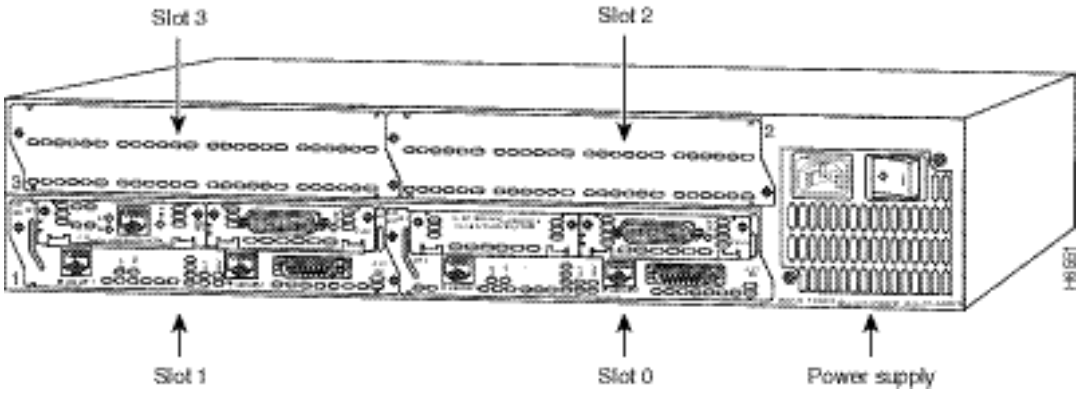


Figure 1-5 Cisco 3620 Router Rear View

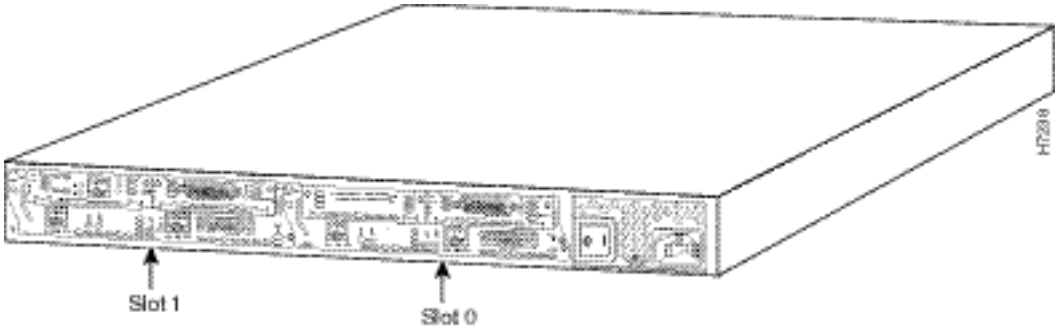
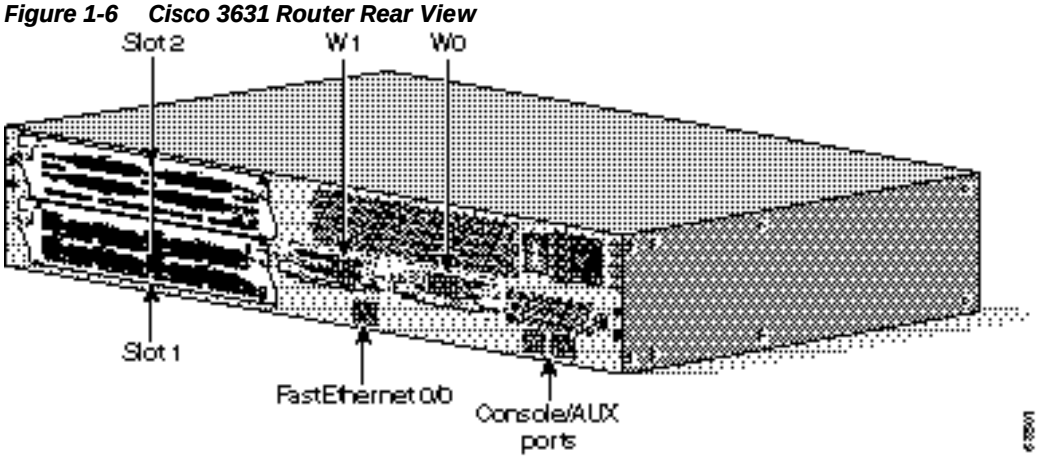


Figure 1-6 Cisco 3631 Router Rear View



For the Cisco 3660 router (see Figure 1-3), the slots are numbered as follows:

- Slot 0 contains fixed FastEthernet ports and is located at the top of the chassis.
- Slot 1 is at the bottom right (as viewed from the rear of the chassis), near the power supply.
- Slot 2 is at the bottom left.
- Slot 3 is at the right, above slot 1.
- Slot 4 is at the left, above slot 2
- Slot 5 is at the right, above slot 3.
- Slot 6 is at the left, above slot 4.

For the Cisco 3620 and Cisco 3640 routers shown in Figure 1-4 and Figure 1-5, the slots are numbered as follows:

- Slot 0 is at the bottom right (as viewed from the rear of the chassis), near the power supply.
- Slot 1 is at the bottom left.
- Slot 2 is at the top right, above slot 0.
- Slot 3 is at the top left, above slot 1.

For the Cisco 3631 router shown in Figure 1-6, the slots are numbered as follows:

- Slot 0 for all built-in interfaces like the FastEthernet port at the bottom center near the Console/AUX ports
- Slot 0 for all WAN interface card (WIC) interfaces
- Slot 1 for network module interfaces at the bottom left.
- Slot 2 for network module interfaces at the top left, above slot 1.

Figure 1-7 Example of the Cisco 3631 Router Interface Numbering

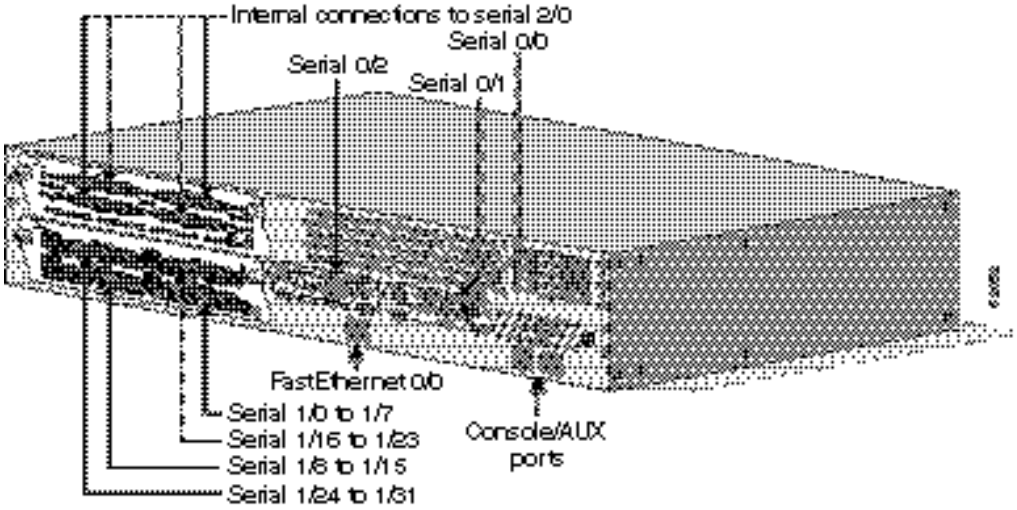


Figure 1-7 shows an example of the interface numbering where the following interfaces are installed:

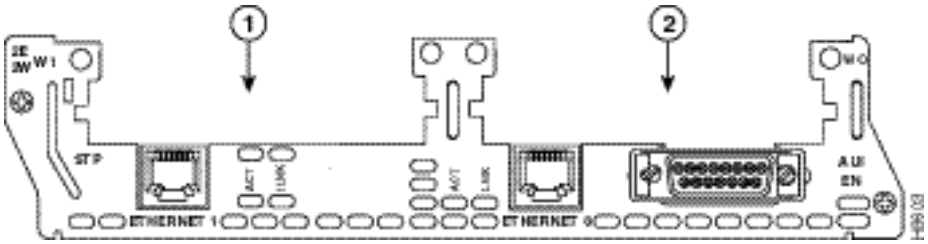
- A WIC in each WIC slot (containing interfaces serial 0/0 and serial 0/1 in physical slot W0, and interface serial 0/2 in physical slot W1)
- A 32-port asynchronous network module in slot 1 (containing interfaces serial 1/0 through serial 1/31)
- An alarm interface controller network module in slot 2 (internally connected to interface serial 2/0)
- One built-in Ethernet 10/100 interface—FastEthernet 0/0

Note The logical slot number for all WIC interfaces is always 0. (The W0 and W1 slot designations are for physical slot identification only.) Interfaces in the WICs are numbered from right to left, starting with 0/0 for each interface type, regardless of which physical slot the WICs are installed in. Some examples are:

  - If physical slot W0 is empty and physical slot W1 contains a 1-port serial WIC, then the logical interface in the WIC is numbered serial 0/0.
  - If physical slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port serial WIC, then the logical interfaces in physical slot W0 are numbered serial 0/0 and serial 0/1 and the logical interface in physical slot W1 is numbered Serial 0/2.
  - If physical slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port BRI WIC, then the logical interfaces in physical slot W0 are numbered serial 0/0 and serial 0/1, and the logical interface in physical slot W1 is numbered BRI 0/0.

Some modules have two small slots, labeled W0 and W1, for WAN interface cards. For example, Figure 1-8 shows the W0 and W1 slots of the 2 Ethernet 2 WAN card slot (2E 2-slot) module. You can install WAN interface cards into the small module slots (W0 and W1). Integrated Services Digital Network (ISDN) Basic Rate Interface (BRI) WAN interface cards are keyed so that you can install them into slot W1 only. Serial WAN interface cards can be installed into either slot, W0 or W1.

Figure 1-8 WAN Interface Card Slots



Cisco 3600 Series Router Unit Numbering

Cisco 3600 series routers unit numbers identify the interfaces on the modules and WAN interface cards installed in the router. Unit numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top. Modules and WAN interface cards are identified by interface type, slot number, followed by a forward slash
(/), and then the unit number; for example, Ethernet 0/0.

Note In the Cisco 3660 router, the fixed FastEthernet ports are located in chassis slot 0, and are identified by: *interface type chassis slot/ unit number*
For example: FastEthernet 0/0

Figure 1-9 shows a router with a 2E 2-slot module in slots 0 and 1. Two serial WAN interface cards are installed in the module in slot 0. One serial and one ISDN BRI WAN interface card are installed in the module in slot 1.

As shown in Figure 1-9, the unit numbers are as follows:

- Slot 0, Ethernet interface 0, referred to as Ethernet 0/0
- Slot 0, Ethernet interface 1, referred to as Ethernet 0/1
- Slot 0, serial interface 0, referred to as serial 0/0
- Slot 0, serial interface 1, referred to as serial 0/1
- Slot 1, Ethernet interface 0, referred to as Ethernet 1/0
- Slot 1, Ethernet interface 1, referred to as Ethernet 1/1
- Slot 1, serial interface 0, referred to as serial 1/0
- Slot 1, BRI interface 0, referred to as BRI 1/0

Note The 2E 2-slot module described in this example provides both an attachment unit interface (AUI) and 10BASE-T port. Only one of these ports can be used at a time. The module automatically detects which port, AUI or 10BASE-T, is in use.

Cisco 3600 Series Routers Voice Interface Numbering

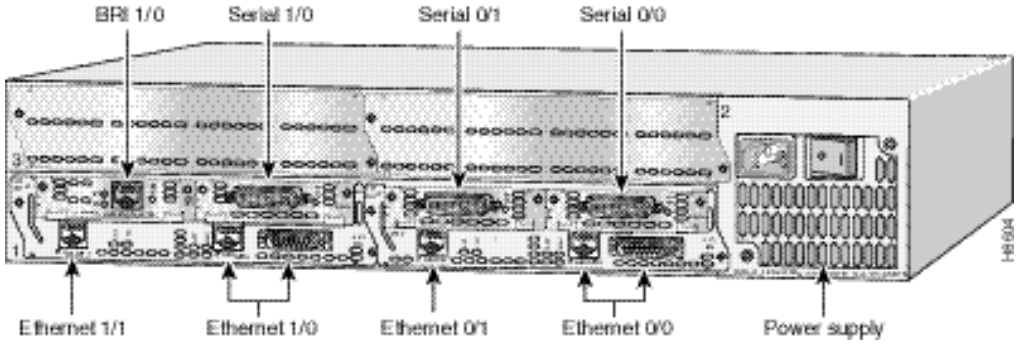
Voice interfaces are numbered differently from WAN interfaces described in the previous section, "Cisco 3600 Series Router Unit Numbering." Voice interfaces are numbered as follows:

interface type chassis slot/voice module slot/voice interface

If you have a 4-channel voice network module installed in slot 1 of your router, the voice interfaces will be:

- Slot 1, voice network module slot 0, voice interface 0, referred to as voice 1/0/0 (closest to chassis slot 0)
- Slot 1, voice network module slot 0, voice interface 1, referred to as voice 1/0/1
- Slot 1, voice network module slot 1, voice interface 0, referred to as voice 1/1/0
- Slot 1, voice network module slot 1, voice interface 1, referred to as voice 1/1/1 (farthest from chassis slot 0)

Figure 1-9 Cisco 3600 Series Unit Numbers



Cisco 3700 Series Interface Numbering

Each WAN and LAN interface on a Cisco 3700 series router is identified by a slot number and a unit number. The Cisco 3700 series includes the Cisco 3725 and Cisco 3745.

Cisco 3725 Router Interface Numbering

The Cisco 3725 router chassis contains the following wide-area network (WAN) and local area network (LAN) interface types:

- Two built-in FastEthernet LAN interfaces
- Three slots in which you can install WAN interface cards (WICs)
- One single-width slot (slot 1) in which you can install one network module
- One double-width slot (slot 2) in which you can install one single-width or double-width network module

Cisco 3725 Router Slot Numbering

The numbering format is *Interface-type Slot-number*/*Interface-number*. Two examples are:

```
FastEthernet 0/0
Serial 1/2.
```

The slot numbers are as follows:

- 0 for all built-in interfaces
- 0 for all WIC interfaces

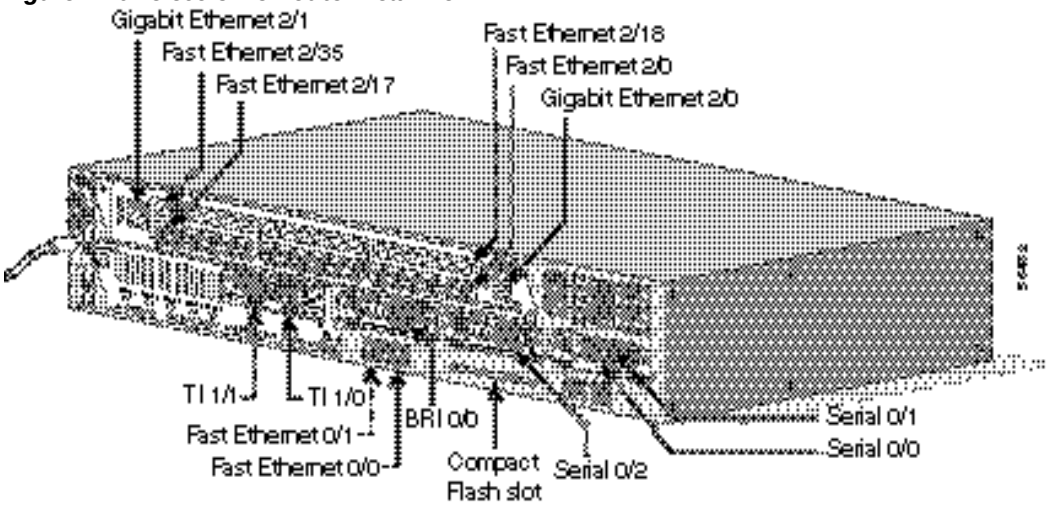
- 1 for interfaces in the single-width network module slot
- 2 for interfaces in the double-width network module slot

Interface (port) numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top.

Figure 1-10 below shows an example of interface numbering on a Cisco 3725 router with:

- A WIC in each WIC slot (containing interfaces Serial 0/0 and Serial 0/1 in physical slot W0, interface Serial 0/2 in physical slot W1, and interface BRI 0/0 in physical slot W2)
- A 2-port T1 network module in slot 1 (containing the following ports: T1 1/0 and T1 1/1)
- A 36-port Etherswitch network module in slot 2 (containing the following ports: FastEthernet 2/0 through 2/35, and GigabitEthernet 2/0 and 2/1)
- Two built-in Ethernet 10/100 interfaces—FastEthernet 0/0 and FastEthernet 0/1

Figure 1-10 Cisco 3725 Router Rear View



Note The slot number for all WIC interfaces is always 0. (The W0 and W1 slot designations are for physical slot identification only.) Interfaces in the WICs are numbered from right to left, starting with 0/0 for each interface type, regardless of which physical slot the WICs are installed in. Some examples are:

- If physical slot W0 is empty and physical slot W1 contains a 1-port serial WIC, the interface in the WIC is numbered Serial 0/0.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port serial WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered Serial 0/2.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port BRI WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered BRI 0/0.

Cisco 3745 Router Interface Numbering

The Cisco 3745 router chassis contains the following wide-area network (WAN) and local-area network (LAN) interface types:

- 2 built-in FastEthernet LAN interfaces

- 3 slots in which you can install WAN or voice interface cards
- 4 network module slots.

Cisco 3745 Router Slot Numbering

The numbering format in the Cisco 3745 router is *Interface type Slot number*/*Interface number*. Two examples are:

```
FastEthernet 0/0
Serial 1/2.
```

The slot numbers are as follows:

- 0 for all built-in interfaces
- 0 for all WIC interfaces
- 1 for the lower right network module slot
- 2 for the lower left network module slot
- 3 for the upper right network module slot
- 4 for the upper left network module slot

If double-wide network modules are installed, the slot numbers are as follows:

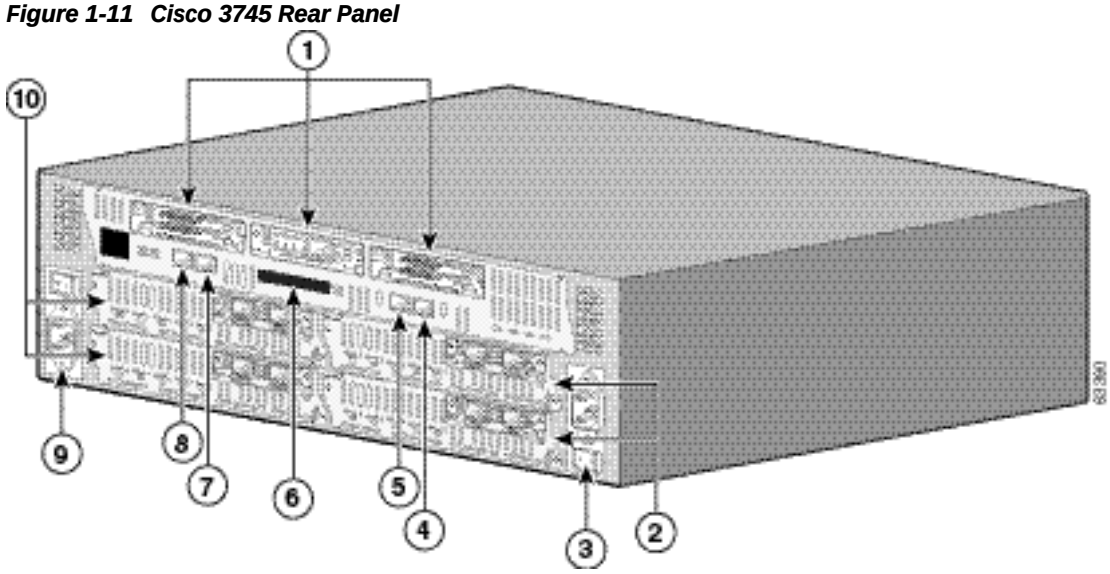
- 2 for the lower double-wide slot
- 4 for the upper double-wide slot

Interface (port) numbers begin at 0 for each interface type, and continue from right to left and (if necessary) from bottom to top.

Figure 1-11 shows the rear panel of the Cisco 3745 with:

- A WIC in each of the three WAN interface card slots
- A single-width network module in each of the four network module slots
- Two AC power supplies

Figure 1-11 Cisco 3745 Rear Panel



1	Interface card slots	**6**	Cisco 3700 compact Flash slot
2	Network modules	**7**	Auxiliary port
3	Power supply	**8**	Console port
4	Fast Ethernet 0/0 port	**9**	Power supply
5	Fast Ethernet 0/1 port	**10**	Network modules

Note The slot number for all WIC interfaces is always 0. (The W0, W1, and W2 slot designations are for physical slot identification only.) Interfaces in the WICs are numbered from right to left, starting with 0/0 for each interface type, regardless of which physical slot the WICs are installed in. Some examples are:

- If physical slot W0 is empty and physical slot W1 contains a 1-port serial WIC, the interface in the WIC is numbered Serial 0/0.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port serial WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered Serial 0/2.
- If slot W0 contains a 2-port serial WIC and slot W1 contains a 1-port BRI WIC, the interfaces in physical slot W0 are numbered Serial 0/0 and Serial 0/1, and the interface in physical slot W1 is numbered BRI 0/0.

Cisco 3700 Series Routers Voice Interface Numbering

Voice interfaces in Cisco 3725 and Cisco 3745 routers are numbered differently from the WAN interfaces described in the previous section Voice interfaces are numbered as follows:

chassis slot/voice module slot/voice interface

If a 4-channel voice network module is installed in chassis slot 1, the voice interfaces are:

- 1/0/0—Chassis slot 1/Voice module slot 0/Voice interface 0

- 1/0/1—Chassis slot 1/Voice module slot 0/Voice interface 1
- 1/1/0—Chassis slot 1/Voice module slot 1/Voice interface 0
- 1/1/1—Chassis slot 1/Voice module slot 1/Voice interface 1

Understanding Cisco IOS Software Basics

This section describes what you need to know about the Cisco IOS software before you configure the router using the command-line interface (CLI). This chapter includes the following:

Understanding these concepts will save time as you begin to use the CLI. If you have never used the Cisco IOS software or need a refresher, take a few minutes to read this chapter before you proceed to the next chapter.

If you are already familiar with Cisco IOS software, proceed to Chapter 2, "Using the Setup Command Facility."

Getting Help

Use the question mark (?) and arrow keys to help you enter commands:

- For a list of available commands, enter a question mark:

  ```
  Router> ?
  ```

- To complete a command, enter a few known characters followed by a question mark (with no space):

  ```
  Router> s?
  ```

- For a list of command variables, enter the command followed by a space and a question mark:

  ```
  Router> show ?
  ```

- To redisplay a command you previously entered, press the up arrow key. You can continue to press the up arrow key for more commands.

Understanding Command Modes

The Cisco IOS user interface is divided into different modes. Each command mode permits you to configure different components on your router. The commands available at any given time depend on which mode you are currently in. Entering a question mark (**?**) at the prompt displays a list of commands available for each command mode. Table 1-2 lists the most common command modes.

Table 1-2 Common Command Modes

Command Mode	Access Method	Router Prompt Displayed	Exit Method
User EXEC	Log in.	`Router>`	Use the **logout** command.
Privileged EXEC	From user EXEC mode, enter the **enable** command.	`Router#`	To exit to user EXEC mode, use the **disable**, **exit**, or **logout** command.
Global configuration	From the privileged EXEC mode, enter the **configure terminal** command.	`Router (config)#`	To exit to privileged EXEC mode, use the **exit** or **end** command, or press **Ctrl-z**.
Interface configuration	From the global configuration mode, enter the **interface** *type number* command, such as **interface serial 0/0**.	`Router (config-if)#`	To exit to global configuration mode, use the **exit** command. To exit directly to privileged EXEC mode, press **Ctrl-z**.

Timesaver Each command mode restricts you to a subset of commands. If you are having trouble entering a command, check the prompt, and enter the question mark (**?**) for a list of available commands. You might be in the wrong command mode or using the wrong syntax.

In the following example, notice how the prompt changes after each command to indicate a new command mode:

```
Router> enable
Password: <enable password>
Router# configure terminal
Router(config)# interface serial 0/0
Router(config-if)# line 0
Router(config-line)# controller t1 0
Router(config-controller)# exit
Router(config)# exit
Router#
%SYS-5-CONFIG_I: Configured from console by console
```

The last message is normal and does not indicate an error. Press **Return** to get the `Router#` prompt.

Note You can press **Ctrl-z** in any mode to immediately return to enable mode (`Router#`), instead of entering **exit**, which returns you to the previous mode.

Undoing a Command or Feature

If you want to undo a command you entered or disable a feature, enter the keyword **no** before most commands; for example, **no ip routing**.

Saving Configuration Changes

You need to enter the **copy running-config startup-config** command to save your configuration changes to nonvolatile random-access memory (NVRAM), so the changes are not lost if there is a system reload or power outage. For example:

```
Router# copy running-config startup-config
Building configuration...
```

It might take a minute or two to save the configuration to NVRAM. After the configuration has been saved, the following appears:

```
[OK]
Router#
```

Upgrading to a New Cisco IOS Release

To install or upgrade to a new Cisco IOS release, refer to Appendix B, "Formatting the Compact Flash Memory Cards."

Where to Go Next

Now that you have learned some Cisco IOS software basics, you can begin to configure the router using the CLI.

Remember that:

- You can use the question mark (?) and arrow keys to help you enter commands.
- Each command mode restricts you to a set of commands. If you have difficulty entering a command, check the prompt and then enter the question mark (**?**) for a list of available commands. You might be in the wrong command mode or using the wrong syntax.
- To disable a feature, enter the keyword **no** before the command; for example, **no ip routing**.
- You need to save your configuration changes to NVRAM so the changes are not lost if there is a system reload or power outage.

Proceed to Chapter 2, "Using the Setup Command Facility," to begin configuring the router.

Using the Setup Command Facility

This chapter describes how to use the **setup** command facility to configure your router. The **setup** command facility prompts you to enter information needed to start a router functioning quickly. The facility steps you through a basic configuration, including local-area network (LAN) and wide-area network (WAN) interfaces. The following sections are included:

If you prefer to configure the router manually or you wish to configure a module or interface that is not included in the **setup** command facility, proceed to "Chapter 3, "Configuring with the Command-Line Interface," for step-by-step instructions.

Before Starting Your Router

Before you power on your router and begin to use the **setup** command facility, make sure you follow these steps:

Step 1 Set up the hardware as described in the documentation appropriate to your router.

Step 2 Configure your PC terminal emulation program for 9600 baud, 8 data bits, no parity, and 1 stop bit.

Step 3 Determine which network protocols you are supporting (for example, AppleTalk, IP, Novell IPX, and so on).

Step 4 Determine the following for each network protocol:

- Addressing plan
- Which WAN protocols you will run on each interface (for example, Frame Relay, HDLC, X.25, and so on)

Using the setup Command Facility

The setup command facility displays from your PC terminal emulation program window.

To create a basic configuration for your router, do the following:

- Complete the steps in the "Configuring Global Parameters" section on page 2-2.
- Complete the steps in the "Configuring Interface Parameters" section on page 2-5 that apply to your router and network.
- Complete the steps in the "Completing the Configuration" section on page 2-23.

Note If you make a mistake while using the **setup** command facility, you can exit and run the facility again. Press **Ctrl-c**, and type **setup** at the enable mode prompt (`2600#`).

Configuring Global Parameters

Step 1 Power on the router. The power switch is on the rear panel of the router, at the lower right corner, near the power cord.

Messages will begin to appear in your terminal emulation program window.

Caution *Do not press any keys on the keyboard until the messages stop*. Any keys pressed during this time are interpreted as the first command typed when the messages stop, which might cause the router to power off and start over. It takes a few minutes for the messages to stop.

The messages look similar to the following:

Note The messages vary, depending on the Cisco IOS software release, interface modules in place in your router, and feature set you select. The screen displays in this section are for reference only and might not exactly reflect the messages on your console.

```
System Bootstrap, Version 11.3(1)XA, PLATFORM SPECIFIC RELEASE SOFTWARE (fc1)
Copyright (c) 1998 by cisco Systems, Inc.
C2600 platform with 32768 Kbytes of main memory

rommon 1 b f
program load complete, entry point: 0x80008000, size: 0xef4e0
Self decompressing the image : ############################################
[OK]

Notice: NVRAM invalid, possibly due to write erase.
program load complete, entry point: 0x80008000, size: 0x415b20
Self decompressing the image :
########################################################################################################
########################################################################################################
########################################################################################################
###############[OK]


                    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) C2600 Software (C2600-JS-M), Version 11.3(2)XA,
PLATFORM SPECIFIC RELEASE SOFTWARE (fc1)
Copyright (c) 1986-1998 by cisco Systems, Inc.
Compiled Tue 10-Mar-98 14:18 by rnapier
Image text-base: 0x80008084, data-base: 0x809CD49C

cisco 2611 (MPC860) processor (revision 0x100) with 24576K/8192K bytes of memory.
Processor board ID 04614954
M860 processor, part number 0 mask 32
Bridging software.
X.25 software, Version 3.0.0.
2 Ethernet/IEEE 802.3 interface(s)
3 Serial network interface(s)
32 terminal line(s)
DRAM configuration parity is disabled.
32K bytes of non-volatile configuration memory.
8192K bytes of processor board System flash (Read/Write)

          --- System Configuration Dialog ---

At any point you may enter a question mark '?' for help.
Use ctrl-c to abort configuration dialog at any prompt.
Default settings are in square brackets '[]'.
```

Step 2 When the following message appears, enter **yes** to begin the initial configuration dialog:

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

Note If you answer **no** to this message, you are prompted to terminate AutoInstall. AutoInstall is a procedure that configures a new router based on the configuration of an existing router.

If you terminate AutoInstall, you enter the Cisco IOS software CLI.

Note The interface numbering that appears in the next step is dependent on the type of Cisco modular router platform. This example shows a Cisco 2600 series router.

Step 3 When the following message appears, press **Return** to see the current interface summary:

```
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
Ethernet0/0     unassigned     NO  unset  up            up
Serial0/0       unassigned     NO  unset  up            down
BRI0/0          unassigned     NO  unset  up            up
```

```
Serial0/1       unassigned      NO  unset  up            down
Serial0/2       unassigned      NO  unset  up            down
```

Step 4 Enter a host name for the router (this example uses 2600):

```
Configuring global parameters:

  Enter host name [Router]: 2600

The enable secret is a password used to protect access to privileged EXEC and
configuration modes. This password, after entered, becomes encrypted in the configuration.
```

Step 5 Enter an enable secret password. This password is encrypted (more secure) and cannot be seen when viewing the configuration:

```
   Enter enable secret: xxxx

The enable password is used when you do not specify an enable secret password, with some
older software versions, and some boot images.
```

Step 6 Enter an enable password that is different from the enable secret password. This password is *not* encrypted (less secure) and can be seen when viewing the configuration:

```
   Enter enable password: guessme

The virtual terminal password is used to protect access to the router over a network
interface.
```

Step 7 Enter the virtual terminal password, which prevents unauthenticated access to the router through ports other than the console port:

```
  Enter virtual terminal password: guessagain
```

Step 8 Respond to the following prompts as appropriate for your network:

```
Configure SNMP Network Management? [yes]:
    Community string [public]:
Configure LAT? [no]:
Configure AppleTalk? [no]:
Configure DECnet? [no]:
Configure IP? [yes]:
    Configure IGRP routing? [yes]:
      Your IGRP autonomous system number [1]: 15
```

Note If you answer **no** to IGRP, you are prompted to configure RIP.

```
Configure CLNS? [no]:
Configure IPX? [no]:
Configure Vines? [no]:
Configure XNS? [no]:
Configure Apollo? [no]:
Configure bridging? [no]:
```

Step 9 Configure the ISDN switch type used by the Basic Rate Interface (BRI) module:

```
BRI interface needs isdn switch-type to be configured
Valid switch types are :
  [0] none.....Only if you don't want to configure BRI.
  [1] basic-1tr6....1TR6 switch type for Germany
  [2] basic-5ess....AT&T 5ESS switch type for the US/Canada
  [3] basic-dms100..Northern DMS-100 switch type for US/Canada
  [4] basic-net3....NET3 switch type for UK and Europe
  [5] basic-ni......National ISDN switch type
```

```
  [6] basic-ts013...TS013 switch type for Australia
  [7] ntt...........NTT switch type for Japan
  [8] vn3...........VN3 and VN4 switch types for France
Choose ISDN BRI Switch Type [2]:
```

Step 10 Configure the asynchronous serial lines for the integrated modems on the modules installed in the router. (If you want to allow users to dial in through the integrated modems, you must configure the asynchronous lines.)

```
Async lines accept incoming modems calls. If you will have
users dialing in via modems, configure these lines.

Configure Async lines? [yes]:
    Async line speed [115200]:
```

Note Cisco recommends that you do not change this speed.

```
Will you be using the modems for inbound dialing? [yes]:
```

Note If your asynchronous interfaces will be using the same basic configuration parameters, Cisco recommends answering **yes** to the next prompt. That way, you group the modems so that they can be configured as a group. Otherwise, you will need to configure each interface separately.

```
Would you like to put all async interfaces in a group and configure them all at one time?
[yes]:
      Allow dial-in users to choose a static IP addresses? [no]:
      Configure for TCP header compression? [yes]:
      Configure for routing updates on async links? [no]:
Enter the starting address of IP local pool? [X.X.X.X]:   172.20.30.40
```

Note Make sure the starting and ending addresses of the IP pool are in the same subnet.

```
      Enter the ending address of IP local pool? [X.X.X.X]: 172.20.30.88

You can configure a test user to verify that your
dial-up service is working properly
What is the username of the test user? [user]:
What is the password of the test user? [passwd]:
Will you be using the modems for outbound dialing? [no]:

Configuring interface parameters:
```

Configuring Interface Parameters

From this point on in the **setup** process, the prompts you see vary depending on the network modules and WAN interface cards in place in your router. The following sections provide examples of the setup steps for each interface module. Refer to the sections appropriate to your router.

Configuration for network modules includes:

- Ethernet Interface Configuration, page 2-6
- FastEthernet Interface Configuration, page 2-6
- Token Ring Interface Configuration, page 2-7

When you complete the setup steps for your interface modules, go to the "Completing the Configuration" section on page 2-23 for directions on saving your configuration.

Ethernet Interface Configuration

This section contains a sample configuration for the Ethernet interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
Do you want to configure Ethernet0/0 interface [yes]:
 Configure IP on this interface? [yes]:
    IP address for this interface: 255.255.255.0
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 1.0.0.0, 8 subnet bits, mask is /8
 Configure IPX on this interface? [no]: y
    IPX network number [1]:
    Need to select encapsulation type
             [0] sap (IEEE 802.2)
             [1] snap (IEEE 802.2 SNAP)
             [2] arpa (Ethernet_II)
             [3] novell-ether (Novell Ethernet_802.3)
    Enter the encapsulation type [2]:
```

FastEthernet Interface Configuration

This section contains a sample configuration for the FastEthernet interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
Do you want to configure FastEthernet0/0 interface [yes]:
 Use the 100 Base-TX (RJ-45) connector? [yes]:
 Operate in full-duplex mode? [no]:
 Configure IP on this interface? [no]: yes
 IP address for this interface: 6.0.0.1
 Number of bits in subnet field [0]:
 Class A network is 6.0.0.0, 0 subnet bits, mask is /8
Configure IPX on this interface? [yes]:
    IPX network number [1]:
    Need to select encapsulation type
             [0] sap (IEEE 802.2)
             [1] snap (IEEE 802.2 SNAP)
             [2] arpa (Ethernet_II)
             [3] novell-ether (Novell Ethernet_802.3)
    Enter the encapsulation type [2]:
```

Token Ring Interface Configuration

This section contains a sample configuration for the Token Ring interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
Do you want to configure TokenRing0/0 interface? [yes]:
 Tokenring ring speed (4 or 16)? [16]:
 Configure IP on this interface? [yes]:
    IP address for this interface: 1.0.0.1
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 1.0.0.0, 8 subnet bits; mask is /8
 Configure IPX on this interface? [no]: y
    IPX network number [1]:
    Need to select encapsulation type
                [0] sap (IEEE 802.2)
                [1] snap (IEEE 802.2 SNAP)
    Enter the encapsulation type [0]:
```

Serial Interface Configuration

This section contains a sample configuration for the 1- or 2-port serial interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
Do you want to configure Serial0/0 interface? [yes]:

    Some encapsulations supported are
            ppp/hdlc/frame-relay/lapb/atm-dxi/smds/x25
    Choose encapsulation type   [ppp]:
```

Note The following sections describe the prompts for each encapsulation type. For PPP and HDLC encapsulation, no further configuration is needed.

```
No serial cable seen.
Choose mode from (dce/dte) [dte]:
```

Note If no cable is plugged in to your router, you need to indicate whether the interface is to be used as DTE or DCE. If a cable is present, the **setup** command facility determines the DTE/DCE status. If the serial cable is DCE, you see the following prompt:

```
Serial interface needs clock rate to be set in dce mode.
 The following clock rates are supported on the serial interface.
    0
    1200, 2400, 4800, 9600, 19200, 38400
    56000, 64000, 72000, 125000, 148000, 500000
    800000, 1000000, 1300000, 2000000, 4000000, 8000000

 Choose clock rate from above: [2000000]:
 Configure IP on this interface? [yes]:
    IP address for this interface: 2.0.0.1
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 2.0.0.0, 8 subnet bits; mask is /8
Configure IPX on this interface? [no]: yes
    IPX network number [8]:
```

Frame Relay Encapsulation

```
The following lmi-types are available to be set,
   when connected to a frame relay switch
               [0] none
               [1] ansi
               [2] cisco
               [3] q933a
 Enter lmi-type [2]:
```

Note The **setup** command facility only prompts for the data-link connection identifier (DLCI) number if you specify **none** for the Local Management Interface (LMI) type. If you accept the default or specify another LMI type, the DLCI number is provided by the specified protocol.

```
Enter the DLCI number for this interface [16]:

Do you want to map a remote machine's IP address to dlci? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map a remote machine's IPX address to dlci? [yes]:
   IPX address for the remote interface: 40.1234.5678

Serial interface needs clock rate to be set in dce mode.
The following clock rates are supported on the serial interface.
     0
     1200, 2400, 4800, 9600, 19200, 38400
     56000, 64000, 72000, 125000, 148000, 500000
     800000, 1000000, 1300000, 2000000, 4000000, 8000000

choose speed from above: [2000000]: 1200
Configure IP on this interface? [yes]:
  IP address for this interface: 2.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 2.0.0.0, 8 subnet bits; mask is /8
```

If IPX is configured on the router, the **setup** command facility prompts for the IPX map:

```
Do you want to map a remote machine's IPX address to dlci? [yes]:
  IPX address for the remote interface: 40.0060.34c6.90ed
```

LAPB Encapsulation

```
  lapb circuit can be either in dce/dte mode.
  Choose either from (dce/dte) [dte]:
```

X.25 Encapsulation

```
x25 circuit can be either in dce/dte mode.
  Choose from either dce/dte [dte]:
  Enter local x25 address: 1234

We will need to map the remote x.25 station's x25 address
  to the remote stations IP/IPX address
Enter remote x25 address: 4321

Do you want to map the remote machine's x25 address to IP address? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map the remote machine's x25 address to IPX address? [yes]:
   IPX address for the remote interface: 40.1234.5678
```

```
Enter lowest 2-way channel [1]:
Enter highest 2-way channel [64]:
Enter frame window (K) [7]:
Enter Packet window (W) [2]:
Enter Packet size (must be powers of 2) [128]:
```

ATM-DXI Encapsulation

```
Enter VPI number [1]:
Enter VCI number [1]:

Do you want to map the remote machine's IP address to vpi and vci's? [yes]:
     IP address for the remote interface: 2.0.0.2
Do you want to map the remote machine's IPX address to vpi and vci's? [yes]:
     IPX address for the remote interface: 40.1234.5678
```

SMDS Encapsulation

```
Enter smds address for the local interface: c141.5556.1415

We will need to map the remote smds station's address
  to the remote stations IP/IPX address
Enter smds address for the remote interface: c141.5556.1414

Do you want to map the remote machine's smds address to IP address? [yes]:
      IP address for the remote interface: 2.0.0.2
Do you want to map the remote machine's smds address to IPX address? [yes]:
      IPX address for the remote interface: 40.1234.5678
```

Serial Cisco IOS Commands Generated

The following is an example of the Cisco IOS commands generated by a typical serial configuration:

```
interface Serial0/0
encapsulation ppp
clock rate 2000000
ip address 2.0.0.1 255.0.0.0
```

Asynchronous/Synchronous Serial Interface Configuration

This section contains sample configurations for an asynchronous/synchronous serial interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
Do you want to configure Serial1/0 interface? [yes]:
Enter mode (async/sync) [sync]:
```

Synchronous Configuration

If you select synchronous, you see screen displays similar to the following:

```
Do you want to configure Serial1/0 interface? [yes]:
Enter mode (async/sync) [sync]:

Some supported encapsulations are
    ppp/hdlc/frame-relay/lapb/x25/atm-dxi/smds
  Choose encapsulation type [hdlc]:
```

Note The following sections describe the prompts for each encapsulation type. For PPP and HDLC encapsulation, no further configuration is needed.

```
No serial cable seen.
Choose mode from (dce/dte) [dte]:
```

Note If no cable is plugged in to your router, you need to indicate whether the interface is to be used as DTE or DCE. If a cable is present, the **setup** command facility determines the DTE/DCE status. If the serial cable is DCE, you see the following prompt:

```
Configure IP on this interface? [no]: yes
Configure IP unnumbered on this interface? [no]:
   IP address for this interface: 2.0.0.0
   Subnet mask for this interface [255.0.0.0]:
   Class A network is 2.0.0.0, 0 subnet bits; mask is /8
Configure LAT on this interface? [no]:
```

Frame Relay Encapsulation

```
The following lmi-types are available to be set,
   when connected to a frame relay switch
               [0] none
               [1] ansi
               [2] cisco
               [3] q933a
  Enter lmi-type [2]:
```

Note The **setup** command facility only prompts for the data-link connection identifier (DLCI) number if you specify **none** for the Local Management Interface (LMI) type. If you accept the default or specify another LMI type, the DLCI number is provided by the specified protocol.

```
Enter the DLCI number for this interface [16]:

Do you want to map a remote machine's IP address to dlci? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map a remote machine's IPX address to dlci? [yes]:
   IPX address for the remote interface: 40.1234.5678

Serial interface needs clock rate to be set in dce mode.
The following clock rates are supported on the serial interface.
     0
     1200, 2400, 4800, 9600, 19200, 38400
     56000, 64000, 72000, 125000, 148000, 500000
     800000, 1000000, 1300000, 2000000, 4000000, 8000000

choose speed from above: [2000000]: 1200
Configure IP on this interface? [yes]:
  IP address for this interface: 2.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 2.0.0.0, 8 subnet bits; mask is /8
```

Note If IPX is configured on the router, the **setup** command facility prompts for the IPX map:

```
Do you want to map a remote machine's IPX address to dlci? [yes]:
  IPX address for the remote interface: 40.0060.34c6.90ed
```

LAPB Encapsulation

```
  lapb circuit can be either in dce/dte mode.
  Choose either from (dce/dte) [dte]:
```

X.25 Encapsulation

```
x25 circuit can be either in dce/dte mode.
  Choose from either dce/dte [dte]:
  Enter local x25 address: 1234

  We will need to map the remote x.25 station's x25 address
  to the remote stations IP/IPX address
  Enter remote x25 address: 4321

  Do you want to map the remote machine's x25 address to IP address? [yes]:
     IP address for the remote interface: 2.0.0.2
  Do you want to map the remote machine's x25 address to IPX address? [yes]:
     IPX address for the remote interface: 40.1234.5678

   Enter lowest 2-way channel [1]:
   Enter highest 2-way channel [64]:
   Enter frame window (K) [7]:
   Enter Packet window (W) [2]:
   Enter Packet size (must be powers of 2) [128]:
```

ATM-DXI Encapsulation

```
Enter VPI number [1]:
Enter VCI number [1]:

Do you want to map the remote machine's IP address to vpi and vci's? [yes]:
     IP address for the remote interface: 2.0.0.2
Do you want to map the remote machine's IPX address to vpi and vci's? [yes]:
     IPX address for the remote interface: 40.1234.5678
```

SMDS Encapsulation

```
Enter smds address for the local interface: c141.5556.1415

We will need to map the remote smds station's address
 to the remote stations IP/IPX address
Enter smds address for the remote interface: c141.5556.1414

Do you want to map the remote machine's smds address to IP address? [yes]:
      IP address for the remote interface: 2.0.0.2
Do you want to map the remote machine's smds address to IPX address? [yes]:
      IPX address for the remote interface: 40.1234.5678
```

Asynchronous Configuration

If you select asynchronous, you see screen displays similar to the following:

```
Do you want to configure Serial1/1 interface? [yes]:
Enter mode (async/sync) [sync]: async
Configure IP on this interface? [yes]:
Configure IP unnumbered on this interface? [no]:
    IP address for this interface: 2.0.0.0
    Subnet mask for this interface [255.0.0.0]:
    Class A network is 2.0.0.0, 0 subnet bits; mask is /8
Configure LAT on this interface? [no]:
```

```
Configure AppleTalk on this interface? [no]:
Configure DECnet on this interface? [no]:
Configure CLNS on this interface? [no]:
Configure IPX on this interface? [no]: yes
  IPX network number [8]:
Configure Vines on this interface? [no]:
Configure XNS on this interface? [no]:
Configure Apollo on this interface? [no]:
```

ISDN BRI Interface Configuration

Use the System Configuration Dialog to configure an ISDN BRI interface. This configuration requires you to enter the ISDN switch type. These switch types are shown in Table 2-1.

Table 2-1 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 others)
	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

When you reach the following prompt on the System Configuration Dialog, enter an ISDN switch type from Table 2-1:

```
BRI interface needs isdn switch-type to be configured
   Valid switch types are:
           [0]  none.....Only if you don't want to configure BRI.
         [1]  basic-1tr6....1TR6 switch type for Germany
           [2]  basic-5ess....AT&T 5ESS switch type for the US/Canada
           [3]  basic-dms100..Northern DMS-100 switch type for US/Canada
           [4]  basic-net3....NET3 switch type for UK and Europe
         [5]  basic-ni......National ISDN switch type
         [6]  basic-ts013...TS013 switch type for Australia
         [7]  ntt...........NTT switch type for Japan
           [8]  vn3...........VN3 and VN4 switch types for France

   Choose ISDN BRI Switch Type [2]:

Do you want to configure BRI0/0 interface? [yes]:

   Some encapsulations supported are
             ppp/hdlc/frame-relay/lapb/x25
```

```
   Choose encapsulation type   [ppp]:
```

Note The following sections describe the prompts for each encapsulation type. No further configuration is needed for HDLC encapsulation.

```
  Do you have a service profile identifiers (SPIDs) assigned? [no]: y
  Enter SPID1: 12345
  Enter SPID2: 12345
```

Note The **setup** command facility only prompts for the SPID number if you specify **basic-5ess**, **basic-ni1**, or **basic-dms100** for the switch type.

```
Do you want to map the remote machine's IP address in dialer map? [yes]:
   IP address for the remote interface: 2.0.0.1
Do you want to map the remote machine's IP address in dialer map? [yes]:
   IPX address of the remote interface: 40.0060.34c6.90ed

To get to 2.0.0.1 we will need to make a phone call.
Please enter the phone number to call: 1234567890
Configure IP on this interface? [yes]:
```

Note If your router has at least one configured LAN interface, you can choose to use an unnumbered IP address on the interface.

```
Configure IP unnumbered on this interface? [no]: y
  Assign to which interface [Ethernet0/0]:
```

Note If your router does not have a configured LAN interface, you must use a numbered IP address.

```
IP address for this interface: 2.0.0.0.1
  Enter the subnet mask [255.0.0.0]:
```

PPP Encapsulation

```
Would you like to enable multilink PPP [yes]:

Enter a remote hostname for PPP authentication [Router]:
Enter a password for PPP authentication:
```

Note The password, which is used by the Challenge Handshake Authentication Protocol (CHAP) authentication process, is case sensitive and must match the remote router's password exactly.

Frame Relay Encapsulation

```
The following lmi-types are available to be set,
   when connected to a frame relay switch
               [0] none
               [1] ansi
               [2] cisco
               [3] q933a
  Enter lmi-type [2]:
```

Note The **setup** command facility only prompts for the data-link connection identifier (DLCI) number if you specify **none** for the Local Management Interface (LMI) type. If you accept the default or specify another LMI type, the DLCI number is provided by the specified protocol.

```
Enter the DLCI number for this interface [16]:

Do you want to map a remote machine's IP address to dlci? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map a remote machine's IPX address to dlci? [yes]:
   IPX address for the remote interface: 40.1234.5678

Serial interface needs clock rate to be set in dce mode.
The following clock rates are supported on the serial interface.
     0
     1200, 2400, 4800, 9600, 19200, 38400
     56000, 64000, 72000, 125000, 148000, 500000
     800000, 1000000, 1300000, 2000000, 4000000, 8000000

choose speed from above: [2000000]: 1200
Configure IP on this interface? [yes]:
  IP address for this interface: 2.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 2.0.0.0, 8 subnet bits; mask is /8
```

Note If IPX is configured on the router, the **setup** command facility prompts for the IPX map:

```
Do you want to map a remote machine's IPX address to dlci? [yes]:
  IPX address for the remote interface: 40.0060.34c6.90ed
```

LAPB Encapsulation

```
lapb circuit can be either in dce/dte mode
Choose either from (dce/dte) [dte]:
```

ATM-DXI Encapsulation

```
Enter VPI number [1]:
Enter VCI number [1]:
 Do you want to map the remote machine's IP address to vpi and vci's? [yes]:
    IP address for the remote interface: 6.0.0.1
 Do you want to map the remote machine's IPX address to vpi and vci's? [yes]:
     IPX address for the remote interface: 40.0060.34c6.90ed
```

SMDS Encapsulation

```
Enter smds address for the local interface: c141.5556.1415

  We will need to map the remote smds station's address to the remote stations IP address
   Enter smds address for the remote interface: c141.5556.1414

  Do you want to map the remote machine's smds address to IP address? [yes]:
    IP address for the remote interface: 2.0.0.1
 Do you want to map the remote machine's smds address to IP address? [yes]:
    IPX address for the remote interface: 40.0060.34c6.90ed
```

X.25 Encapsulation

```
x25 circuit can be either in dce/dte mode.
Choose from either dce/dte [dte]:
Enter local x25 address: 1234

We will need to map the remote x.25 station's x25 address
 to the remote stations IP/IPX address
Do you want to map the remote machine's x25 address to IP address? [yes]:
    IP address for the remote interface: 6.0.0.1
Do you want to map the remote machine's x25 address to IPX address? [yes]:
      IPX address for the remote interface: 40.0060.34c6.90ed
Enter remote x25 address: 4321
Enter lowest 2-way channel [1]:
Enter highest 2-way channel [64]:
Enter frame window (K) [7]:
Enter Packet window (W) [2]:
Enter Packet size (must be powers of 2) [128]:
```

ISDN BRI Line Configuration

Before using a router with an ISDN BRI interface, you must order a correctly configured ISDN BRI line from your local telecommunications service provider.

The ordering process varies from provider to provider and from country to country. However, here are some general guidelines:

- Ask for two channels to be called by one number.
- Ask for delivery of calling line identification, also known as caller ID or Automatic Number Identification (ANI).
- If the router will be the only device attached to the ISDN BRI line, ask for point-to-point service and a data-only line.
- If you plan to connect another ISDN device (such as an ISDN telephone) to the ISDN BRI line through the router, ask for point-to-multipoint service (subaddressing is required) and a voice-and-data line.

ISDN BRI Provisioning by Switch Type

ISDN BRI provisioning refers to the types of services provided by the ISDN BRI line. Although provisioning is performed by your ISDN BRI service provider, you must tell the provider what you want.

Table 2-2 lists the provisioning you should order for the router based on switch type.

Table 2-2 ISDN Provisioning by Switch Type

Switch Type	Provisioning
5ESS Custom BRI	**For data only** 2 B channels for data Point to point Terminal type = E 1 directory number (DN) assigned by service provider MTERM = 1 Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange
5ESS Custom BRI	**For voice and data** (Use these values only if you have an ISDN telephone connected.) 2 B channels for voice or data MultiPoint Terminal type = D 2 directory numbers assigned by service provider 2 service profile identifiers (SPIDs) required, assigned by service provider MTERM = 2 Number of call appearances = 1 Display = No Ringing/idle call appearances = idle Autohold= no Onetouch = no Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2
5ESS National ISDN (NI-1) BRI	Terminal type = A 2 B channels for voice and data 2 directory numbers assigned by service provider 2 SPIDs required; assigned by service provider Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2
DMS-100 BRI	2 B channels for voice and data 2 directory numbers assigned by service provider 2 SPIDs required; assigned by service provider Functional signaling Dynamic terminal endpoint identifier (TEI) assignment Maximum number of keys = 64 Release key = no, or key number = no Ringing indicator = no EKTS = no PVC = 2 Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2

Defining ISDN Service Profile Identifiers

Some service providers assign service profile identifiers (SPIDs) to define the services subscribed to by an ISDN device. If your service provider requires SPIDs, your ISDN device cannot place or receive calls until it sends a valid SPID to the service provider when initializing the connection. A SPID is usually a seven-digit telephone number plus some optional numbers, but service providers may use different numbering schemes. SPIDs have significance at the local access ISDN interface only; remote routers are never sent the SPID.

Currently, only DMS-100 and NI-1 switch types require SPIDs. Two SPIDs are assigned for the DMS-100 switch type, one for each B channel. The AT&T 5ESS switch type may support SPIDs, but Cisco recommends that you set up that ISDN service without SPIDs.

If your service provider assigns you SPIDs, you must define these SPIDs on the router. To define SPIDs and the local directory number (LDN) on the router for both ISDN BRI B channels, use the following **isdn spid** commands:

```
Router(config-if)# isdn spid1 spid-number [ldn]

Router(config-if)# isdn spid2 spid-number [ldn]
```

Note Although the LDN is an optional parameter in the command, you may need to enter it so the router can answer calls made to the second directory number.

E1/T1 ISDN PRI Configuration

This section contains a sample configuration for the channelized E1/T1 ISDN PRI interface. Enter the values appropriate for your router and network. The messages you see may vary.

```
The following ISDN switch types are available:
    [0] none.............If you do not want to configure ISDN
     [1] primary-4ess....AT&T 4ESS switch type for US and Canada
     [2] primary-5ess....AT&T 5ESS switch type for US and Canada
     [3] primary-dms100..Northern Telecom switch type for US and Canada
    [4] primary-net5....European switch type for NET5
    [5] primary-ni......National ISDN Switch type for the U.S
    [6] primary-ntt.....Japan switch type
    [7] primary-ts014...Australian switch type
  Choose ISDN PRI Switch Type [2]:

Configuring controller T1 1/0 in pri or channelized mode
  Do you want to configure this interface controller? [no]:
  Will you be using PRI on this controller? [yes]:
```

E1/T1 PRI Mode

The following is an example of a E1/T1 PRI mode configuration using the **setup** command facility:

```
The following framing types are available:
                esf | sf
Enter the framing type [esf]:

The following linecode types are available:
                ami | b8zs
Enter the line code type [b8zs]:
Enter number of time slots [24]:

Do you want to configure Serial1/0:23 interface? [yes]:
```

```
Configuring the PRI D-channel
  Would you like to enable multilink PPP? [yes]:
  Configure IP on this interface? [no]: y
  Configure IP unnumbered on this interface? [no]: y
    Assign to which interface [Ethernet0/0]:

All users dialing in through the PRI will need to be
  authenticated using CHAP. The username and password are
  case sensitive.
Enter more username and passwords for PPP authentication? [no]: y
Enter the username used for dial-in CHAP authentication [Router]:   Enter the PPP password
of the user dialling in on PRI:
Enter more username and passwords for PPP authentication? [no]:
```

E1 Channelized Mode

The following is an example of an E1 channelized mode configuration using the **setup** command facility:

```
The following framing types are available:
                 no-crc4 | crc4
  Enter the framing type [crc4]:

  The following linecode types are available:
                 ami | hdb3
  Enter the line code type [hdb3]:

Do you want to configure Serial1/1:0 interface?: [Yes]:

Configuring the Channelized E1/T1 serial channels

Some encapsulations supported are
             ppp/hdlc/frame-relay/lapb/atm-dxi/smds/x25
Choose encapsulation type   [ppp]:
Configure IP on this interface? [no]: y
Configure IP unnumbered on this interface? [no]:
  IP address for this interface: 3.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 3.0.0.0, 8 subnet bits; mask is /8
```

Note The following sections describe the prompts for each encapsulation type. No further configuration is needed for HDLC encapsulation.

PPP Encapsulation

```
Would you like to enable multilink PPP [yes]:

Enter a remote hostname for PPP authentication [Router]:
Enter a password for PPP authentication:
```

Note The password, which is used by the Challenge Handshake Authentication Protocol (CHAP) authentication process, is case sensitive and must match the remote router's password exactly.

Frame Relay Encapsulation

```
The following lmi-types are available to be set,
   when connected to a frame relay switch
               [0] none
```

```
                [1] ansi
                [2] cisco
                [3] q933a
  Enter lmi-type [2]:
```

Note The **setup** command facility only prompts for the data-link connection identifier (DLCI) number if you specify **none** for the Local Management Interface (LMI) type. If you accept the default or specify another LMI type, the DLCI number is provided by the specified protocol.

```
Enter the DLCI number for this interface [16]:

Do you want to map a remote machine's IP address to dlci? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map a remote machine's IPX address to dlci? [yes]:
   IPX address for the remote interface: 40.1234.5678

Serial interface needs clock rate to be set in dce mode.
The following clock rates are supported on the serial interface.
     0
     1200, 2400, 4800, 9600, 19200, 38400
     56000, 64000, 72000, 125000, 148000, 500000
     800000, 1000000, 1300000, 2000000, 4000000, 8000000

choose speed from above: [2000000]: 1200
Configure IP on this interface? [yes]:
  IP address for this interface: 2.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 2.0.0.0, 8 subnet bits; mask is /8
```

Note If IPX is configured on the router, the **setup** command facility prompts for the IPX map:

```
Do you want to map a remote machine's IPX address to dlci? [yes]:
  IPX address for the remote interface: 40.0060.34c6.90ed
```

LAPB Encapsulation

```
lapb circuit can be either in dce/dte mode
Choose either from (dce/dte) [dte]:
```

ATM-DXI Encapsulation

```
Enter VPI number [1]:
Enter VCI number [1]:
 Do you want to map the remote machine's IP address to vpi and vci's? [yes]:
    IP address for the remote interface: 6.0.0.1
 Do you want to map the remote machine's IPX address to vpi and vci's? [yes]:
     IPX address for the remote interface: 40.0060.34c6.90ed
```

SMDS Encapsulation

```
Enter smds address for the local interface: c141.5556.1415

  We will need to map the remote smds station's address to the remote stations IP address
   Enter smds address for the remote interface: c141.5556.1414

  Do you want to map the remote machine's smds address to IP address? [yes]:
    IP address for the remote interface: 2.0.0.1
 Do you want to map the remote machine's smds address to IP address? [yes]:
    IPX address for the remote interface: 40.0060.34c6.90ed
```

X.25 Encapsulation

```
x25 circuit can be either in dce/dte mode.
Choose from either dce/dte [dte]:
Enter local x25 address: 1234

We will need to map the remote x.25 station's x25 address
 to the remote stations IP/IPX address
Do you want to map the remote machine's x25 address to IP address? [yes]:
    IP address for the remote interface: 6.0.0.1
Do you want to map the remote machine's x25 address to IPX address? [yes]:
      IPX address for the remote interface: 40.0060.34c6.90ed
Enter remote x25 address: 4321
Enter lowest 2-way channel [1]:
Enter highest 2-way channel [64]:
Enter frame window (K) [7]:
Enter Packet window (W) [2]:
Enter Packet size (must be powers of 2) [128]:
```

T1 Channelized Mode

The following is an example of a T1 channelized mode configuration using the **setup** command facility:

```
The following framing types are available:
                esf | sf
  Enter the framing type [esf]:

  The following linecode types are available:
                ami | b8zs
  Enter the line code type [b8zs]:

T1 is capable of being configured for channel 1-24
  Enter number of time slots [24]: 3
  Configure more channel groups? [no]: y
  Enter number of time slots [21]: 3
  Configure more channel groups? [no]: y
  Enter number of time slots [18]: 3
  Configure more channel groups? [no]: y
  Enter number of time slots [15]:
  Configure more channel groups? [no]:
```

Note The following sections describe the prompts for each encapsulation type. No further configuration is needed for HDLC encapsulation.

PPP Encapsulation

```
Would you like to enable multilink PPP [yes]:

Enter a remote hostname for PPP authentication [Router]:
Enter a password for PPP authentication:
```

Note The password, which is used by the Challenge Handshake Authentication Protocol (CHAP) authentication process, is case sensitive and must match the remote router's password exactly.

Frame Relay Encapsulation

```
The following lmi-types are available to be set,
```

```
   when connected to a frame relay switch
               [0] none
               [1] ansi
               [2] cisco
               [3] q933a
  Enter lmi-type [2]:
```

Note The **setup** command facility only prompts for the data-link connection identifier (DLCI) number if you specify **none** for the Local Management Interface (LMI) type. If you accept the default or specify another LMI type, the DLCI number is provided by the specified protocol.

```
Enter the DLCI number for this interface [16]:

Do you want to map a remote machine's IP address to dlci? [yes]:
   IP address for the remote interface: 2.0.0.2
Do you want to map a remote machine's IPX address to dlci? [yes]:
   IPX address for the remote interface: 40.1234.5678

Serial interface needs clock rate to be set in dce mode.
The following clock rates are supported on the serial interface.
     0
     1200, 2400, 4800, 9600, 19200, 38400
     56000, 64000, 72000, 125000, 148000, 500000
     800000, 1000000, 1300000, 2000000, 4000000, 8000000

choose speed from above: [2000000]: 1200
Configure IP on this interface? [yes]:
  IP address for this interface: 2.0.0.1
  Subnet mask for this interface [255.0.0.0]:
  Class A network is 2.0.0.0, 8 subnet bits; mask is /8
```

If IPX is configured on the router, the **setup** command facility prompts for the IPX map:

```
Do you want to map a remote machine's IPX address to dlci? [yes]:
  IPX address for the remote interface: 40.0060.34c6.90ed
```

LAPB Encapsulation

```
lapb circuit can be either in dce/dte mode
Choose either from (dce/dte) [dte]:
```

ATM-DXI Encapsulation

```
Enter VPI number [1]:
Enter VCI number [1]:
 Do you want to map the remote machine's IP address to vpi and vci's? [yes]:
    IP address for the remote interface: 6.0.0.1
 Do you want to map the remote machine's IPX address to vpi and vci's? [yes]:
     IPX address for the remote interface: 40.0060.34c6.90ed
```

SMDS Encapsulation

```
Enter smds address for the local interface: c141.5556.1415

  We will need to map the remote smds station's address to the remote stations IP address
   Enter smds address for the remote interface: c141.5556.1414

  Do you want to map the remote machine's smds address to IP address? [yes]:
    IP address for the remote interface: 2.0.0.1
 Do you want to map the remote machine's smds address to IP address? [yes]:
```

```
    IPX address for the remote interface: 40.0060.34c6.90ed
```

1-Port, 4-Wire 56-kbps DSU/CSU Configuration Setup

This section describes using **setup** command facility to configure a 1-port, 4-wire 56-kbps DSU/CSU WAN interface card. It discusses the following:

Choosing Circuit-Switched or Dedicated-Line Service

The switched-56 WAN interface card is configured for dedicated or leased-line service by default, but it can also be configured for circuit-switched service. Depending on the type of data transmissions you typically use, you can configure the switched-56 WAN interface card for circuit-switched or dedicated-line service.

Generally, circuit-switched service is ideal for short duration data transmissions or as an alternative route if a dedicated line fails. For example, circuit-switched service is ideal for sending electronic mail messages or doing such tasks as updating inventory and ordering records from one network database to another at the end of each day.

Dedicated service is ideal for heavy network traffic. Dedicated service is ideal if you need a constant network connection or you need connection for more than eight hours per day.

Switched Mode

The following is an example of a 1-port, 4-wire 56-kbps DSU/CSU switched-mode configuration using the **setup** command facility:

```
Do you want to configure Serial0/0 interface? [yes]:
   Some encapsulations supported are
             ppp/hdlc/frame-relay/lapb/atm-dxi/smds/x25
  Choose encapsulation type   [ppp]:

Switched 56k interface may either be in switched/Dedicated mode
  Choose from either (switched/dedicated)  [switched]:

The following switched carrier types are to be set when in switched mode
(at&t, sprint or other)
  Choose carrier (at&t/sprint/other)  [other]:

Do you want to map the remote machine's ip address in dialer map? [yes]:
     IP address for the remote interface : 1.0.0.2
Do you want to map the remote machine's ipx address in dialer map? [yes]:
    IPX  address for the remote interface : 40.0060.34c6.90ed
```

Note The **setup** command facility will ask for only one telephone number for both IP and IPX (if enabled).

```
Please enter the phone number to call : 1234567890
  Configure IP on this interface? [yes]:
    IP address for this interface: 1.0.0.1
    Subnet mask for this interface [255.0.0.0] :
    Class A network is 1.0.0.0, 8 subnet bits; mask is /8
```

Dedicated Mode

The following is an example of a 1-port, 4-wire 56-kbps DSU/CSU dedicated-mode configuration using the **setup** command facility:

```
Do you want to configure Serial0/0 interface? [yes]:

  Some encapsulations supported are
            ppp/hdlc/frame-relay/lapb/atm-dxi/smds/x25
  Choose encapsulation type   [ppp]:

  Switched 56k interface may either be in switched/Dedicated mode
  Choose from either (switched/dedicated)  [switched]: dedi

  When in dds mode, the clock for sw56 module can either from line/internal.
  Choose clock from (line/internal)  [line]:
```

Note If **internal** is selected, speed cannot be set to "auto." Auto-sensing is only allowed when the clock source is line.

```
When in dds mode, the clock for sw56 module can either from line/internal.
  Choose clock from (line/internal)  [line]: internal
  Warning: internal can be choose only when connected back to back.

  Serial interface needs clock rate to be set in dce mode.
  The following clock rates are supported on the serial interface.

        auto, 2.4, 4.8, 9.6, 19.2, 38.4
        56, 64

  choose clock rate from above  [56]:
  Configure IP on this interface? [yes]:
    IP address for this interface: 1.0.0.1
    Subnet mask for this interface [255.0.0.0] :
    Class A network is 1.0.0.0, 8 subnet bits; mask is /8
```

Completing the Configuration

When you have provided all the information prompted for by the **setup** command facility, the configuration appears. Some examples of the configurations of the Cisco 2600 Series, Cisco 3600 series, and Cisco 3700 series routers are shown inAppendix A, "Configuration Examples."

To complete your router configuration, do the following:

Step 1 A **setup** command facility prompt asks if you want to save this configuration.

If you answer no, the configuration information you entered is *not* saved, and you return to the router enable prompt (`2600#`). Type **setup** to return to the System Configuration Dialog.

If you answer yes, the configuration is saved and your are returned to the EXEC prompt(`2600>`).

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


Press RETURN to get started!
```

```
%LINK-3-UPDOWN: Interface Ethernet0/0, changed state to up
%LINK-3-UPDOWN: Interface Ethernet0/1, changed state to up
%LINK-3-UPDOWN: Interface Serial0/0, changed state to up
%LINK-3-UPDOWN: Interface Serial0/1, changed state to down
%LINK-3-UPDOWN: Interface Serial0/2, changed state to down
%LINK-3-UPDOWN: Interface Serial1/0, changed state to up
%LINK-3-UPDOWN: Interface Serial1/1, changed state to down
%LINK-3-UPDOWN: Interface Serial1/2, changed state to down

<Additional messages omitted.>
```

Step 2 When the messages stop displaying on your screen, press **Return** to get the `2600>` prompt.

Note If you see the next message, it means that no other AppleTalk routers were found on the network attached to the port.

```
%AT-6-ONLYROUTER: Ethernet0/0: AppleTalk port enabled; no neighbors found
```

Step 3 The `2600>` prompt indicates that you are now at the command-line interface (CLI) and you have just completed a basic router configuration. However, this is *not* a complete configuration. At this point you have two choices:

- Run the **setup** command facility again and create another configuration. Enter the following:

```
2600> enable
Password: password
2600# setup
```

- Modify the existing configuration or configure additional features with the CLI as described in Chapter 3, "Configuring with the Command-Line Interface."

Where to Go Next

At this point you can proceed to the following:

- "Chapter 3, "Configuring with the Command-Line Interface," to learn how to use the CLI to configure additional features.
- The Cisco IOS software configuration guide and command reference publications for more advanced configuration topics. These publications are available on Cisco.com, the Documentation CD-ROM that came with your router, or you can order printed copies. For more information, refer to "Obtaining Documentation."

Configuring with the Command-Line Interface

This chapter describes how to use the Cisco IOS software command-line interface (CLI) to configure basic router functionality, including:

Follow the procedures in this chapter to configure the router manually, or if you want to change the configuration after you have run the setup command facility Using the Setup Command Facility, page 2-1.

This chapter does not describe every configuration possible—only a small portion of the most commonly used configuration procedures. For advanced configuration topics, refer to the Cisco IOS configuration guide and command reference publications. These publications are available on the Documentation CD-ROM that came with your router, on the World Wide Web from Cisco's home page, or you can order printed copies separately.

Note If you skipped the previous chapter, Chapter 2, "Using the Setup Command Facility," and you have never configured a Cisco router, go back to that chapter and read it now. The chapter contains important information you need to successfully configure your router.

Configuring the Host Name and Password

One of the first configuration tasks you might want to do is configure the host name and set an encrypted password. Configuring a host name allows you to distinguish multiple Cisco routers from each other. Setting an encrypted password allows you to prevent unauthorized configuration changes.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router(config)# hostname Router` `Router(config)#`	Change the name of the router to a meaningful name. Substitute your host name for `Router`.
Step 4	`Router(config)# enable secret guessme`	Enter an enable secret password. This password provides access to privileged EXEC mode. When a user types **enable** at the EXEC prompt (`Router>`), they must enter the enable secret password to gain access to configuration mode. Substitute your enable secret for `guessme`.
Step 5	`Router(config)# line con 0`	Enter line configuration mode to configure the console port. When you enter line configuration mode, the prompt changes to `Router(config-line)#`.
	`Router(config-line)# exec-timeout 0 0`	Prevent the router's EXEC facility from timing out if you do not type any information on the console screen for an extended period.
	`Router(config-line)# exit` `Router(config)#`	Exit back to global configuration mode.

Verifying the Host Name and Password

To verify that you configured the correct host name and password:

Step 1 Enter the **show config** command:

```
Router(config)# show config
```

```
Using 1888 out of 126968 bytes
!
version XX.X
.
.
.
!
hostname Router
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1loO/w8/
.
.
.
```

Check the host name and encrypted password displayed near the top of the command output.

Step 2 Exit global configuration mode and attempt to re-enter it using the new enable password:

```
Router# exit
.
.
.
Router con0 is now available
Press RETURN to get started.
Router> enable
Password: guessme
Router#
```

Tip If you are having trouble, check the following:

- **Caps Lock** is off.
- You entered the correct passwords. Passwords are case sensitive.

Configuring 1-Port and 2-Port Ethernet Interfaces

You can configure Ethernet interfaces manually by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Timesaver Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

Before you begin configuring the Ethernet interface, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose
Step 1	`Router>` **`enable`** `Password:` *`password`* `Router#`	Enter enable mode. Enter the password. You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router#` **`configure terminal`**
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router#` **`ip routing`** `Router#` **`appletalk routing`** `Router#` **`ipx routing`**	Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.
Step 4	`Router(config)#` **`interface ethernet 0/0`** `Router(config-if)#`	Enter the interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)#` **`ip address 172.16.74.3 255.255.255.0`**	Assign the IP address and subnet mask to the interface.
Step 6	`Router(config-if)#` **`appletalk static cable-range 3-3`** `Router(config-if)#` **`appletalk zone ZZEth`** `Router(config-if)#` **`ipx network B005`**	Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.
Step 7	`Router(config-if)#` **`exit`**	Exit back to global configuration mode. Repeat Step 4 through Step 6 if your router has more that one LAN interface that you need to configure.
Step 8	`Router(config)#` **`Ctrl-z`** `Router#`	When you finish configuring interfaces, return to enable mode.

Configuring Fast Ethernet Interfaces

To configure a Fast Ethernet interface, use the configuration software provided with your router or network module, if any. Otherwise, for greatest power and flexibility use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the router prompt.

Note Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends and the router does not have a valid configuration file stored in NVRAM (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

This section describes basic configuration, including enabling the interface and specifying IP routing. Depending on your own requirements and the protocols you plan to route, you might also need to enter other configuration commands.

Before you begin configuring the interfaces, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface fastethernet 0/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ip address 172.16.74.3 255.255.255.0`	Assign an IP address and subnet mask to the interface.

Step 6	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 7	`Router(config-if)# exit`	Exit back to global configuration mode. Repeat Step 4 through Step 6 if your router has more than one interface that you need to configure.
Step 8	`Router(config)# Ctrl-z` `Router#`	When you finish configuring interfaces, return to enable mode.

Configuring Asynchronous/Synchronous Serial Network Modules or WAN Interface Cards

You can configure the serial interfaces on your asynchronous/synchronous serial network module or WAN interface card manually by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Timesaver Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access

memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

Before you begin configuring the asynchronous/synchronous serial interface, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface serial 0/0` `Router(config-if)#`	Enter the interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ip address 172.16.74.1 255.255.255.0`	Assign the IP address and subnet mask to the interface.

Step 6	`Router(config-if)# appletalk static cable-range 5-5`
	`Router(config-if)# appletalk zone ZZSerial`
	`Router(config-if)# ipx network B003`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 7	`Router(config-if)# physical-layer async`	All serial ports are initially configured as synchronous. Enter this command if you want to configure the port as asynchronous.
Step 8	`Router(config-if)# async mode dedicated` `Router(config-if)# async default routing`	Configure asynchronous parameters according to your needs.
Step 9	`Router(config-if)# line async <#>`	Configure the asynchronous line setting.
Step 10	`Router(config-if)# half-duplex timer dcd-drop-delay 100`	Specify the time that the interface waits in controlled carrier mode. See Table 3-1 for a list of half-duplex timer commands.
Step 11	`Router(config-if)# clockrate 7200`	To use a port in DCE mode, connect a DCE cable and set the internal transmit clock signal (TXC) speed in bits per second. See Table 3-2 through Table 3-5 for a list of clock rate settings for your specific interface. (For ports used in DTE mode, the router automatically uses the external timing signal.)

	Command	Purpose
Step 12	`Router(config-if)#` **`dce-terminal-timing-enable`**	When a port is operating in DCE mode, the default operation is for the DCE to send serial clock transmit (SCT) and serial clock receive (SCR) clock signals to the DTE, and for the DTE to return a serial clock transmit external (SCTE) signal to the DCE. If the DTE does not return SCTE, enter this command to configure the DCE port to use its own clock signal.
Step 13	`Router(config-if)#` **`invert-txc`**	Routers that use long cables might experience high error rates when operating at higher transmission speeds, because the clock and data signals can shift out of phase. If a DCE port is reporting a high number of error packets, inverting the clock using this command can often correct the shift.
Step 14	`Router(config-if)#` **`nrzi-encoding`**	All serial interfaces support both nonreturn to zero (NRZ) and nonreturn to zero inverted (NRZI) formats. NRZ is the default; NRZI is commonly used with EIA/TIA-232 connections in IBM environments. To enable NRZI encoding on an interface, enter this command.
Step 15	`Router(config-if)#` **`exit`**	Exit back to global configuration mode. Repeat Step 4 through Step 14 if your router has more that one serial interface that you need to configure.
Step 16	`Router(config)#` **`Ctrl-z`** `Router#`	When you finish configuring interface, return to enable mode.

Table 3-1 Half-Duplex Timer Commands

Timer	Syntax	Default Setting (Milliseconds)
CTS delay[1]	**half-duplex timer cts-delay**	100
CTS drop timeout	**half-duplex timer cts-drop-timeout**	5000
DCD drop delay	**half-duplex timer dcd-drop-delay**	100
DCD transmission start delay	**half-duplex timer dcd-txstart-delay**	100
RTS[2] drop delay	**half-duplex timer rts-drop-delay**	100
RTS timeout	**half-duplex timer rts-timeout**	2000
Transmit delay	**half-duplex timer transmit-delay**	0

1. CTS = Clear To Send.
2. RTS = Request To Send.

Table 3-2 Clock Rate Settings for 1-Port/2-Port Serial WAN Interface Card in Synchronous Mode

Timer (bits per second)	Syntax (bits per second)	Default Setting (bits per second)
1200	38400	148000
2400	56000	500000
4800	57600	800000
9600	64000	1000000
14400	72000	1300000
19200	115200	2000000
28800	125000	4000000
32000	128000	148000

Table 3-3 Clock Rate Settings for 1-Port/2-Port Serial WAN Interface Card in Asynchronous Mode

Timer (bits per second)	Syntax (bits per second)	Default Setting (bits per second)
1200	28800	72000
2400	32000	115200
4800	38400	125000
9600	56000	128000
14400	57600	
19200	64000	

Table 3-4 Clock Rate Settings for 2-Port Asynchronous/Synchronous Serial WAN Interface Card

Timer (bits per second)	Syntax (bits per second)	Default Setting (bits per second)
1200	28800	72000
2400	32000	115200
4800	38400	125000
9600	56000	128000
14400	57600	
19200	64000	

Table 3-5 Clock Rate Settings for 4-Port/8-Port Asynchronous/Synchronous Serial Network Module

Timer (bits per second)	Syntax (bits per second)	Default Setting (bits per second)
300	19200	64000
1200	28800	72000
2400	32000	115200
4800	38400	128000
9600	56000	
14400	57600	

Configuring 16-Port and 32-Port Asynchronous Network Modules

You can configure the asynchronous interface manually by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Timesaver Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

Before you begin configuring the asynchronous interface, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose
Step 1	`Router>` **`enable`** `Password:` *`password`* `Router#`	Enter enable mode. Enter the password. You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router#` **`configure terminal`**
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router#` **`ip routing`** `Router#` **`appletalk routing`** `Router#` **`ipx routing`**	Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

	Command	Purpose
Step 4	`Router(config)# interface async 45` `Router(config-if)#`	Enter the interface configuration mode and specify the asynchronous interface to configure. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ip address 172.16.74.1 255.255.255.0`	Assign the IP address and subnet mask to the interface.

Step 6	`Router(config-if)# appletalk static cable-range 5-5`
	`Router(config-if)# appletalk zone ZZAsync`
	`Router(config-if)# ipx network B003`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 7	`Router(config-if)# async mode dedicated`
	`Router(config-if)# async default routing`
	`Router(config-if)# line async 45`
	`Router(config-if)# speed 115200`
		Configure asynchronous parameters according to your needs.

Step 8	`Router(config-if)# exit`	Return to the global configuration mode and repeat Step 4 through Step 7 if your router has more than one interface that you need to configure.
Step 9	`Router(config)# Ctrl-z` `Router#`	Return to enable mode.

Configuring ISDN BRI WAN Interface Cards

You can configure the interfaces on your BRI WAN interface card manually by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Timesaver Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

Before you begin configuring the BRI interface, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router(config)# isdn switch-type basic-5ess`	Enter an ISDN switch type. See Table 3-5 for a list of ISDN switch types. **Note** Switch types configured in interface configuration mode override this setting for the configured interface.

Step 4	`Router(config)# ip routing`
	`Router(config)# appletalk routing`
	`Router(config)# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 5	`Router(config)# interface bri 0/0` `Router(config-if)#`	Enter the interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 6	`Router(config-if)# ip address 172.16.74.2 255.255.255.0` `Router(config-if)# isdn switch-type basic-5ess`	Assign the IP address and subnet mask to the interface. If you are configuring this interface for voice, enter the switch type instead of an IP address.

Step 7	`Router(config-if)# appletalk static cable-range 5-5`
	`Router(config-if)# appletalk zone ZZBRI`
	`Router(config-if)# ipx network B004`
	`Router(config-if)# isdn incoming-voice modem`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.
		If you are configuring this router for voice, use the *isdn incoming-voice modem* command.

Step 8	`Router(config-if)# exit`	Exit back to global configuration mode. Repeat Step 5 through Step 7 if your router has more than one BRI interface that you need to configure.
Step 9	`Router(config-if)# memory-size iomem 40`	By default, the router allocates 25 percent of DRAM to shared memory (used for data transmitted or received by network modules and WAN interface cards). If your router includes 16 or more ISDN BRI interfaces, you must increase the amount of shared memory by entering the **memory-size iomem** command. This example increases shared memory from 25 percent to 40 percent.
Step 10	`Router(config)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Table 3-6 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)
	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-nil1	National ISDN-1 switches

Configuring ISDN BRI Lines

Before using a router with an ISDN BRI interface, you must order a correctly configured ISDN BRI line from your local telecommunications service provider.

The ordering process varies from provider to provider and from country to country; however, here are some general guidelines:

- Ask for two channels to be called by one number.
- Ask for delivery of calling line identification, also known as caller ID or Automatic Number Identification (ANI).
- If the router will be the only device attached to the ISDN BRI line, ask for point-to-point service and a data-only line.
- If you plan to connect another ISDN device (such as an ISDN telephone) to the ISDN BRI line through the router, ask for point-to-multipoint service (subaddressing is required) and a voice-and-data line.

ISDN BRI Provisioning by Switch Type

ISDN BRI provisioning refers to the types of services provided by the ISDN BRI line. Although provisioning is performed by your ISDN BRI service provider, you must tell the provider what you want. Table 3-7 lists the provisioning you should order for your router.

Table 3-7 ISDN Provisioning by Switch Type

Switch Type	Provisioning
5ESS Custom BRI	**For data only:** 2 B channels for data Point to point Terminal type = E 1 directory number (DN) assigned by service provider MTERM = 1 Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange
5ESS Custom BRI	**For voice and data:** (Use these values only if you have an ISDN telephone connected.)| 2 B channels for voice or data Multipoint Terminal type = D 2 directory numbers assigned by service provider 2 service profile (SPIDs) required, assigned by service provider MTERM = 2 Number of cal appearances = 1 Display = No Ringing/idle call appearances = 1 Autohold = no Onetouch = no Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2
5ESS National ISDN (NI-1) BRI	Terminal type = A 2 B channels for voice or data 2 directory numbers assigned by service provider 2 SPIDs required, assigned by service provider Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2
DMS-100 BRI	2 B channels for voice or data 2 directory numbers assigned by service provider 2 SPIDs required, assigned by service provider Functional signaling Dynamic terminal endpoint identifier (TEI) assignment Maximum number of keys = 64 Release key = no, or key number = no Ringing indicator = no EKTS = no PVC = 2 Request delivery of calling line ID on Centrex lines Set speed for ISDN calls to 56 kbps outside local exchange Directory number 1 can hunt to directory number 2

Defining ISDN Service Profile Identifiers

Some service providers assign service profile identifiers (SPIDs) to define the services to which an ISDN device subscribes. If your service provider requires SPIDs, your ISDN device cannot place or receive calls until it sends a valid SPID to the service provider when initializing the connection. A SPID is usually a seven-digit telephone number plus some optional numbers, but service providers might use different numbering schemes. SPIDs have significance at the local access ISDN interface only; remote routers are never sent the SPID.

Currently, only DMS-100 and NI-1 switch types require SPIDs. Two SPIDs are assigned for the DMS-100 switch type, one for each B channel. The AT&T 5ESS switch type might support SPIDs, but Cisco recommends that you set up that ISDN service without SPIDs.

If your service provider assigns you SPIDs, you must define these SPIDs on the router. To define SPIDs and the local directory number (LDN) on the router for both ISDN BRI B channels, use the following **isdn spid** commands:

```
Router (config-if)# isdn spid1 spid-number [ldn]
Router (config-if)# isdn spid2 spid-number [ldn]
```

Note Although the LDN is an optional parameter in the command, you might need to enter it so the router can answer calls made to the second directory number.

For further information on configuring ISDN, see the chapters "Configuring ISDN" and "Configuring DDR" in the *Wide-Area Networking Configuration Guide* publication, for your Cisco IOS software release.

Configuring T1 and E1 Interfaces

To configure an ISDN PRI interface or T1/E1 multiflex trunk interface, use the configuration software provided with your router or network module, if any. Otherwise, for greatest power and flexibility use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the router prompt.

Note Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends and the router does not have a valid configuration file stored in NVRAM (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

This section describes basic configuration, including enabling the interface and specifying IP routing. Depending on your own requirements and the protocols you plan to route, you might also need to enter other configuration commands.

Before you begin configuring the interfaces, make sure you:

- Connect a console to the router.
- Power on the router.

Configuring T1 Interfaces

Use the following procedure to configure a new T1, CT1/PRI or CT1/PRI-CSU interface or to change the configuration of an existing interface.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# controller t1 1/0`	Select the CT1/PRI interface to configure. This example configures a T1 interface in slot 1 and unit 0.
Step 5	`Router(config-controller)# clock source line`	Specify which end of the circuit provides clocking. The clock source should be set to use internal clocking only for testing the network or if the full T1 line is used as the channel group. Only one end of the T1 line should be set to internal.
Step 6	`Router(config-controller)# framing esf`	Specify the framing type.
Step 7	`Router(config-controller)# linecode b8zs`	Specify the line code format.
Step 8	`Router(config-controller)# channel-group 0 timeslots 1,3-5,7`	Specify the channel group and time slots to be mapped. For multiflex trunk interfaces, only channel 0 can be configured.
Step 9	`Router(config-controller)# interface serial 1/0:0`	Configure each channel group as a virtual serial interface. Specify the T1 interface, unit number, and channel group to modify.
Step 10	`Router(config-if)# ip address 10.1.15.1 255.255.255.0`	Assign an IP address and subnet mask to the interface.

Step 11	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 12	`Router(config-if)# exit`	Exit back to global configuration mode. Return to Step 4 if your router has more than one CT1/PRI interface that you need to configure.
Step 13	`Router(config)# Ctrl-z` `Router#`	When you finish configuring interfaces, return to enable mode.

Configuring E1 Interfaces

Use the following procedure to configure a new E1 or CE1/PRI interface (balanced or unbalanced) or to change the configuration of an existing interface.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# controller e1 1/0`	Select the CE1/PRI interface to configure. This example configures an E1 interface in slot 1 and unit 0.
Step 5	`Router(config-controller)# framing crc4`	Specify the framing type.
Step 6	`Router(config-controller)# linecode hdb3`	Specify the line code format.
Step 7	`Router(config-controller)# channel-group 0 timeslots 1,3-5,7`	Specify the channel group and time slots to be mapped. For multiflex trunk interfaces, only channel 0 can be configured.
Step 8	`Router(config-controller)# interface serial 1/0:0`	Configure each channel group as a virtual serial interface. Specify the E1 interface, unit number, and channel group to modify.
Step 9	`Router(config-if)# ip address 10.1.15.1 255.255.255.0`	Assign an IP address and subnet mask to the interface.

Step 10	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 11	`Router(config-if)# exit`	Exit back to global configuration mode. Return to Step 4 if your router has more than one CE1/PRI interface that you need to configure.
Step 12	`Router(config)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Configuring TDM Connect (Data Pass-Through)

For multiflex trunk interfaces using the time-division multiplexing (TDM) connect function, you can use the **connect** command to connect two groups of DS0 timeslots from two controllers.

To configure TDM connect, complete the following steps in controller configuration mode:

	Command	Purpose
Step 1	**To configure a TDM channel group for T1:**	
a	`Router(config-controller)# tdm-group tdm-group-no timeslot timeslot-list [type {e&m | fxs [loop-start | ground-start] | fxo [loop-start | ground-start]}]`	Configure a TDM channel group for T1. If configuring cross-connect for data traffic only, do not specify the **type** option. The **type** option only applies if the **mode cas** command is enabled.
	To configure a TDM channel gorup for E1:	
b	`Router(config-controller)# tdm-group tdm-group-no timeslot timeslot-list [type {e&m | fxs [loop-start | ground-start] | fxo [loop-start | ground-start] | fxs-melcas | fxo-melcas | e&m-melcas}]`	Configure a TDM channel group for E1. The "melcas" options are supported only on E1 and apply to the Mercury Exchange Limited (MEL) Channel Associated Signaling (CAS) standard, used primarily in the United Kingdom. The MEL options help preserve CAS integrity on the line. If configuring cross-connect for data traffic only, do not specify the **type** option. The **type** option only applies if the **mode cas** command is enabled.
Step 2	`Router(config-controller)# exit`	Exit controller configuration mode.
Step 3	`Router(config)# connect id controller-1 tdm-group-no-1 controller-2 tdm-group-no-2`	Configure cross-connect pass-through between two controllers.

Configuring Codec Complexity

The number of channels that an HDV network module can support depends on the number of PVDMs that are installed and the complexity level of the codecs (vocoders) needed to support the required compression method. The HDV network module supports the following number of channels:

- Up to 6 channels per PVDM (up to 30 channels for cards with 5 PVDMs installed) for high complexity codecs (vocoders) that support the following services: G.711, G.726, G.729, G.723.1, G.728, and fax relay
- Up to 12 channels per PVDM (up to 60 channels for cards with 5 PVDMs installed) for medium complexity codecs (vocoders) that support the following services: G.711, G.726, G.729a, and fax relay

Each HDV network module can support only one type of compression complexity (either high or medium), although HDV network modules with different compression complexity types can be installed in the same router.

Use the following procedure to configure the codec (vocoder) complexity on your HDV network module.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router(config)# voice-card {0-4}`	Select the voice card to configure.
Step 4	`Router(config-voicecard)# codec complexity {high |medium}`	Specify the compression complexity for the voice card.One complexity type is allowed per router.
Step 5	`Router(config-voicecard)# exit`	Exit back to global configuration mode. Return to Step 3 if your router has more than one voice card that you need to configure.
Step 6	`Router(config)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Configuring T1 (FT1) WAN Interface Cards

The 1-port T1 and fractional (FT1) WAN interface card includes an integrated data service unit/channel service unit (DSU/CSU) and can be configured either for full T1 service at 1.544 Mbps or for fractionalized T1 service. You can configure the interfaces on your T1 WAN interface card manually by entering Cisco IOS commands on the command line. This method, called configuration mode, provides the greatest power and flexibility.

Timesaver Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it ON, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

Before you begin configuring the BRI interface, make sure you:

- Connect a console to the router.
- Power on the router.

Default Configuration

The Cisco IOS software provides the following default configuration for CSU/DSU- and T1-specific parameters:

```
service-module t1 clock source line
service-module t1 data-coding normal
service-module t1 timeslots all speed 64
service-module t1 framing esf
```

```
service-module t1 lbo none
service-module t1 linecode b8zs
no service-module t1 remote-alarm-enable
service-module t1 remote-loopback
no service-module t1 fdl
```

To change this configuration, enter commands in configuration mode, as described in the next section. To view the current configuration, enter the **show service-module** *serial slot/port* command. For further information about these commands, refer to the Cisco IOS configuration guides and command references.

	Command	Purpose
Step 1	`Router>` **`enable`** `Password:` *`password`* `Router#`	Enter enable mode. Enter the password. You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router#` **`configure terminal`**
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router#` **`ip routing`** `Router#` **`appletalk routing`** `Router#` **`ipx routing`**	Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.
Step 4	`Router(config)#` **`interface serial 0/0`** `Router(config-if)#`	Enter the interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)#` **`ip address 172.16.74.2 255.255.255.0`**	Assign the IP address and subnet mask to the interface
Step 6	`Router(config-if)#` **`no keepalive`** `Router(config-if)#` **`appletalk static cable-range 5-5`** `Router(config-if)#` **`appletalk zone ZZ`** `Router(config-if)#` **`ipx network B004`**	Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.
Step 7	`Router(config-if)#` **`service-module t1 framing sf`** `Router(config-if)#` **`service-module t1 linecode ami`**	Enter the framing type and linecode type. In this example, the framing type specified is `sf` (Superframe) and the linecode specified is `ami`.
Step 8	`Router(config-if)#` **`service-module t1 timeslots 1-20 speed 64`**	If you are using fractional T1 service, enter the time slot range and speed. In this example, the time slot range specified is from 1 to 20, and the speed specified is 64 kbps.
Step 9	`Router(config-if)#` **`exit`**	Exit back to global configuration mode. Repeat Step 4 through Step 8 if your router has more than one interface that you need to configure.
Step 10	`Router(config)#` **`Ctrl-z`** `Router#`	When you finish configuring interfaces, return to enable mode.

Configuring ATM Interfaces

To configure an ATM interface, you must use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the router prompt.

Note Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

This section describes basic configuration, including enabling the interface and specifying IP routing. Depending on your own requirements and the protocols you plan to route, you might also need to enter other configuration commands.

Configuring PVCs

To configure the ATM interface with PVCs, follow this procedure:

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface atm 1/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ip address 192.168.74.3 255.255.255.0`	Assign an IP address and subnet mask to the interface.

Step 6	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

	Command	Purpose
Step 7	`Router(config-if)# pvc 0/100`	Configure a new ATM PVC. Enter interface-ATM-VC configuration mode. The PVC command has the format **pvc** [name] *vpi/vci* [**ilmi**|**qsaal**] You have entered interface-ATM-VC configuration mode when the prompt changes to `Router(config-if-atm-vc)`.
Step 8	`Router(config-if-atm-vc)# protocol ip 200.200.200.2 broadcast`	Map the PVC to an address.
Step 9	`Router(config-if-atm-vc)# exit`	Exit back to global configuration mode. Repeat Step 4 through Step 8 if your router has more than one interface that you need to configure.
Step 10	`Router(config)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Configuring SVCs

To configure the ATM interface with switched virtual circuits (SVCs), follow this procedure:

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface atm 1/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# pvc 0/5 qsaal`	Configure a signaling channel for the SVC.
Step 6	`Router(config-if-atm-vc)# exit`	Exit back to interface configuration mode.
Step 7	`Router(config-if)# pvc 0/6 ilmi`	Configure additional signaling channels for the SVC.
Step 8	`Router(config-if-atm-vc)# exit`	Exit back to interface configuration mode.
Step 9	`Router(config-if)# ip address 192.168.74.3 255.255.255.0`	Assign an IP address and subnet mask to the interface.

	Command	Purpose

Step 10	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 11	`Router(config-if)# svc nsap BC.CDEF.01.234567.890A.BCDE.F012.3456.7890.1234.12`	Configure the signaling PVC and the ATM network service access point (NSAP) address. The signaling PVC command has the format **svc** [name] **nasp** <20-byte address>. You have entered interface-ATM-VC configuration mode when the prompt changes to `Router(config-if-atm-vc)`.
Step 12	`Router(config-if-atm-vc)# protocol ip 200.200.200.2 broadcast`	Map the PVC to an address.
Step 13	`Router(config-if-atm-vc)# exit`	Exit back to global configuration mode. Repeat Step 4 through Step 12 if your router has more than one interface that you need to configure.
Step 14	`Router(config)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Configuring Inverse Multiplexing for ATM Interfaces

To configure an inverse multiplexing for ATM (IMA) interface, you must use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the router prompt.

Note Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on, if there is a WAN connection on both ends and the router does not have a valid configuration file stored in nonvolatile random-access memory (NVRAM) (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

This section describes basic configuration, including enabling the interface and specifying IP routing. Depending on your own requirements and the protocols you plan to route, you might also need to enter other configuration commands.

Note The T1/E1 physical layer information is configured underneath an interface called `interface atm`.

The ATM interfaces (representing the individual T1/E1 interfaces) are automatically created depending on the configuration of the individual T1/E1 interfaces. You cannot directly add or delete these interfaces.

Each port can be used as an independent T1/E1 ATM port with all the properties and functionality of ATM interfaces. When the port becomes part of an IMA group, its ATM functionality ceases. At the same time, the IMA group can use ATM commands.

Note On the 8-port E1 or T1 network module, only four ATM layer interfaces can be operational at the same time. All the interfaces can be activated (configured as "no shutdown") but only four at a time can be operational and pass network traffic.

Configuring the ATM T1/E1 Interface

To configure the ATM interface, follow this procedure:

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface atm 1/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ima clock line`	Enter the transmit clock mode for the selected ATM interface. The choices are **internal**, **line**, or **loop**. The default is **line**.
Step 6	`Router(config-if)# cablelength short 133`	For T1 interfaces only, specify the cable length (**short** or **long**) followed by the length in feet. You can view the acceptable cable lengths by including the **?** option after the **long** or **short** commands.
Step 7	`Router(config-if)# loopback local`	Specify the loopback type for this ATM interface by entering the **loopback** command followed by one of the following: **line**, **local**, **payload**, **remote**. You can view command descriptions by including the **?** option after the **loopback** command.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface atm 1/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ima clock line`	Enter the transmit clock mode for the selected ATM interface. The choices are **internal**, **line**, or **loop**. The default is **line**.
Step 6	`Router(config-if)# cablelength short 133`	For T1 interfaces only, specify the cable length (**short** or **long**) followed by the length in feet. You can view the acceptable cable lengths by including the **?** option after the **long** or **short** commands.
Step 7	`Router(config-if)# loopback local`	Specify the loopback type for this ATM interface by entering the **loopback** command followed by one of the following: **line**, **local**, **payload**, **remote**. You can view command descriptions by including the **?** option after the **loopback** command.

Configuring the IMA Interface

To configure the IMA interface, follow this procedure:

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface atm 1/0` `Router(config-if)#`	Enter interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ima-group 2`	Assign the ATM interface to an IMA group (numbered from **0** to **3**). The interface is now assigned to a group and ATM functionality is no longer available for the individual link.
Step 6	`Router(config-if)# no shutdown`	Enable the individual link by canceling the shutdown state. **Note** The **no shutdown** command at this point activates the individual ATM link. If this command is omitted, the ATM link is added to the group but is "inhibited" at the IMA protocol level. This would prevent it from carrying network traffic. Repeat Step 4 through Step 6 if your router has more than one interface that you need to configure.
Step 7	`Router(config-if)# interface atm2/ima3`	Create the IMA group interface. **Note** The group interface is deleted with the **no interface atm 2/ima 3** command.
Step 8	`Router(config-if)# ima clock-mode common`	Select the transmit clock mode for the selected IMA group. The choices are **common** or **independent**.
Step 9	`Router(config-if)# ima differential-delay-maximum 75`	Enter the maximum differential delay in milliseconds for the selected IMA group.
Step 10	`Router(config-if)# ima active-links-minimum 2`	Enter the minimum number of links that need to be operational for the selected IMA group.
Step 11	`Router(config-if)# ima test link 4`	Select the test port for the selected IMA group. The link number is one of the physcial ports on the network module.
Step 12	`Router(config-if)# ip address 192.168.74.3 255.255.255.0`	Assign an IP address and subnet mask to the interface.

	Command	Purpose

Step 13	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 14	`Router(config-if)# no shutdown`	Enable the IMA group by canceling the shutdown state.
Step 15	`Router(config-if)# Ctrl-z` `Router#`	When you finish configuring interfaces, return to enable mode.

Checking the IMA Configuration

After configuring the new IMA interface, you can perform the following tests to verify that the new interface is operating correctly:

- Enter the **show ima interface atm1/3** command to verify information for the specified IMA group.
- Enter the **show controllers atm0/ima2** command to display IMA diagnostic information for the specified group.

If an interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, make sure that the new interface is properly connected and configured.

Configuring Analog Modem Interfaces

To configure an analog modem interface, use the configuration software provided with your router or modem network module, if any. Otherwise, use configuration mode (manual configuration). In this mode, you enter Cisco IOS commands at the router prompt.

Note Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends and the router does not have a valid configuration file stored in NVRAM (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

This section describes basic configuration, including enabling the interface and specifying IP routing. Depending on your own requirements and the protocols you plan to route, you might also need to enter other configuration commands.

Note This section does not describe modem AT commands. For information about these commands, see the *AT Command Set and Register Summary for Analog Modem Network Modules* publication on Cisco.com, or Documentation CD-ROM.

Before you begin configuring the interfaces, make sure you:

- Connect a console to the router.
- Power on the router.

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enter enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# configure terminal`
	`Enter configuration commands, one per line. End with CNTL/Z.`
	`Router(config)#`
		Enter global configuration mode. You have entered global configuration mode when the prompt changes to `Router(config)#`.

Step 3	`Router# ip routing`
	`Router# appletalk routing`
	`Router# ipx routing`
		Enable routing protocols as required for your global configuration. This example uses IP routing, AppleTalk routing, and Internetwork Packet Exchange (IPX) routing.

Step 4	`Router(config)# interface async 45` `Router(config-if)#`	You can configure asynchronous interfaces either individually or as a group. This command selects an individual interface to configure. The prompt changes to `Router(config-if)#`.
Step 5	`Router(config-if)# ip address 172.16.74.1 255.255.255.0`	Assign an IP address and subnet mask to the interface.
Step 6	`Router(config)# interface group-async 1`	Assign asynchronous interfaces to a group so you can configure them together.
Step 7	`Router(config-if)# ip unnumbered ethernet 0`	Configure the asynchronous interface group as unnumbered and assign the IP address of the Ethernet interface to the group.
Step 8	`Router(config-if)# peer default ip address pool default`	Define the pool of addresses at the global level.
Step 9	`Router(config-if)# group-range 1 16`	Define the group range of the interface. This command defines the range as all modems in slot 0.

Step 10	`Router(config-if)# appletalk static cable-range 3-3`
	`Router(config-if)# appletalk zone ZZEth`
	`Router(config-if)# ipx network B005`
		Configure routing protocols on the interface or group. You must have previously enabled these protocols as part of global configuration. In this example, AppleTalk and IPX are being configured on the interface.

Step 11	`Router(config-if)# async mode interactive`
	`Router(config-if)# async default routing`
	`Router(config-if)# encapsulation ppp`
	`Router(config-if)# ppp authentication chap pap`
		Configure asynchronous parameters according to your needs.

Step 12	`Router(config-if)# exit`	Exit back to global configuration mode. Return to Step 4 if your router has more than one interface that you need to configure.
Step 13	`Router(config)# modem country microcom_hdms country-name`	Set modem parameters (including encoding) to the correct country. Table 3-8 shows country codes. The default is usa.
Step 14	`Router(config-if)# line 1 16`	Enter the modem line or range of modem lines to configure.

	Command	Purpose
Step 15	`Router(config-line)# transport input all`	Allow all protocols to be used when connecting to the line.
Step 16	`Router(config-line)# autoselect ppp`	Enable remote IP users running a PPP application to dial in, bypass the EXEC facility, and connect directly to the network.
Step 17	`Router(config-line)# modem inout`	Enable incoming and outgoing calls.
Step 18	`Router(config-if)# Ctrl-z`	When you finish configuring interfaces, return to enable mode.

Table 3-8 Modem Country Codes

Country Codes			
argentina	Finland	japan	saudi-arabia
australia	France	korea	singapore
austria	Germany	malaysia	south-africa
belgium	Greece	mexico	spain
brazil	hong-kong	netherlands	sweden
canada	hungary	new-zealand	switzerland
chile	india	norway	taiwan
china	indonesia	peru	thailand
columbia	ireland	philippines	united-kingdom
czech-republic	israel	poland	usa
Denmark	italy	portugal	

Checking the Modem Configuration

After configuring the new modem interface, you can perform the following tests to verify that the new interface is operating correctly:

- To verify your group interface configuration, enter the **show interface async** command.
- To display a summary for all modem lines, enter the **show line** command.
- To display a summary for a single modem line, enter the **show line** *number* command.

If an interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, make sure that the new interface is properly connected and configured.

Configuring Wireless Multipoint Interfaces

The configuration process for the fixed wireless multipoint subscriber-unit is automated. For information about the following optional configuration tasks, see the *Multipoint Wireless Support for the Cisco 2600 and Cisco 3600 Series Routers* feature module:

- Specifying an alternative boot location
- Configuring cable loss

- Configuring RF loopback

Checking the Interface Configuration

After configuring the new interface, you can perform the following tests to verify that the new interface is operating correctly:

- Display the router hardware configuration with the **show version** command. Check that the list includes the new interface.
- Display all network modules and their interfaces with the **show controllers** command.
- Specify an interface with the **show interfaces** [*type slot/port*] command and verify that the first line of the display shows the interface with the correct slot and port number, and that the interface and line protocol are in the correct state, up or down.
- Display the protocols configured for the entire router and for individual interfaces with the **show protocols** command. If necessary, return to configuration mode to add or remove protocol routing on the router or its interfaces.
- Display the running configuration with the **show running-config** command, and the configuration stored in NVRAM using the **show startup-config** command.
- Use the **ping** command to send an echo request to a specified IP address. Each returned signal is displayed as an exclamation point (!) on the console; each signal that is not returned before the timeout is displayed as a period (.). A series of exclamation points (!!!!!) indicates a good connection; a series of periods (.....) or the message “timed out” or “failed” indicate that the connection failed.

If an interface is down and you configured it as up, or if the displays indicate that the hardware is not functioning properly, make sure that the new interface is properly connected and configured.

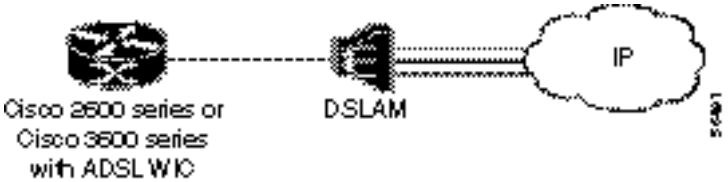
Configuring 1-Port ADSL WAN Interface Card

The ADSL WAN interface card is a 1-port WAN interface card (WIC) for the Cisco 2600 series and Cisco 3600 series routers. The card provides asymmetric digital subscriber line (ADSL) high-speed digital data transfer between a single customer premises equipment (CPE) subscriber and the central office.

The ADSL WIC is compatible with the Alcatel Digital Subscriber Loop Access Multiplexer (DSLAM) and the Cisco 6130, Cisco 6160, and Cisco 6260 DSLAMs with Flexi-line cards. It supports Asynchronous Transfer Mode (ATM) Adaptation Layer 2 (AAL2) and AAL5 for the Cisco 2600 series and Cisco 3600 series platforms for both voice and data service.

The general topology is shown in Figure 3-1.

Figure 3-1 General Topology for ADSL WIC



Note ADSL is a last-mile access technology, which has an asymmetrical data rate running over a single copper wire pair.

Benefits

- Enables business class broadband service with voice integration, scalable performance, flexibility, and security.
- Aggregates both ADSL and other transport options into a single box.
- Provides both POTS and ADSL high-speed digital data transmissions between the customer premises equipment (CPE) and the central office (CO).
- Supports ITU G.992.1 (or G.DMT, which specifies full-rate ADSL).
- Supports and complies with ANSI T1.413 issue 2, and ITU G.992.1 (G.DMT for full-rate ADSL).
- Supports ATM AAL2 and AAL5 services on the Cisco 2600 series and Cisco 3600 series platforms.
- Supports applications (including VoATM voice), ATM class of service, variable bit rate-nonreal time [VBR-NRT], variable bit rate-real time [VBR-rt], and unspecified bit rate [UBR]) and up to 23 virtual circuits on a WIC.
- Provides ATM traffic management to enable service providers to manage their core ATM network infrastructures.

Restrictions

- The ADSL WAN interface card does not support dual latency. When the ADSL link is intended to support both voice and data traffic simultaneously, the link should be configured for either all fast-path data or all interleave data with an interleave depth of zero to insure that latency is minimized. In addition, the total supported data rate must be reduced to adjust for the reduced coding gain, which is usually present with high-latency traffic.
- The ADSL WAN interface card does not support available bit rate (ABR) class of service (CoS).
- For the Cisco 2600 series routers, the ADSL WAN interface card should be inserted only into on-board WIC slots or 2W network modules. This card does not function properly in older network modules.
- For the Cisco 3600 series routers, the ADSL WAN interface card should be inserted only into onboard WIC slots or 2W, 1FE2W, 2FE2W, or 1FE1R2W network modules. This card does not function properly in older network modules.
- When using AAL2, analog voice is not supported. Voice calls should come through a digital voice card, such as the NM-HDV.
- VoATM is supported in both AAL2 and AAL5 modes on the Cisco 2600 series and Cisco 3600 series routers.
- VoATM AAL2 and AAL5 are supported only if voice and data use separate permanent virtual circuits (PVCs).
- VoATM AAL2 supports digital voice (T1/E1) only, while VoATM AAL5 supports both analog and digital voice.
- VoIP is not supported unless the ADSL WIC carries only voice traffic (with no data). The QoS features necessary for VoIP and data sharing the same PVC, or different PVCs on the same interface, are not supported yet. These features include LLQ, LFI, and tx-ring tuning.

Prerequisites

A 1-Port ADSL WIC must be installed in the router to match the DSL service to be configured.

Configuration Tasks

See the following sections for configuration tasks for this feature. Each task in the list is identified as either required or optional:

- Configuring the ADSL Port on the ADSL WAN Interface Card (required)
- Verifying ATM Configuration (optional)

Features used on the ADSL WAN interface card must also be configured on the DSLAM. See the documentation for the specific DSLAM for information about configuring features.

Configuring the ADSL Port on the ADSL WAN Interface Card

To configure an ADSL port on the ADSL WAN interface card, complete the following steps:

	Command	Purpose
Step 1	`Router> configure terminal`	Enter global configuration mode.
Step 2	`Router(config)# interface atm slot/port`	Enter ATM configuration mode for the ATM interface in the specified slot and port.
Step 3	`Router(config-if)# ip address IP-address`	Assign an IP address to the ADSL ATM interface.
Step 4	`Router(config-if)# pvc [name] vpi/vci`	Entes atm-virtual-circuit (interface-atm-vc) configuration mode, and configures a new ATM PVC by assigning a name (optional) and virtual path identifier (VPI)/virtual channel identifier (VCI) numbers. The default traffic shaping is UBR; the default encapsulation is AAL5+LLC/SNAP.
Step 5	`Router(config-if-vc)# protocol ip IP-address`	(Optional) Enable IP connectivity and create a point-to-point IP address for the virtual circuit (VC).
Step 6	`Router(config-if-vc)# vbr-rt peak-rate average-rate burst`	(Optional) Configure the PVC for real-time variable bit rate (VBR) traffic shaping. • *peak rate*—Peak information rate (PIR) • *average rate*—Average information rate (AIR) • *burst*—Burst size in cells
Step 7	`Router(config-if-vc)# encapsulation {aal2 | aal5ciscoppp | aal5mux | aal5nlpid | aal5snap}`	(Optional) Configure the ATM adaptation layer (AAL) and encapsulation type. • *aal2*—AAL2 • *aal5ciscoppp*—Cisco PPP over AAL5 • *aal5mux*—AAL5+MUX • *aal5nlpid*—AAL5+NLPID • *aal5snap*—AAL5+LLC/SNAP (the default)

	Command	Purpose
Step 8	`Router(config-if-vc)# exit`	Exit from interface-atm-vc configuration mode.
Step 9	`Router(config-if)# dsl operating-mode {ansi-dmt | auto | itu-dmt | splitterless}`	Configure the ADSL interface to operate in a specified mode: • *ansi-dmt*—ANSI full rate mode per T1.413 (ITU G.DMT Issue 1) • *auto*—Automatic detection mode • *itu-dmt*—ITU full rate mode (ITU G.DMT Issue 1) • *splitterless*—G.lite mode per ITU G.992.2 **Caution** This command is for testing or lab environments only. Using a configuration other than the default configuration for the DSL operating mode can lead to unpredictable behavior on the ADSL line.
Step 10	`Router(config-if)# no shutdown`	Activate the ATM interface.
Step 11	`Router(config-if)# exit`	Exit from ATM interface configuration mode.
Step 12	`Router(config)# exit`	Exit from global configuration mode.
Step 13	`Router# show interface atm 1/0`	Verify the ATM interface configuration.

Verifying ATM Configuration

Use the following commands to verify configuration:

- To verify current configuration and to view the status for all controllers, use the **show running-config** command.
- To view ATM controller statistics, use the **show controllers atm** *slot/port* command.
- To verify the PVC status, use the **show atm vc** command. Make sure that active PVCs are up.
- To help identify ATM-related events as they are generated, use the **debug atm events** command.
- To indicate what interfaces are having trouble, use the **debug atm errors** command.
- To identify an entry for the ATM interface you configured and to show an entry for the ATM slot/port you configured, use the **show ip route** command.
- To display the configured list of ATM static maps to remote hosts on an ATM network, use the **show atm map** command.
- To view the status of ATM interface, use the **show interface atm** *slot/port* command. Make sure that ATM slot/port and line protocol is up, as shown in the following example:

```
Router# show interface atm1/0
ATM 1/0 is up, line protocol is up
  Hardware is DSLSAR (with Alcatel ADSL Module)
  MTU 4470 bytes, sub MTU 4470, BW 800 Kbit, DLY 2560 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Keepalive not supported
```

```
  Encapsulation(s):AAL5 AAL2, PVC mode
  24 maximum active VCs, 256 VCs per VP, 2 current VCCs
  VC idle disconnect time:300 seconds
  Last input never, output 00:00:01, output hang never
  Last clearing of "show interface" counters 03:16:00
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     2527 packets input, 57116 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     10798 packets output, 892801 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out


Router# show atm vc

VCD /                                        Peak  Avg/Min Burst
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells  Sts
1/0.3       2           9    36   PVC    MUX      UBR     800                UP
1/0.2       1           9    37   PVC    SNAP     UBR     800                UP


Router# show controllers atm 1/0

Interface ATM1/0 is up
  Hardware is DSLSAR (with Alcatel ADSL Module)
IDB:    62586758  Instance:6258E054  reg_dslsar:3C810000  wic_regs:3C810080
PHY Inst:62588490  Ser0Inst:62573074  Ser1Inst: 6257CBD8  us_bwidth:800
Slot:   1         Unit:    1         Subunit:  0         pkt Size:4496
VCperVP:256       max_vp:  256       max_vc:   65536     total vc:2
rct_size:65536     vpivcibit:16        connTblVCI:8         vpi_bits:8
vpvc_sel:3         enabled: 0         throttled:0

WIC    Register   Value      Notes
--------------   ---------- ----------
FPGA Dev ID (LB)  0x44       'D'
FPGA Dev ID (UB)  0x53       'S'
FPGA Revision     0x99
WIC Config Reg    0x45       WIC / VIC select = WIC;
                             CTRLE addr bit 8 = 1;
                             OK LED on;
                             LOOPBACK LED off;
                             CD LED on;
WIC Config Reg2   0x07       Gen bus error on bad ADSL access
Int 0 Enable Reg  0x03       ADSL normal interrupt enabled
                             ADSL error interrupt enabled
```

Configuration Examples

Examples of the following configurations are described in Appendix A, “Configuration Examples,”on page A-1:

- VoATM over AAL2 on the ATM Interface Configuration Example, page A-12
- VoATM over AAL5 on the ATM Interface Configuration Example, page A-14

Configuring the NM-AIC-64, Contact Closure Network Module

The Alarm Interface Card Network Module (AICNM) is an optional card that expands network management capabilities for customer-defined alarms. The AIC has its own CPU that communicates with the router and external media through serial communication channels. The AIC reduces service provider and enterprise operating costs by providing a flexible, low-cost network solution for migrating existing data communications networks (DCNs) to IP-based DCNs. The AIC provides its users with a single “box” solution because it can be configured in the same router along with other operation, alarm, maintenance, and provisioning (OAMP) interfaces.

More than one AIC can be installed per router. For example, a Cisco 3662 can have up to five AICs, and its sixth NM slot can be used for router communication. The Cisco 3640 can have up to three AICs, with the fourth NM slot reserved for communication, and so forth.

The AIC provides a total of 64 alarm inputs. Eight of the 64 point are software configurable for measuring either analog inputs or discrete inputs. The remaining 56 points are fixed to measure discrete points only. The AIC also provides 16 control relay outputs.

The discrete alarm input can be activated through ground or negative battery input. The negative battery range is -36V to -72V. The analog alarm is software configurable for either DC voltage or current. It can measure voltage from -60 to 60V or current from 0 to 20mA, but the configurable range is 4 mA to 20mA. The standard 16 control relays can be configured to turn on or turn off an external device.

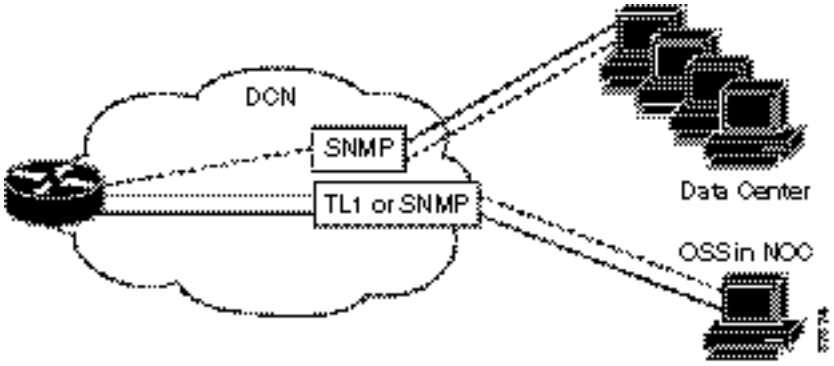
The AIC’s 64 input contact points can control and monitor network elements and other non-intelligent interfaces, permitting the detection and report of alarms such as the following:

- Network element alarm states
- Building security (door and window open and close)
- Fire and smoke indication
- Building environmentals (temperature and humidity)
- Utility power readings

When an event occurs, such as a door alarm or an open gate, the AIC maps the simple discrete and analog alarms to preprogrammed intelligent messages and transports the messages to destinations in the IP network, typically to a Network Operations Center (NOC). These messages are generated either in Transaction Language 1 (TL1) or in Simple Network Management Protocol (SNMP), which are used by a NOC’s Operations Support System (OSS).

When the AIC is incorporated into the Cisco DCN solution platforms, all the AIC’s contact-closure alarms are routed and reported through the same network and systems as the intelligent network elements (NEs). This facilitates continued use of the existing OSS and its associated networks. A Cisco router with an AIC sends TL1 or SNMP messages to the OSS autonomously or in response to TL1 or SNMP commands from the OSS, as shown in Figure 3-2. TL1 supports two sessions, with the port numbers 5011 and 5012, respectively, and SNMP supports four sessions.

Figure 3-2 TL1 and SNMP Message Flow in a DCN Application

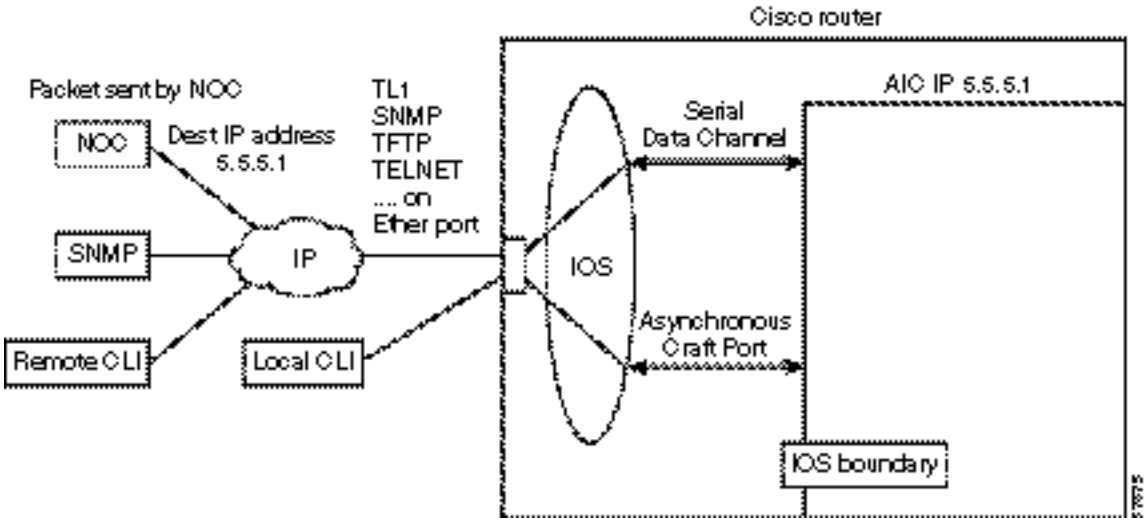


Serial Communication Channels

As illustrated in Figure 3-3, the AIC has two serial communications channels that provide different types of interfaces to Cisco IOS software:

- Serial data channel
- Asynchronous craft port

Figure 3-3 OS Boundary into the AIC



Serial Data Channel

The serial data channel supports all TCP/IP traffic to and from the AIC. This includes communication over IP with NOCs and data centers. The channel consists of one physical interface that provides support for the following applications:

- Telnet
- TL1
- TFTP

- SNMP

The Cisco IOS software assigns an IP address to the AIC for use by the serial data channel. To route traffic, the serial data channel uses IP over synchronous High-Level Data Link Control (HDLC). All IP packets coming to the Cisco router with a destination IP address that matches the AIC's IP address are forwarded to the serial data channel using IP over HDLC.

Asynchronous Craft Port

The asynchronous craft port supports Telnet to the AIC's port number. This Telnet method, called local-CLI, is useful for debugging when remote Telnet to the AIC's IP address (remote-CLI) is not applicable. For more information, see the "Configuring the NOC IP Address" section on page 3-40.

The asynchronous craft port also supports an AIC boot sequence, similar to the ROM monitor in Cisco IOS software, which allows the user to recover from a corrupted software image or configuration. See the "Override" section on page 3-46.

Configuring the AIC

From a top-level view, AIC configuration involves assigning an IP address to the AIC using Cisco IOS commands and setting up alarm configurations with either TL1 or the AIC command-line interface (CLI). The flexible TL1 and AIC CLI permit a broad range of alarm configuration scenarios. The following are examplesof alarm configurations that can be programmed with the AIC CLI:

Configuring a Discrete Alarm

```
enable
config terminal
alarm 1
description "west door"
normally closed
description normal "door closed"
description alarm "door open"
level 2
exit
```

Configuring an Analog Alarm as an Analog Monitoring Voltage

```
enable
config terminal
alarm 57
description "tank level"
description normal "full"
description low "low"
description low-low "empty"
analog voltage 2.5 30 60 60
exit
```

Configuring an Analog Alarm as a Discrete Monitoring Current

```
enable
config terminal
alarm 58
description "east door"
discrete current-loop 0.0 3.2 5.9
```

```
exit
```

Configuring an Analog Alarm as a Discrete Monitoring Voltage

```
enable
config terminal
alarm 58
description "backup battery"
discrete voltage 9.0 high
exit
```

Configuring an Analog Alarm to Act Like a Discrete Alarm (Minimal Configuration Method)

```
enable
config terminal
alarm 59
discrete
exit
```

Configuration Tasks

See the following sections for configuration tasks for the AIC feature. Each task in the list is identified as either required or optional:

- Configuring the AIC, page 3-37 (required)
  - Entering Alarm Configuration Mode and Configuring the AIC IP Address, page 3-37
  - Configuring the IP Route to the AIC, page 3-38
- Configuring the NOC IP Address, page 3-40 (optional)
- Configuring Alarms, page 3-41 (optional)

Configuring the AIC

Cisco IOS commands are used for configuring the AIC IP address and the IP routing to the AIC NM. After the IP address and the IP routing are set, alarm configurations can then be set up with either TL1 or the AIC command-line interface. See the"Configuring the NOC IP Address" section on page 3-40 or the "Configuring Alarms" section on page 3-41 for more information.

The following sections describe how to configure the AIC IP address and the IP Routing to the AIC NM.

Entering Alarm Configuration Mode and Configuring the AIC IP Address

Enter alarm configuration mode and configure the AIC IP address, beginning in privileged EXEC mode:

Table 3-9 Configuring IP Routing to the AIC with an Unnumbered IP Address

	Command	Purpose
Step 1	`Router# show run`	Determines if the AIC is installed correctly in the router. If the AIC has been installed correctly, then the following appears: `interface serial`*`slot/port`* where the slot is the slot in which the AIC is inserted, and the port is 0.
Step 2	`Router# configure terminal`	Starts the configuration session.
Step 3	`Router(config)# alarm-interface` *`slot`*	Enters the AIC interface mode, specifying the slot number into which the AIC is installed.
Step 4	`Router(config-aic)# ip address` *`ip-address mask`*	Enters the IP address of the AIC. Entering a mask is optional, because the IP address does not use a subnet address.
Step 5	`Router(config-aic)# reset`	Resets the AIC. Changing the IP configuration may not take until the next time the card is started. The **reset** command restarts the card.
Step 6	`Router(config-aic)# exit`	Exits the AIC interface mode.

Configuring the IP Route to the AIC

There are many ways to configure IP routing to the AIC. Below are two methods. The first method, shown in Table 3-10, uses an unnumbered IP address. It is used when an administrator wants to assign an IP address that is already known to the router, such as an address that is one of the addresses in the subnet of a FastEthernet IP address.

The second method, shown in Table 3-11, does not use an unnumbered IP address and is used when there is a subnet available to the serial interface and to the AIC. Usually this subnet is small with a subnet mask such as 255.255.255.252.

Configure IP routing to the AIC, beginning in global configuration mode:

Table 3-10 Configuring IP Routing to the AIC with an Unnumbered IP Address

	Command	Purpose
Step 1	`Router(config)# ip route network-number network-mask {IP address | interface} [distance] [name name]`	Establish the discrete IP route and mask on the router's serial interface. The arguments have the following meanings: *network-number*—IP address of the target network or subnet. *network-mask*—Network mask that lets you mask network and subnetwork bits. *IP address*—Internet address of the next hop that can be used to reach that network in standard IP address notation. Example: 10.1.1.1. *interface*—Network interface to use. *distance*—(Optional) An administrative distance, which is a rating of the trustworthiness of a routing information source, such as an individual router or a group of routers. **name** *name*—(Optional) Name of the user profile. Example: `Router(config)#ip route 10.5.5.2 255.255.255.255 serial2/0`
Step 2	`Router(config)# interface serial slot/port`	Enter serial interface mode. Enter the slot in which the AIC is installed and port 0.
Step 3	`Router(config-if)# ip unnumbered type interface-number`	Enable IP processing on the serial interface to the AIC without assigning an explicit IP address to the interface. The *type* and *interface-number* arguments indicate another interface on which the router has an assigned IP address. The other interface cannot be an unnumbered interface, because only an interface that has its own IP address can be used to "lend" its IP to the serial port. Enter, for example: `Router(config-if)# ip unnumbered FastEthernet 0/0`
Step 4	`Router(config-if)# exit`	Exit serial interface mode.

Table 3-11 Configuring IP Routing to the AIC without an Unnumbered IP Address

	Command	Purpose
Step 1	`Router(config)# interface serial slot/port`	Enter the serial interface mode. Enter the slot in which the AIC is installed and the port 0.
Step 2	`Router(config-if)# ip address ip-address network-mask`	Specifie the IP address and mask of the router's serial interface to the AIC. For example: `Router(config)# ip route 10.5.5.1 255.255.255.0`
Step 3	`Router(config-if)# exit`	Exits the serial interface mode.

Accessing the AIC

Remote-CLI and local-CLI are the two methods for accessing the AIC:

- Remote-CLI involves telneting to the IP address of the AIC. For example:

  ```
  telnet 10.5.5.2
  ```

- Local-CLI involves accessing the asynchronous craft port by telneting to the IP address of the router and the AIC's TCP port number. For example:

  ```
  telnet 10.2.130.105 2001
  ```

  where 10.2.130.105 is the router's IP address and 2001 is on slot 0 of the AIC.

  The AIC's TCP port number depends on the slot number in which the AIC is installed. As shown in Table 3-12, the Cisco IOS software reserves the first line of each slot for the asynchronous craft port.

Table 3-12 TCP Port Number Allocation for the AIC on the Cisco 2600 and Cisco 3600 Series

Slot Number	Terminal Line Number for the AIC's Asynchronous Craft Port	TCP Port Number
0	1	2001
1	33	2033
2	65	2065
3	97	2097
4	129	2129
5	161	2161
6	193	2193

Configuring the NOC IP Address

Configure up to four NOC IP addresses to which the AIC will send SNMP messages, beginning in global configuration mode:

Note The *aic* command-line prompt indicates that either TL1 or AIC CLI commands must be used.

	Command	Purpose
Step 1	`aic(config)# snmp`	Enter SNMP configuration mode.
Step 2	`aic(config)# noc ip-address {number} ip-address`	Enter an NOC IP address in which the AIC will send SNMP messages. The *number* argument can be the numbers 1 through 4.
Step 3	`aic(config)# exit`	Exit the AIC CLI.

Configuring Alarms

After the AIC and NOC IP addresses have been configured, you can the configure alarms by programming the AIC's discrete and analog contact points. These tasks can be performed on-site or by Telneting as described in the "Accessing the AIC" section on page 3-40.

Alarms are configured using either TL1 or AIC CLI. Information about TL1 commands can be found in the Telcordia Technology (formerly Bellcore) document *Network Maintenance: Network Element and Transport Surveillance Messages*, GR-833-CORE, Issue 5, November 1996. For a reference of security-related commands (ACT-USER and CANC-USER) refer to Telcordia Technology's *Operations Applications Messages-Network Element and Network System Security Admin Messages*, TR-NWT-000835, Issue 2, January 1993. The following TL1 messages and commands are supported by the AIC:

- TL1 Messages
  - REPT-ALM-ENV
  - REPT-ALM-EQPT
  - REPT-EVT
- TL1 Commands
  - ACT-USER
  - CANC-USER
  - OPR-EXT-CONT
  - RLS-EXT-CONT
  - RTRV-ALM
  - RTRV-ALM-ENV
  - RTRV-ATTR
  - RTRV-ATTR-CONT
  - RTRV-ATTR-ENV
  - RTRV-ATTR-LOG
  - RTRV-HDR
  - RTRV-LOG
  - RTRV-EXT-CONT
  - SET-ATTR-ENV
  - SET-ATTR-EQPT
  - SET-ATTR-LOG
  - STA-LOG
  - STP-LOG

Programming the Analog Contact Points

Alarm points 57 through 64 are analog inputs, which are configurable as discrete inputs. When configured as an analog input, the user must select whether the point is monitoring voltage or current. The user must also define five ranges by selecting four values for a point monitoring voltage or six ranges for a point monitoring current. For current-monitoring points, the lowest and highest values

define the range of possible values. (Valid values are from –9999999.9 to 9999999.9.) For voltage-monitoring alarms, the range of possible values is always –60V to 60V. The other four values must be within the defined range, and they partition the range into low-low, low, high, and high-high ranges. Except for the normal range, each range is associated with an alarm condition.

Analog points have four unique alarm states. Each alarm state has its own alarm description string. Only one alarm state per point may be active at any given time. In other words, when a threshold is crossed, the previous alarm state is cleared and the new alarm state is active.

When an analog input is configured as discrete, the user must select whether the point is monitoring voltage or current. Similar to the analog configuration, the user must also select the range of acceptable values for a current-monitoring alarm. (Valid values are from –9999999.9 to 9999999.9.) The voltage range is always –60V to 60V. The user must define the threshold that will cause the alarm condition and whether the normal state of the alarm is the higher or lower range.

Note For the current analog point, the lower boundary is 4 mA and the upper boundary is 20 mA. For example,

```
analog current-loop 10 13 16 17 20 26
```

has 16 units between 10 and 26. If the AIC measures 4 mA, then it will factor that the point is registering at the lower boundary. The AIC will interpret 13 as 7 mA, 16 as 10 mA, 17 as 11 mA, 20 as 14 mA, and 26 as the upper boundary, which is 20 mA.

Following are examples:

Point 57 is monitoring the ambient temperature of a building and the sensor range is –20 to 75 degrees Celsius. Below 0 degrees is a critical alarm, 0 to 10 degrees is a major alarm, 10 to 35 degrees is the normal range, 35 to 45 degrees is a minor alarm, and above 45 degrees is a major alarm. The configuration for this point follows:

```
alarm 57
analog current-loop –20 0 10 35 45 75
level low-low 1
level low 2
level high 3
level high-high 2
```

Point 58 is monitoring a fuel tank level with a resistive sensor. Below –46 volts is a critical alarm, –46 to –40 volts is a minor alarm, and above –40 volts is the normal range. This is a unidirectional alarm, so the high thresholds are set equal to the high bound (since this threshold cannot be crossed). The configuration for this point follows:

```
alarm 58
analog voltage –46 –40 60 60
level low-low 1
level low 3
```

Point 59 is monitoring a battery bank. Below –42 volts is a critical alarm and above –42 volts is the normal range. The configuration for this point follows:

```
alarm 59
discrete voltage –42 high
level 1
```

Programming the Discrete Contact Points

The discrete alarms do not require as much programming as the analog alarms. The AIC CLI commands available are the following:

Command	Description
no	Reversal option
exit	Exits current mode
description	Sets the description. If **no** is set, then the description is not required.
normally	Sets the alarm's normal state to closed. If the **no** option is used, the normal state is set to open. This command applies only to points 1 - 56.
level	Sets the alarm's level to the specified level.

Verifying the IP Address

To verify that the correct AIC IP address and IP route was entered, use the **show run** command. Below are samples of before-configuration and after-configuration **show run command** outputs:

```
interface Serial5/0
 ip unnumbered FastEthernet0/0
!
ip route 10.2.130.102 255.255.255.255 Serial5/0
!
alarm-interface 5
 ip address 10.2.130.102


********Before Configuration show run Output*******
version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uut2-3660
!
logging rate-limit console 10 except errors
!
ip subnet-zero
!
!
no ip finger
no ip domain-lookup
!
call rsvp-sync
cns event-service server
!
!
interface FastEthernet0/0
 ip address 10.2.130.2 255.255.0.0
 duplex auto
 speed auto
 no cdp enable
```

```
!
interface Serial5/0
 no ip address
!
ip kerberos source-interface any
ip classless
ip route 0.0.0.0 0.0.0.0 10.2.0.1
ip http server
!
no cdp run
!
!
dial-peer cor custom
!
!
line con 0
 exec-timeout 0 0
 transport input none
line 161
 no exec
 transport preferred none
 transport input telnet
 transport output none
 stopbits 1
line aux 0
line vty 0 4
 password lab
 login
!
end


*****After Configuration show run Output*******

version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uut2-3660
!
logging rate-limit console 10 except errors
no logging console
!
ip subnet-zero
!
!
no ip finger
no ip domain-lookup
!
call rsvp-sync
cns event-service server
!
interface FastEthernet0/0
 ip address 10.2.130.2 255.255.0.0
 duplex auto
 speed auto
 no cdp enable
!
interface Serial5/0
ip unnumbered FastEthernet0/0
!
```

```
ip kerberos source-interface any
ip classless
ip route 0.0.0.0 0.0.0.0 10.2.0.1
ip route 10.2.130.102 255.255.255.255 Serial5/0
ip http server
!
no cdp run
!
!
alarm-interface 5
 ip address 10.2.130.102
!
dial-peer cor custom
!
!
!
line con 0
 exec-timeout 0 0
 transport input none
line 161
 no exec
 transport preferred none
 transport input telnet
 transport output none
 stopbits 1
line aux 0
line vty 0 4
 password lab
 login
!
end
```

Troubleshooting Tips

If no alarm messages are sent for an unusually long period of time, ping the AIC address to check for connectivity.

Monitoring and Maintaining the NM-AIC-64 Contact Closure Network Module

The AIC provides a TFTP client for software upgrade and configuration image transfer. The methods for both actions, as well as how to override the existing software or configuration, are described below.

Software Upgrade

When upgrading software, the AIC must be reset to run the new software. The AIC provides a protected (login required) command for software download. When the user invokes this command with the TFTP server address as a parameter, the AIC connects to the IP address and, via TFTP, retrieves the software image file. After verifying that the software has been transferred successfully, the AIC replaces its running software with the newly downloaded software.

In the case of incompatible versions of Cisco IOS and AIC software, the Cisco IOS software recognizes the difference and displays this information to the user. The user makes the decision whether to upgrade or downgrade either the Cisco IOS or AIC software or to take no corrective action.

Configuration Backup

The AIC CLI provides commands for storing and restoring configurations. Users can transfer the current configuration of the AIC to or from the TFTP server whose address is given as a parameter to the **get config** command. When a configuration file is transferred from the server to the AIC, the AIC takes on the new configuration.

The configuration is stored as a list of commands (script) that can be applied to the CLI of an AIC for configuration.

Two other useful commands are the **get image** and **put config commands**. Use the **get image** command to get a new image, and the **put config command** to back up the configuration to the TFTP server.

Backup is not automatic, but the AIC reminds the user, on logout, to back up the configuration.

Override

In the case that bad software is resident on the AIC or that the configured administrator password is lost, the AIC provides a method for recovering the card. Upon booting, the AIC begins a countdown, visible at the AIC local CLI (Craft Port). If an ASCII character is received on that local CLI channel (DSCC4 channel 2) during this countdown, the AIC enters a mode in which a limited CLI is available. At this limited CLI, available over the Craft Port only, no login is necessary. The user may enter commands for software upgrade and configuration transfer. The new configuration takes effect upon a reset of the AIC card.

After interrupting the countdown, the user will see an **AIC Boot]:** prompt. From this prompt, the user can enter "?" to see the available commands, "g" to **get** a new application image, or "d" to **delete** the current configuration and return to the defaults. (All commands require a carriage return.) In the case of the **get** command, the user will be prompted for the name of the file, the IP address of the TFTP server, and a confirmation.

Configuration Examples

The following configuration examples are shown in Appendix A, "Configuration Examples":

- AIC IP Address Configuration Example, page A-16
- IP Route to the AIC Configuration Examples, page A-20
  - With an Unnumbered IP Address, page A-20
  - Without an Unnumbered IP Address, page A-21

Configuring the 1-Port HSSI Network Module

The Cisco 3600 series 1-port high-speed serial interface (HSSI) network module provides full-duplex connectivity at Synchronous Optical Network (SONET) OC-1/STS-1 (51.840 Mhz), T3 (44.736 MHz), and E3 (34.368 MHz) rates in conformance with the EIA/TIA-612 and EIA/TIA-613 specifications. The actual rate of the interface depends on the external data service unit (DSU) and the type of service to which it is connected. This 1-port HSSI network module can reach speeds of up to 52 Mbps in unidirectional traffic with 1,548-byte packets and 4,250 packets per second. Asynchronous Transfer Mode (ATM), High-Level Data Link Control (HDLC), Point-to-Point Protocol (PPP), Frame Relay, and Switched Multi-Megabit Data Service (SMDS) WAN services are all fully supported.

The 1-port HSSI network module provides the following benefits:

- Supports speeds up to 52 Mbps
- Supports a range of connectivity options: ATM, Frame Relay, PPP, and SMDS
- Supports EIA/TIA-612 and EIA/TIA-613 specifications at T3, E3, SONET OC1/STS-1 and NXT1 subrates

Configuration Tasks

Perform the tasks in the following sections to configure a HSSI interface. The first task is required; the remaining tasks are optional.

- Specify a HSSI, page 3-47
- Specify HSSI Encapsulation, page 3-47
- Invoke ATM on a HSSI Line, page 3-47
- Convert HSSI to Clock Master, page 3-48
- Disable Fair Queueing, page 3-48

Specify a HSSI

To specify a HSSI and enter interface configuration mode, perform the following tasks in global configuration mode:

Task	Command
Begin interface configuration.	**interface hssi** *slot/port*

Specify HSSI Encapsulation

The HSSI supports the serial encapsulation methods, except for X.25-based encapsulations. The default method is HDLC. You can define the encapsulation method by performing the following task in interface configuration mode:

Task	Command
Configure HSSI encapsulation.	**encapsulation** {**atm-dxi** | **hdlc** | **frame-relay** | **ppp** | **sdlc-primary** | **sdlc-secondary** | **smds** | **stun**}

For information about PPP, see the “Configure SLIP and PPP” chapter of the Cisco IOS Release 11.3 *Access Services Configuration Guide* and the “Configure PPP for Wide-Area Networking” chapter of the Cisco IOS Release 11.3 *Wide-Area Networking Configuration Guide*.

Invoke ATM on a HSSI Line

If you have an ATM DSU, you can invoke ATM over a HSSI line by mapping an ATM virtual path identifier (VPI) and virtual channel identifier (VCI) to a DXI frame address. ATM-DXI encapsulation defines a data exchange interface that allows a DTE (such as a router) and a DCE (such as an ATM DSU) to cooperate to provide a User-Network Interface (UNI) for ATM networks.

To invoke ATM over a serial line, perform the following tasks in interface configuration mode:

Task	Command
Specify the encapsulation method.	`encapsulation atm-dxi`
Map a given VPI and VCI to a DXI frame address.	**dxi map** *protocol address vpi vci* [**broadcast**]

Convert HSSI to Clock Master

You can convert the HSSI interface into a 45-MHz clock master by performing the following task in interface configuration mode:

Task	Command
Convert the HSSI interface into a 51.84-MHz clock master.	**hssi internal-clock**

Disable Fair Queueing

Disabling fair queuing will dramatically improve fast switching rates over the HSSI. To disable fair queueing, perform the following task in interface configuration mode:

Task	Command
Disable fair queueing.	**no fair-queue**

For more information about configuring HSSI interfaces, refer to the "Configuring Serial Interfaces" chapter in the Cisco IOS Release 11.3 *Configuration Fundamentals Configuration Guide*.

Configuration Examples

The following example shows how to configure a 1-port HSSI network module on a Cisco 3600 series router. Both sides of the network connection need to be configured:

```
interface hssi 0/0
 ip address 10.1.1.1 255.255.255.0
 hssi internal-clock
 no fair-queue
 no shutdown

interface hssi 1/0
 ip address 10.1.1.2 255.255.255.0
 hssi internal-clock
 no fair-queue
 no shutdown
```

In this example:

- The **interface hssi** command specifies a HSSI interface and changes the configuration mode from global to interface.
- The **ip address** command assigns an IP address to this interface.
- The **hssi internal-clock** command sets the HSSI clock source.

- The **no fair-queue** command disables fair queuing, which is enabled by default. This optimizes HSSI performance.
- The **no shutdown** command enables the port.

Configuring the Compression Network Module for the Cisco 3600 Series Routers

Cisco 3640 and Cisco 3620 routers now support a compression port module that provides high-performance, hardware-based data compression using simultaneous Stacker compression algorithms. Independent full-duplex compression and decompression capabilities are used on point-to-point (PPP) encapsulated packets.

A router's central processing unit is generally reserved for tasks such as creating and maintaining routing tables, not performing compression duties. When a hardware compression port module is used in a router, all compression activity is offloaded from the router's central processing unit. This kind of hardware configuration is needed for routers that require B-channel compression for multiple WAN connections, such as two ISDN PRI interfaces carrying 46 B channels. Signaling over the D channel is not compressed. One compression port module supports up to 128 WAN interfaces.

WAN or serial connections have limited bandwidth and greatly benefit from compressed data. For example, a hardware compression card that achieves 2:1 compression can compress 500 bytes of data down to 250 bytes. Transmission time is reduced by 50 percent. A line that transmits at 56 kbps without compress transmits at 112 kbps with compression. An achieved compression ratio or rate is dependent on the type of file being compressed. Graphics files, sound files, and text files all have different compression requirements and results.

A hardware card can compress and decompress outgoing and incoming data. For negotiated compression configured between two routers, the incoming compressed data sent by the remote router is decompressed by the receiving or local compression card.

Configuration Task

You can configure point-to-point compression on interfaces that use PPP encapsulation. Compression reduces the size of a PPP frame via lossless data compression. PPP encapsulations support Stacker and Predictor compression algorithms, but the compression port module installed in Cisco 3600 series routers support only Stacker compression over PPP encapsulations.

If the majority of your traffic is already compressed files, do not use compression. A hardware compression card should be used if the router's main processor CPU load exceeds 40 percent. To display the CPU load, use the **show process cpu** EXEC command.

To configure compression over PPP, perform the following tasks in interface configuration mode:

	Command	Task
Step 1	`interface serial` *number*	Specify a serial interface.
Step 2	`encapsulation ppp`	Enable encapsulation of a single protocol on the serial line.
Step 3	`compress stac`	Enable compression on a specified WAN interface.

Configuration Example

The following example enables hardware compression and PPP encapsulation on serial interface 3/1. Although the Serial interface in slot 3/1 is configured with the **compress stac** command, the actual data compression takes place in the hardware compression card inserted in a different slot.

```
Router(config)# interface serial 3/1
Router(config-if)# encapsulate ppp
Router(config-if)# compress stac
Router(config-if)# exit
Router(config)#
```

Configuring the Digital Modem Network Module for the Cisco 3640 Router

The Digital Modem Network Module for the Cisco 3640 is a high-density digital network module containing 6, 12, 18, 24, or 30 digital (MICA) modems. These modems provide a direct digital connection to an Integrated Services Digital Network (ISDN) Primary Rate Interface (PRI) channel. This digital modem network module allows the access server to support a mix of both digital data calls (ISDN) and analog modem calls over a single digital network interface.

Depending on the modem license you purchase with your Cisco 3640, the modems on the Digital Modem Network Module are either manageable or not manageable by Cisco IOS software commands. If the license you purchase includes this modem management capability, you can use the modem management commands to gather call and performance statistics at any time, even if there is an active call on the modem.

The Digital Modem Network Module for the Cisco 3640 provides the following benefits:

- Enables you, as the Enterprise customer, to support a mix of digital (ISDN) and POTS analog modem calls over a single digital network interface.
- Modem management commands enable you to gather call and performance statistics.
- Supports 56 kbps modem connections via the K56 Flex and V.90 standards when the portware for these standards becomes available.

Prerequisites

Before you can configure a modem interface, complete the following prerequisite tasks:

- Install a PRI network module and another module (such as Ethernet) to provide connectivity to the LAN. Digital modem network modules do not provide physical network interfaces of their own, but instead handle analog calls passing through the PRI network module. The PRI module is capable of concurrently handling digital ISDN data and remote voice-channel (analog) modem connections. The digital modem module provides a pool of available modems that can be used for both incoming and outgoing calls.

  For information on how to correctly install a PRI network module, refer to the *1-Port and 2-Port ISDN-PRI Network Module Configuration Note*. For information on how to install an Ethernet module, refer to the *1-Port Ethernet Network Module Configuration Note* or the *4-Port Ethernet Network Module Configuration Note*. For other modules, refer to the specific configuration notes pertaining to them.

Note

- The PRI module must be hardware revision -03; earlier revisions are incompatible with digital modem modules. For more information, refer to the "Software and Hardware Requirements" section in the *Digital Modem Network Module Configuration Notes*.
- Install the Digital Modem Network Module in a chassis slot. For information on how to correctly install this network module, refer to the "Installing a Digital Modem Network Module in a Chassis Slot" section in the *Digital Modem Network Module Configuration Note*.
- Complete basic device configuration, including host name, username, protocol, and security configuration.
- Make sure that you have the following information:
  - ISDN PRI Switch type
  - T1 (or E1) information, such as line code and framing type
  - Channel-group information and time-slot mapping

Configuration Tasks

Complete the following tasks to configure the digital modem module interfaces:

- Configure the E1/T1 Network Module for ISDN PRI, page 3-51
- Configure the ISDN D-Channel Serial Interfaces, page 3-53
- Configure the Loopback Interface, page 3-54
- Configure the LAN Interface, page 3-55
- Create the Group Asynchronous Interface, page 3-55
- Configure the ISDN Dialer Interface, page 3-56
- Configure the Default IP Pool Information, page 3-57
- Configure Modem Lines for Dial-In and Dial-Out, page 3-57

These tasks are described in the following sections.

Configure the E1/T1 Network Module for ISDN PRI

The first step in configuring a digital modem interface is to configure ISDN PRI on either a channelized T1 or E1 controller, depending on the ISDN service in your area. The ISDN PRI network modules can have either one or two ports; if the ISDN PRI module installed in your device has two ports, you need to apply the following procedure to both ports.

Configure Channelized E1 ISDN PRI

To configure ISDN PRI on a channelized E1 controller, perform the following tasks, beginning in global configuration mode:

Command	Description

isdn switch-type *switch type*	Select a service provider switch type that accommodates PRI. Table 3-12 shows a list of supported switch types.
controller e1 *slot/unit*	Specify a controller type and define its location in the Cisco 3640.
framing crc4	Define the framing characteristics as cyclic redundancy check 4 (CRC4).
linecode hdb3	Define the line code as high-density bipolar 3 (HDB3).
pri-group [**timeslots** *range*]	Configure ISDN PRI. This command specifies the time slots on the T1 line to be allocated to PRI service.

Note The values used in this procedure for the **framing** and **linecode** commands are examples only. Use the framing type and line encoding specified by your E1 service provider.

Country	ISDN Switch Type
Australia	primary-ts01
Europe	primary-net5
Japan	primary-ntt
North America	primary-4ess primary-5ess primary-dms100

For more information about configuring ISDN PRI on a channelized E1 controller, refer to the "Configure ISDN PRI" section of the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide*.

Configure Channelized T1 ISDN PRI

To configure ISDN PRI on a channelized T1 controller, perform the following tasks, beginning in global configuration mode:

Command	Description
isdn switch-type *switch type*	Select a service provider switch type that accommodates PRI. Table 3-12 shows a list of supported switch types.
controller t1 *slot/unit*	Specify a controller type and define its location in the Cisco 3640.
clock source line	Specify the clock source for the selected module.
framing esf	Define the framing characteristics as extended superframe format (ESF).

linecode b8zs	Define the line code as binary 8 zero substitution (B8ZS)
pri-group [**timeslots** *range*]	Configure ISDN PRI. This command specifies the time slots on the T1 line to be allocated to PRI service.

Note The values used in this procedure for the **framing** and **linecode** commands are examples only. Use the framing type and line encoding specified by your E1 service provider.

For more information about configuring ISDN PRI on a channelized T1 controller, refer to the "Configure ISDN PRI" section of the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide*.

Note Any router configured for ISDN support must be connected to the same switch type on all of its ISDN interfaces.

Configure the ISDN D-Channel Serial Interfaces

When you configure ISDN PRI on the channelized E1 or channelized T1 controller, you create a corresponding D-channel serial interface used to carry signaling messages for that PRI group. For E1 serial interfaces, slot/port 0:15 is the D-channel. For T1 modules, serial interface 0:23 is the D-channel. You must configure this signaling interface to receive incoming and modem calls.

As mentioned, the PRI Network Module for the Cisco 3600 series can have either one or two ports. Because of this, you might have multiple D-channels to configure.

Configure the ISDN D-Channel Serial Interface for E1 Modules

To configure the ISDN D-channel serial interface for E1 modules, perform the following tasks, beginning in global configuration mode:

Command	Description
interface Serial*slot/port*:15	Specify the D-channel of the first PRI line and switch to the interface configuration mode.
no ip address	Disable IP processing on this interface.
encapsulation ppp	Set the Point-to-Point Protocol (PPP) as the encapsulation method used by this interface.
isdn incoming-voice modem	Configure all incoming voice calls to go to the modems.
dialer rotary-group *number*	Create a rotary dialer group.
dialer-group *number*	Assign the D-channel interface(s) to the defined rotary dialer group.
no fair-queue	Disable fair weighted queuing for this interface.

`no cdp enable`	Disable Cisco Discovery Protocol (CDP) on this interface.

For more information about configuring E1 ISDN D-channel serial interfaces, refer to the "Configure ISDN PRI" section in the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide.*

Configure the ISDN D-Channel Serial Interface for T1 Modules

To configure the ISDN D-channel serial interface for T1 modules, perform the following tasks, beginning in the global configuration mode:

Command	Description
interface Serial*slot/port*:23	Specify the D-channel of the first PRI line and switch to the interface configuration mode.
`no ip address`	Disable IP processing on this interface.
`encapsulation ppp`	Set the Point-to-Point Protocol (PPP) as the encapsulation method used by this interface.
`isdn incoming-voice modem`	Configure all incoming voice calls to go to the modems.
dialer rotary-group *number*	Create a rotary dialer group.
dialer-group *number*	Assign the D-channel interface(s) to the defined rotary dialer group.
`no fair-queue`	Disable fair weighted queuing for this interface.
`no cdp enable`	Disable CDP on this interface.

For more information about configuring T1 ISDN D-channel serial interfaces, refer to the "Configure ISDN PRI" section in the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide.*

Configure the Loopback Interface

The loopback 0 interface is the interface dial-in users access when dialing in to the network. Usually, all dial-in users are assigned to a single IP subnet. This subnet can be identified with the loopback 0 interface, a logical interface whose network number can be borrowed by each asynchronous dial-in interface.

To configure the loopback 0 interface, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**interface Loopback** *number*	Select the loopback 0 interface.
Step 2	**ip address** *ip-address ip-address mask*	Assign an IP address and subnet mask to the loopback 0 interface.

Configure the LAN Interface

The next task you need to perform is to configure the LAN interfaces on your Cisco 3600 series router. For the purpose of this procedure, we are showing how to configure an Ethernet interface. If the interface you are configuring is different, refer to the "Configuring LAN Interfaces" chapter in the Cisco IOS Release 11.3 *Configuration Fundamentals Configuration Guide* or to the configuration notes that shippedwith your module.

To configure an Ethernet interface, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**interface ethernet** *slot/port*	Select the Ethernet interface.
Step 2	**ip address** *ip-address ip-address mask*	Assign an IP address and subnet mask to the Ethernet interface.
Step 3	**no shutdown**	Enable this interface

Note The Ethernet and loopback interfaces should be on different subnets.

Create the Group Asynchronous Interface

A group asynchronous interface is a parent interface that applies protocol characteristics to specified, associated asynchronous interfaces. After you create a group asynchronous interface, all associated asynchronous interfaces (called members) can be configured through it. Group asynchronous interfaces can speed configuration time and help you maintain interface configuration consistency.

To configure a group asynchronous interface, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**interface group-async** *number*	Create a group asynchronous interface.
Step 2	**ip unnumbered Loopback** *number*	Enable IP processing on the loopback interface without assigning an explicit IP address to the interface.
Step 3	**encapsulation ppp**	Set the Point-to-Point Protocol (PPP) as the encapsulation method used by this interface.
Step 4	**async mode interactive**	Enable SLIP and PPP EXEC commands on this interface.
Step 5	**peer default ip address pool** *name*	Specify an IP address from the defined IP address pool to be returned to a remote peer connecting to this interface.
Step 6	**no cdp enable**	Disable CDP on this interface.

Step 7	**group-range** *start-range end-range*	Associate one or more interfaces to the group interface so that all associated interfaces can be configured through the group interface.

For more information about group asynchronous interfaces, refer to the "Asynchronous Configuration Task List" section of the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide*.

Configure the ISDN Dialer Interface

The ISDN dialer interface is the parent interface that holds the central protocol characteristics for the ISDN D channels that are part of the dialer-rotary group. To configure the ISDN dialer interface, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**interface Dialer** *number*	Define a dialer rotary group leader.
Step 2	**ip unnumbered Loopback** *number*	Enable IP processing on the loopback interface without assigning an explicit IP address to the interface.
Step 3	**no ip mroute-cache**	Disable IP multicast fast switching.
Step 4	**encapsulation ppp**	Set the PPP as the encapsulation method used by this interface.
Step 5	**peer default ip address pool** *name*	Specify an IP address from the defined IP address pool to be returned to a remote peer connecting to this interface.
Step 6	**dialer in-band**	Specify that dial-on-demand routing (DDR) be supported.
Step 7	**dialer-group** *number*	Assign this interface to the rotary dialer group.
Step 8	**no fair-queue**	Disable fair weighted queuing for this interface.
Step 9	**no cdp enable**	Disable CDP on this interface.
Step 10	**ppp multilink**	Enable Multilink PPP on this interface.
Step 11	**router eigrp** *autonomous-system-number*	Configure the enhanced IGRP routing process.
Step 12	**network** *network-number*	Enable Enhanced IGRP.
Step 13	**passive-interface Dialer** *number*	Disable sending routing updates on this interface.
Step 14	**no auto-summary**	Transmit subprefix routing information across classful network boundaries.

For more information about configuring ISDN dialer interfaces, refer to the Cisco IOS Release 11.3 *Dial Solutions Configuration Guide*.

Configure the Default IP Pool Information

You need to set a range of IP addresses in the default IP pool. These IP addresses are used for dial-in users. To set the range of addresses, perform the following task in global configuration mode:

	Command	Description
Step 1	**ip pool local default** *low-ip-address [high-ip-address]*	Set the range of addresses in the default IP pool to be assigned to inbound callers.
Step 2	**ip default gateway** *number*	Define a default gateway (router) when IP routing is disabled.
Step 3	**ip classless**	Forward packets destined for a subnet of a network that has no network default route.

For more information about defining IP pool information, refer to the Cisco IOS Release 11.3 *Network Protocols Configuration Guide, Part 1*.

Configure Modem Lines for Dial-In and Dial-Out

The final task in configuring the MICA digital modem network modules is to configure the modem lines for dial-in and dial-out.

Configure the Modem for Dial-In

To configure the modem lines for dial-in, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**line** *start-range end-range*	Select the modem lines for dial-in and switch to the line configuration mode.
Step 2	autoseect during-login	Set the router to display a login prompt to modem callers.
Step 3	autoselect ppp	Set the router to shift automatically to PPP mode if it detects an incoming PPP packet.
Step 4	modem inout	Configure the line for both incoming and outgoing calls.

Configure the Modem for Dial-Out

To configure the modem lines for dial-out, perform the following tasks, beginning in global configuration mode:

	Command	Description
Step 1	**line** *start-range end-range*	Select the modem lines for dial-out and switch to the line configuration mode.

Step 2	`rotary` *number*	Set the router to use previously-defined rotary group.
Step 3	`transport input telnet`	Configure the router to accept inbound Telnet connections.

This configuration procedure ensures that a user trying to dial out using Telnet is connected to the first free line in the rotary group.

Configuration Example

Refer to theAppendix A, “Cisco 3640 Central Site Configuration to Support ISDN and Modem Calls” for an example of the configuration.

Configuring 1-Port G.SHDSL WAN Interface Card

This section describes how to configure the Multirate Symmetrical High-Speed Digital Subscriber Line (G.SHDSL) feature supported on the 1-port G.SHDSL WAN interface card (WIC) (WIC-1SHDSL) on Cisco 2600 series and Cisco 3600 series routers in Cisco IOS Release 12.2(4)T.

This section includes the following sections:

G.SHDSL is ATM-based, multirate, high-speed (up to 2.3 MB), symmetrical digital subscriber line digital data transfer between a single customer premises equipment (CPE) subscriber and a central office.

G.SHDSL is supported on the G.SHDSL WAN interface card, a 1-port WAN interface card (WIC) for Cisco 2600 series and Cisco 3600 series routers.

The G.SHDSL WIC is compatible with the Cisco 6015, Cisco 6130, Cisco 6160, and Cisco 6260 Digital Subscriber Line Access Multiplexers (DSLAMs). The DSLAM must be equipped with G.SHDSL line cards that are compatible with the DSL service to be configured.

The G.SHDSL WIC supports ATM Adaptation Layer 2 (AAL2), ATM Adaptation Layer 5 (AAL5), and various classes of quality of service (QoS) for both voice and data service.

Listed below are some benefits of this feature:

- Enables business-class broadband service with voice integration, scalable performance, flexibility, and security.
- Aggregates G.SHDSL and other transport options into a single box.
- Provides G.SHDSL high-speed digital data transmissions between customer premises equipment (CPE) and the central office (CO), or between routers located within a customer site.
- Supports ITU G.991.2 (SHDSL).
- Supports ANSI T1.601 (BRI), ANSI T1.410 (DDS), and ANSI T1.403 (T1 carrier).

- Supports AAL2 and AAL5 services and applications (including voice), ATM class of service (constant bit rate [CBR], variable bit rate-nonreal time [VBR-nrt], variable bit rate-real time [VBR-rt], and unspecified bit rate [UBR and UBR+]), and up to 23 virtual circuits on a WIC in Cisco 2600 series and Cisco 3600 series routers.
- Provides ATM traffic management and quality of service (QoS) features to enable service providers to manage their core ATM network infrastructures.

This feature is supported on the following router platforms:

- Cisco 2610
- Cisco 2611
- Cisco 2612
- Cisco 2613
- Cisco 2620
- Cisco 2621
- Cisco 2650
- Cisco 2651
- Cisco 3620
- Cisco 3640
- Cisco 3661
- Cisco 3662

Restrictions

- The ADSL WAN does not support dual latency. When the DSL link is intended to support both voice and data traffic simultaneously, the total supported data rate must be reduced to adjust for the reduced coding gain, which is usually present with high-latency traffic.
- The ADSL WAN does not support Dying Gasp in ANSI T1.413 Issue 2.
- The ADSL WAN does not support available bit rate (ABR) class of service (CoS).
- The ADSL WAN should be insertedonly into onboard WIC slots or 1FE2W, 2W, 1FE1R, 2FE2W network modules. This WIC is not supported in old combination network modules.

Prerequisites

A G.SHDSL WIC must be installed in the router to match the DSL service to be configured. A compatible G.SHDSL line card must be installed in the DSLAM.

Configuration Tasks

See the following sections for configuration tasks for this feature. Each task in the list is identified as either required or optional:

- Configuring G.SHDSL on a Cisco Router, page 3-60 (required)

- Configuring ILMI on the DSLAM Connected to the ADSL WAN, page 3-62 (optional)
- Verifying ATM Configuration, page 3-62 (optional)

Configuring G.SHDSL on a Cisco Router

To configure G.SHDSL service on a Cisco router containing a G.SHDSL WIC, complete the following steps, beginning in global configuration mode:

	Command	Purpose
Step 1	`Router(config)# interface atm 1/0`	Enters ATM configuration mode for interface ATM 0 in slot 1. **Note** If a slot has two subslots for WIC modules and no ATM interface is present in subslot 0, the WIC will take ATM x/0 as its interface number even if placed in subslot 1 (ATMx/1). If a two-port ATM module is present in subslot 0, the WIC will use ATM x/2 as its interface number. This subslot number is pertainent to all interface commands such as **show interface atm** and **show dsl interface atm**.
Step 2	`Router(config-if)# ip-address IP-address`	Assigns an IP address to the DSL ATM interface.
Step 3	`Router(config-if)# atm ilmi-keepalive seconds`	(Optional) Enables Integrated Local Management Interface (ILMI) keepalives. If you enable ILMI keepalives without specifying the seconds, the default time interval is 3 seconds.
Step 4	`Router(config-if)# pvc [name] vpi/vci`	Enters atm-virtual-circuit (interface-atm-vc) configuration mode, and configures a new ATM permanent virtual circuit (PVC) by assigning a name (optional) and VPI/VCI numbers. The default traffic shaping is UBR; the default encapsulation is AAL5+LLC/SNAP.
Step 5	`Router(config-if-vc)# protocol ip IP-address`	(Optional) Enables IP connectivity and create a point-to-point IP address for the virtual circuit (VC).
Step 6	`Router(config-if-vc)# vbr-rt peak-rate average-rate burst`	(Optional) Configures the PVC for real-time variable bit rate (VBR) traffic shaping. • *Peak rate*—Peak information rate (PIR) • *Average rate*—Average information rate (AIR) • *Burst*—Burst size in cells

	Command	Purpose
Step 7	`Router(config-if-vc)# encapsulation {aal1 | aal2 | aal5ciscoppp | aal5mux | aal5nlpid | aal5snap}`	(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type. • **aal1**—AAL1 • **aal2**—AAL2 • **aal5ciscoppp**—Cisco PPP over AAL5 • **aal5mux**—AAL5+MUX • **aal5nlpid**—AAL5+NLPID • **aal5snap**—AAL5+LLC/SNAP (the default)
Step 8	`Router(config-if-vc)# exit`	Exits from interface-atm-vc configuration mode.
Step 9	`Router(config-if)# dsl operating-mode {gshdsl symmetric annex {A | B}`	Configures the DSL interface to operate in a specified DSL mode: • **gshdsl**—Configures multirate, high-speed DSL per ITU G.991.2 • **symmetric**—Configures symmetrical mode per • ITU G.992.1. • **annex**—Configures the regional operating parameters. • **A**—Sets the operating parameters for North America. This value is the default. • **B**—Sets the operating parameters for Europe. The default is **gshdsl symmetric annex A**
Step 10	`Router(config-if)# equipment-type {co | cpe}`	Configures the DSL interface to function as central office equipment or customer premises equipment: • **co**—The WIC functions as central office equipment and can interface with another G.SHDSL WIC configured as **cpe**. • **cpe**—The WIC functions as customer premises equipment and can interface with a DSLAM or with another G.SHDSL WIC configured as **co**. The default is **cpe**.
Step 11	`Router(config-if)# dsl linerate {kbps | auto }`	Configures the DSL line rate: • *kbps*—Line rate (data transfer rate) in kilobits per second. Allowable entries are **72**, **136**, **200**, **264**, **392**, **520**, **776**, **1032**, **1160**, **1544**, **2056**, and **2312**. • **auto**—The WIC automatically trains for an optimal line rate by negotiating with the far-end DSLAM or WIC. The default is **auto**.
Step 12	`Router(config-if)# exit`	Exits from ATM interface configuration mode.
Step 13	`Router(config)# exit`	Exits from global configuration mode.

	Command	Purpose
Step 14	`Router# show interface atm 1/0`	Verifies the ATM interface configuration.
Step 15	`Router# clear interface atm 1/0`	Permits the configuration changes to take effect.

Configuring ILMI on the DSLAM Connected to the ADSL WAN

The ILMI protocol allows DSLAMs to be used for ATM address registration across an ATM User-Network Interface (UNI). If ILMI is configured on the G.SHDSL WIC, the ATM PVC must be configured on the DSLAM. All switch terminating connections use interface 0/0 to connect to the switch CPU.

For information about configuring the DSLAM, see the *Configuration Guide for Cisco DSLAMs with NI-2*.

Verifying ATM Configuration

Use the following commands to verify your configuration:

- To verify current configuration and to view the status for all controllers, use the **show running-config** command.
- To view ATM controller statistics, use the **show controllers atm** *slot/port* command.
- To verify the PVC status, use the **show atm vc** command. Make sure that active PVCs are up.
- To help identify ATM related events as they are generated, use the **debug atm events** command.
- To indicate which interfaces are having trouble, use the **debug atm errors** command.
- To identify an entry for the ATM interface you configured and to show an entry for the ATM slot/port you configured, use the **show ip route** command.
- To view the status of an ATM interface, use the **show interface atm** command. Make sure that the ATM slot/port and the line protocol are up, as shown in the following examples:

```
Router# show interface atm 1/0
ATM1/0 is up, line protocol is up
  Hardware is DSLSAR (with Globespan G.SHDSL Module)
  MTU 4470 bytes, sub MTU 4470, BW 800 Kbit, DLY 2560 usec,
     reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Keepalive not supported
  Encapsulation(s):AAL5 AAL2, PVC mode
  24 maximum active VCs, 256 VCs per VP, 2 current VCCs
  VC idle disconnect time:300 seconds
  Last input never, output 00:00:01, output hang never
  Last clearing of "show interface" counters 03:16:00
  Queueing strategy:fifo
  Output queue 0/40, 0 drops; input queue 0/75, 0 drops
  30 second input rate 0 bits/sec, 0 packets/sec
  30 second output rate 0 bits/sec, 0 packets/sec
     2527 packets input, 57116 bytes, 0 no buffer
     Received 0 broadcasts, 0 runts, 0 giants, 0 throttles
     0 input errors, 0 CRC, 0 frame, 0 overrun, 0 ignored, 0 abort
     10798 packets output, 892801 bytes, 0 underruns
     0 output errors, 0 collisions, 0 interface resets
     0 output buffer failures, 0 output buffers swapped out

Router# show atm vc
            VCD /                                        Peak  Avg/Min Burst
```

```
Interface   Name       VPI   VCI  Type   Encaps   SC   Kbps   Kbps   Cells  Sts
1/0.3      2           9    36   PVC    MUX      UBR     800                UP
1/0.2      1           9    37   PVC    SNAP     UBR     800                UP

Router# show controllers atm 1/0
Interface ATM1/0 is up
  Hardware is DSLSAR (with Globespan G.SHDSL Module)
IDB:    62586758  Instance:6258E054  reg_dslsar:3C810000  wic_regs:3C810080
PHY Inst:62588490  Ser0Inst:62573074  Ser1Inst: 6257CBD8  us_bwidth:800
Slot:   1         Unit:    1         Subunit:  0         pkt Size:4496
VCperVP:256       max_vp:  256       max_vc:   65536     total vc:2
rct_size:65536     vpivcibit:16        connTblVCI:8         vpi_bits:8
vpvc_sel:3         enabled: 0         throttled:0

WIC    Register   Value      Notes
---------------   ---------- ----------
FPGA Dev ID (LB)  0x44       'D'
FPGA Dev ID (UB)  0x53       'S'
FPGA Revision     0x99
WIC Config Reg    0x45       WIC / VIC select = WIC;
                             CTRLE addr bit 8 = 1;
                             OK LED on;
                             LOOPBACK LED off;
                             CD LED on;
WIC Config Reg2   0x07       Gen bus error on bad ADSL access
Int 0 Enable Reg  0x03       ADSL normal interrupt enabled
                             ADSL error interrupt enabled
```

- To view the status of the G.SHDSL modem, use the **show dsl interface atm** command. If the line is down, the following statement appears: Line is not active. Some of the values may not be accurate. You can also verify whether the equipment type and operating mode configuration are correct for your application.

The following sample output shows a WIC configured as central office equipment, and the line is up:

```
Router# show dsl interface atm 0/0
Globespan G.SHDSL Chipset Information

 Equipment Type:        Central Office
 Operating Mode:        G.SHDSL
 Clock Rate Mode:       Auto rate selection Mode
 Reset Count:           2
 Actual rate:           2320 Kbps
 Modem Status:          Data
 Noise Margin:          43 dB
 Loop Attenuation:      0.0 dB
 Transmit Power:        13.5 dB
 Receiver Gain:         204.8000 dB
 Last Activation Status:No Failure
 CRC Errors:            0
 Chipset Version:       1
 Firmware Version:      R1.0

 Farend Statistics since CO boot-time:

   CRC Errors:      0
   Errored Seconds: 0
   Severly ES:      0
   Un Available S:  48
   Loss Of Sync S:  0
```

The following sample output shows a WIC configured as customer premises equipment, and the line is up:

```
Router# show dsl interface atm 0/0
Globespan G.SHDSL Chipset Information

 Equipment Type:        Customer Premise
 Operating Mode:        G.SHDSL
 Clock Rate Mode:       Auto rate selection Mode
 Reset Count:           1
 Actual rate:           2320 Kbps
 Modem Status:          Data
 Noise Margin:          42 dB
 Loop Attenuation:      0.0 dB
 Transmit Power:        13.5 dB
 Receiver Gain:         204.8000 dB
 Last Activation Status:No Failure
 CRC Errors:            0
 Chipset Version:       1
 Firmware Version:      R1.0
```

Configuration Examples

Configuration examples are provided in the following sections:

- Configuration in CPE Mode Example, page A-25
- Configuration in CO Mode Example, page A-27

To prevent the loss of the router configuration, save it to NVRAM.

Saving Configuration Changes

	Command	Purpose

Step 1	`Router> enable`
	`Password: password`
	`Router#`
		Enters enable mode. Enter the password.
		You have entered enable mode when the prompt changes to `Router#`.

Step 2	`Router# copy running-config startup-config`	Saves the configuration changes to NVRAM so that they are not lost during resets, power cycles, or power outages.

Step 3	`Router(config-if)# Ctrl-z`
	`Router#`
	`%SYS-5-CONFIG_I: Configured from console by console`
		Returns to enable mode.
		This message is normal and does not indicate an error.

Where to Go Next

At this point you can proceed to the following:

- The Cisco IOS software configuration guide and command reference publications for more advanced configuration topics. These publications are available on Cisco.com, the Documentation CD-ROM that came with your router, or you can order printed copies.
- The *System Error Messages* and *Debug Command Reference* publications for troubleshooting information. These publications are available on Cisco.com, the Documentation CD-ROM that came with your router, or you can order printed copies.

Configuring Voice-over-IP

This chapter explains how to configure voice network modules with receive and transmit (E&M), Foreign Exchange Office (FXO), and Foreign Exchange Station (FXS) interfaces for your router. Voice network modules convert telephone voice signals into a form that can be transmitted over an IP network. This chapter is divided into the following sections:

You need both a voice network module and a voice interface card for a voice connection. You can install one voice interface card in a 2-channel voice network module, and two voice interface cards in a 4-channel module. At least one other network module or WAN interface card must be installed in the router to provide the connection to the IP LAN or WAN.

Voice over IP (VoIP) enables your router to carry live voice traffic (for example, telephone calls and faxes) over an IP network. VoIP offers the following benefits:

- Toll bypass
- Remote PBX presence over WANs
- Unified voice/data trunking
- Plain old telephone service (POTS)-Internet telephony gateways

Voice-over-IP Prerequisites

Before you can configure your router to use VoIP, you must first do the following:

- Establish a working IP network. For more information about configuring IP, refer to the "Configuring IP" chapter in the *Cisco IOS Release 11.3 Release Network Protocols Configuration Guide, Part 1*.
- Install the voice network module into your router. For more informationabout the voice network modules, refer to the "Connecting Voice Network Modules to a Network" chapter in the *Cisco Network Modules Hardware Installation Guide*.
- Complete your company's dial plan. That is, decide what patterns of dialed numbers will access what telephony endpoints.
- Establish a working telephony network based on your company's dial plan.
- Integrate your dial plan and telephony network into your existing IP network topology.

Configuring the Voice Interface

Whenever you install a new interface, or if you want to change the configuration of an existing interface, you must configure the interface. If you replace a module that was already configured, the router recognizes it and brings up the interface in the existing configuration.

Before you configure an interface, have the following information available:

- Protocols you plan to route on the new interface
- IP addresses, subnet masks, network numbers, zones, or other information related to the routing protocol

Timesaver Obtain this information from your system administrator or network plan before you begin router configuration.

To configure a voice interface, you must use configuration mode (manual configuration). In this mode, you can enter Cisco IOS commands at the router prompt.

Before you begin, disconnect all WAN cables from the router to keep it from trying to run the AutoInstall process. The router tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends, and the router does not have a valid configuration file stored in NVRAM (for instance, when you add a new interface). It can take several minutes for the router to determine that AutoInstall is not connected to a remote Transmission Control Protocol/Internet Protocol (TCP/IP) host.

To configure the voice interface configuration mode, follow this procedure:

Step 1 Connect a console to the router. If you need instructions for connecting a console, refer to the installation chapter of your router installation and configuration guide.

Step 2 Power onthe router. If the current configuration is no longer valid, after about one minute you see the following prompt:

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

Answer **no**. You now enter the normal operating mode of the router.

Note If the current configuration is valid, you enter the normal operating mode automatically.

Step 3 After a few seconds, you see the user EXEC prompt (`Router>`). Type **enable** and the password to enter enable mode:

```
Router> enable
Password: <password>
```

Configuration changes can be made only in enable mode. The prompt changes to the privileged EXEC (enable) prompt (`Router#`):

```
Router#
```

Step 4 Enter the **configure terminal** command to enter configuration mode:

```
Router# configure terminal
Router(config)#
```

The router enters global configuration mode, indicated by the `Router(config)#` prompt.

Step 5 If you have not configured the router before, or want to change the configuration, use Cisco IOS commands to configure global parameters, passwords, network management, and routing protocols. In this example, IP routing is enabled:

```
Router(config)# ip routing
```

For complete information about global configuration commands, refer to the Cisco IOS configuration guides and command references.

Step 6 If you have not already done so, configure the network module or WAN interface card that you plan to use for IP traffic. For instructions, see your router's installation and configuration guide or the configuration note for the network module or WAN interface card.

Step 7 To configure another interface, enter the **exit** command to return to the `Router(config)#` prompt.

Step 8 To configure the router for voice traffic, refer to the detailed instructions in the *Voice over IP Configuration* document.

Step 9 When you finish configuring interfaces, exit configuration mode and return to the enable prompt by pressing **Ctrl-z**. To see the current operating configuration, including any changes you just made, enter the **show running-config** command:

```
Router# show running-config
```

To see the configuration currently stored in NVRAM, enter the **show startup-config** command at the enable prompt:

```
Router# show startup-config
```

Step 10 The results of the **show running-config** and **show startup-config** commands differ from each other if you have made changes to the configuration, but have not yet written them to NVRAM. To write your changes to NVRAM, making them permanent, enter the **copy running-config startup-config** command at the enable prompt:

```
Router# copy running-config startup-config
Building configuration. . .
[OK]
Router#
```

The router is now configured to boot in the new configuration.

Voice-over-IP Configuration Examples

The actual VoIP configuration procedure you complete depends on the topology of your voice network. The following configuration examples should give you a starting point. Of course, these configuration examples would need to be customized to reflect your network topology.

Configuration procedures are supplied for the following scenarios:

- FXS-to-FXS Connection Using RSVP, page 4-4
- Linking PBX Users with E&M Trunk Lines, page 4-6
- PSTN Gateway Access Using FXO Connection, page 4-8
- PSTN Gateway Access Using FXO Connection (PLAR Mode), page 4-9
- Configuring Direct-Inward Dialing on a BRI Port, page 4-10

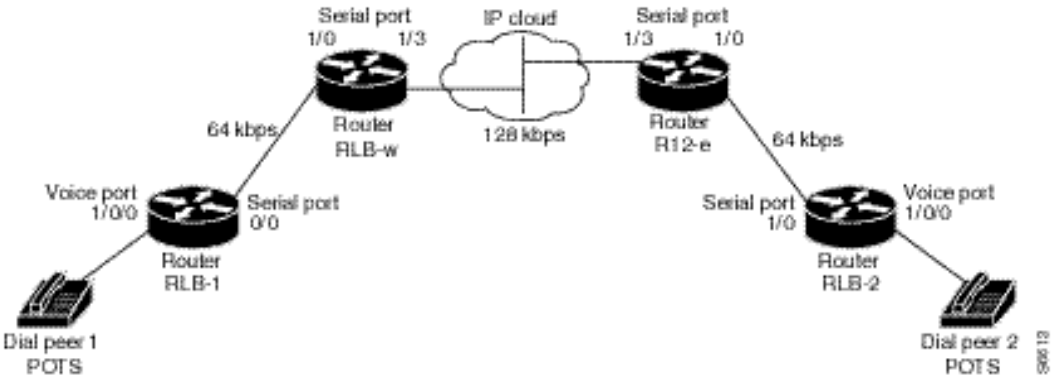
These examples are described in the following sections.

FXS-to-FXS Connection Using RSVP

The following example shows how to configure VoIP for simple FXS-to-FXS connections. In this example, a very small company, consisting of two offices, has decided to integrate VoIP into its existing IP network. One basic telephony device is connected to Router RLB-1; therefore Router RLB-1 has been configured for one POTS peer and one VoIP peer. Router RLB-w and Router R12-e establish the WAN connection between the two offices. Because one POTS telephony device is connected to Router RLB-2, it has also been configured for only one POTS peer and one VoIP peer.

In this example, only the calling end (Router RLB-1) is requesting RSVP. Figure 4-1 illustrates the topology of this FXS-to-FXS connection example.

Figure 4-1 FXS-to-FXS Connection Example



Configuration for Router RLB-1

```
hostname rlb-1
! Create voip dial-peer 10
dial-peer voice 10 voip
! Define its associated telephone number and IP address
 destination-pattern +4155264000
 sess-target ipv4:40.0.0.1
! Request RSVP
 req-qos guaranteedDelay
! Create pots dial-peer 1
dial-peer voice 1 pots
! Define its associated telephone number and voice port
 destination-pattern +4085264000
 port 1/0/0
! Configure serial interface 0/0
interface Serial0/0
 ip address 10.0.0.1 255.0.0.0
 no ip mroute-cache
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 48 48
 fair-queue 64 256 36
 clockrate 64000
router igrp 888
 network 10.0.0.0
 network 20.0.0.0
 network 40.0.0.0
```

Configuration for Router RLB-w

```
hostname rlb-w
! Configure serial interface 1/0
interface Serial1/0
 ip address 10.0.0.2 255.0.0.0
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 96 96
 fair-queue 64 256 3
! Configure serial interface 1/3
interface Serial1/3
 ip address 20.0.0.1 255.0.0.0
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 96 96
 fair-queue 64 256 3
! Configure IGRP
router igrp 888
 network 10.0.0.0
 network 20.0.0.0
 network 40.0.0.0
```

Configuration for Router R12-e

```
hostname r12-e
! Configure serial interface 1/0
interface Serial1/0
 ip address 40.0.0.2 25.0.0.0
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 96 96
 fair-queue 64 256 3
! Configure serial interface 1/3
interface Serial1/3
 ip address 20.0.0.2 255.0.0.0
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 96 96
 fair-queue 64 256 3
 clockrate 128000
! Configure IGRP
router igrp 888
 network 10.0.0.0
 network 20.0.0.0
 network 40.0.0.0
```

Configuration for Router RLB-2

```
hostname r1b-2
! Create pots dial-peer 2
dial-peer voice 2 pots
! Define its associated telephone number and voice-port
```

```
 destination-pattern +4155264000
 port 1/0/0
! Create voip dial-peer 20
dial-peer voice 20 voip
!Define its associated telephone number and IP address
 destination-pattern +4085264000
 sess-target ipv4:10.0.0.1
! Configure serial interface 0/0
interface Serial0/0
 ip address 40.0.0.1 255.0.0.0
 no ip mroute-cache
! Configure RTP header compression
 ip rtp header-compression
 ip rtp compression-connections 25
! Enable RSVP on this interface
 ip rsvp bandwidth 96 96
 fair-queue 64 256 3
 clockrate 64000
! Configure IGRP
router igrp 888
 network 10.0.0.0
 network 20.0.0.0
 network 40.0.0.0
```

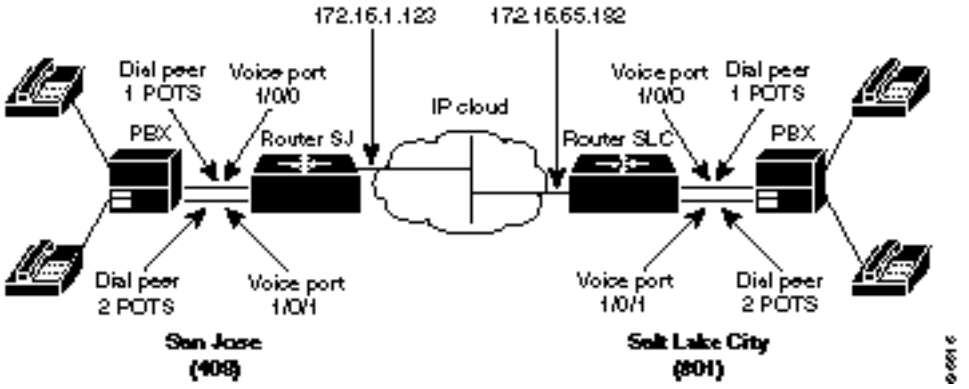
Linking PBX Users with E&M Trunk Lines

The following example shows how to configure VoIP to link PBX users with E&M trunk lines.

In this example, a company wants to connect two offices: one in San Jose, California and the other in Salt Lake City, Utah. Each office has an internal telephone network using PBX, connected to the voice network by an E&M interface. Both the Salt Lake City and the San Jose offices are using E&M Port Type II, with four-wire operation and ImmediateStart signaling. Each E&M interface connects to the router using two voice interface connections. Users in San Jose dial “8-569” and then the extension number to reach a destination in Salt Lake City. Users in Salt Lake City dial “4-527” and then the extension number to reach a destination in San Jose.

Figure 4-2 illustrates the topology of this connection example.

Figure 4-2 Linking PBX Users with E&M Trunk Lines Example



Note This example assumes that the company already has established a working IP connection between its two remote offices.

Router SJ Configuration

```
hostname sanjose
!Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +527....
 port 1/0/0
!Configure pots dial-peer 2
dial-peer voice 2 pots
 destination-pattern +527....
 port 1/0/1
!Configure voip dial-peer 3
dial-peer voice 3 voip
 destination-pattern +569....
 session target ipv4:172.16.65.182
!Configure the E&M interface
voice-port 1/0/0
 signal immediate
 operation 4-wire
 type 2
voice-port 1/0/1
 signal immediate
 operation 4-wire
 type 2
!Configure the serial interface
interface serial 0/0
 description serial interface type dce (provides clock)
 clock rate 2000000
 ip address 172.16.1.123
 no shutdown
```

Router SLC Configuration

```
hostname saltlake
!Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +569....
 port 1/0/0
!Configure pots dial-peer 2
dial-peer voice 2 pots
 destination-pattern +569....
 port 1/0/1
!Configure voip dial-peer 3
dial-peer voice 3 voip
 destination-pattern +527....
 session target ipv4:172.16.1.123
!Configure the E&M interface
voice-port 1/0/0
 signal immediate
 operation 4-wire
 type 2
voice-port 1/0/0
 signal immediate
 operation 4-wire
 type 2
!Configure the serial interface
interface serial 0/0
 description serial interface type dte
 ip address 172.16.65.182
 no shutdown
```

Note PBXs should be configured to pass all DTMF signals to the router. Cisco recommends that you do not configure “store-and-forward” tone.

Note If you change the gain or the telephony port, make sure that the telephony port still accepts DTMF signals.

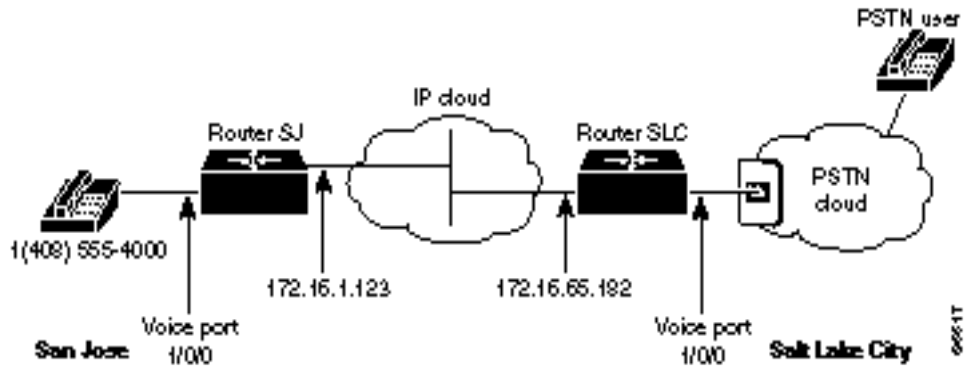
PSTN Gateway Access Using FXO Connection

The following example shows how to configure VoIP to link users with the PSTN gateway using an FXO connection.

In this example, users connected to Router SJ in San Jose, California can reach PSTN users in Salt Lake City, Utah via Router SLC. Router SLC in Salt Lake City is connected directly to the PSTN through an FXO interface.

Figure 4-3 illustrates the topology of this connection example.

Figure 4-3 PSTN Gateway Access Using FXO Connection Example



Note This example assumes that the company already has established a working IP connection between its two remote offices.

Router SJ Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +14085274000
 port 1/0/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +9..........
 session target ipv4:172.16.65.182
! Configure the serial interface
interface serial 0/0
 clock rate 2000000
 ip address 172.16.1.123
 no shutdown
```

Router SLC Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +9..........
 port 1/0/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +14085274000
 session target ipv4:172.16.1.123
! Configure serial interface
interface serial 0/0
 ip address 172.16.65.182
 no shutdown
```

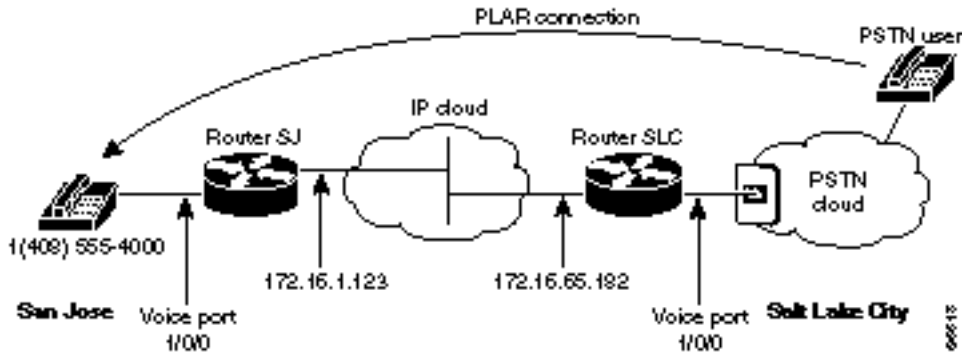
PSTN Gateway Access Using FXO Connection (PLAR Mode)

The following example shows how to configure VoIP to link users with the PSTN gateway using an FXO connection (PLAR mode).

In this example, PSTN users in Salt Lake City, Utah, can dial a local number and establish a private line connection in a remote location. As in the previous example, Router SLC in Salt Lake City is connected directly to the PSTN through an FXO interface.

Figure 4-4 illustrates the topology of this connection example.

Figure 4-4 PSTN Gateway Access Using FXO Connection (PLAR Mode)



Note This example assumes that the company already has established a working IP connection between its two remote offices.

Router SJ Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +14085274000
 port 1/0/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +9..........
 session target ipv4:172.16.65.182
! Configure the serial interface
```

```
interface serial 0/0
 clock rate 2000000
 ip address 172.16.1.123
 no shutdown
```

Router SLC Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +9..........
 port 1/0/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +14085274000
 session target ipv4:172.16.1.123
! Configure the voice port
voice port 1/0/0
connection plar 14085274000
! Configure the serial interface
interface serial 0/0
 ip address 172.16.65.182
 no shutdown
```

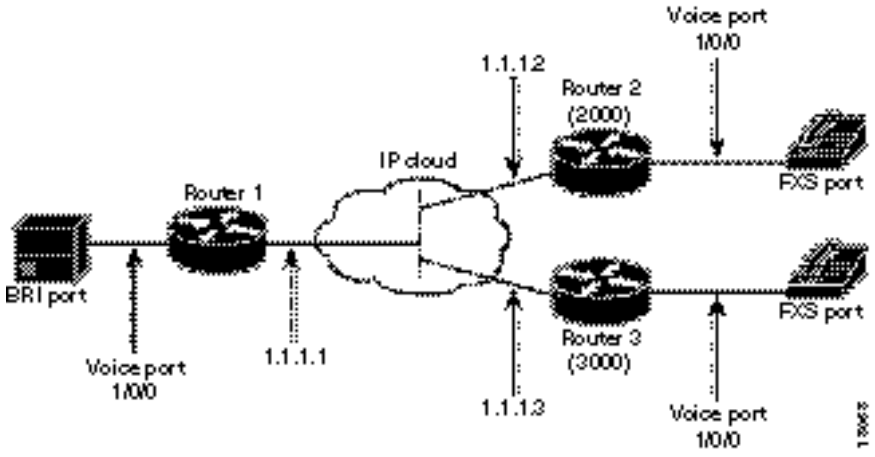
Configuring Direct-Inward Dialing on a BRI Port

The following example shows how to configure a BRI port for direct-inward dialing (DID). This configuration allows the called number information from the ISDN Q.931 setup message to be used for routing on an ISDN line.

In this example, a call comes in to router 1 on the BRI port. The DID information allows the router to route the call based on the called number. If the called number is 2xxx, the call is routed to router 2000, and if the called number is 3xxx, the call is routed to router 3000.

Figure 4-5 illustrates the topology of this connection example.

Figure 4-5 Configuring DID on a BRI Port



Router 1 Configuration

```
dial-peer voice 1 pots
     port 1/0/0
     destination-pattern 1...
     direct-inward-dial
dial-peer voice 2 voip
     session target ipv4:1.1.1.2
     destination-pattern 2...
dial-peer voice 3 voip
         session target ipv4:1.1.1.3
     destination-pattern 3...
```

Router 2 Configuration

```
dial-peer voice 1 pots
     port 1/0/0
     destination-pattern 2000
```

Router 3 Configuration

```
dial-peer voice 1 pots
     port 1/0/0
     destination-pattern 3000
```

Where to Go Next

At this point you can proceed to the following:

- *Voice over IP Software Configuration Guide* for further information on Voice over IP configuration procedures and commands.
- Cisco IOS software configuration guide and command reference publications for more advanced configuration topics. These publications are available on Cisco.com, the Documentation CD-ROM that came with your router, or you can order printed copies.

Configuration Examples

This appendix shows some examples of the configuration in the Cisco 2600 series, Cisco 3600 series, and Cisco 3700 series routers.

Cisco 2600 Series Router Configuration Example

Following is an example of a configuration on a Cisco 2600 series router.

```
The following configuration command script was created:

hostname 2600
enable secret 5 $1$zxxT$YZMzUP1/wQvyLn5cWeyPu.
enable password guessme
line vty 0 4
password guessagain
snmp-server community public
!
no appletalk routing
no decnet routing
ip routing
no clns routing
no ipx routing
no vines routing
no xns routing
no apollo routing
no bridge 1
!
line 1 64
speed 115200
flowcontrol hardware
login local
autoselect during-login
autoselect ppp
modem dialin
ip local pool setup_pool 172.20.30.40 172.20.30.88
!
username user password passwd
line 1 64
modem output
transport input all
!
interface Ethernet0/0
no shutdown
ip address 255.255.255.0 255.255.0.0
lat enabled
```

```
no mop enabled
!
interface Serial0/0
encapsulation hdlc
clock rate 2000000
ip address 1.0.0.1 255.0.0.0
lat enabled
appletalk cable-range 3-3 3.3
appletalk zone myzone
ipx network 8
no vines metric
mop enabled
!
interface Ethernet0/1
ip address 255.255.255.1 255.255.0.0
lat enabled
no vines metric
mop enabled
!
interface Serial0/1
physical-layer sync
encapsulation ppp
ip address 2.0.0.1 255.0.0.0
lat enabled
appletalk cable-range 6-6 6.6
appletalk zone myzone
ipx network 6
no vines metric
xns network 7
mop enabled
!
interface Serial0/2
physical-layer async
ip address 3.0.0.1 255.0.0.0
lat enabled
appletalk cable-range 8-8 8.8
appletalk zone myzone
ipx network 8
no vines metric
mop enabled
!
interface Serial1/0
physical-layer sync
encapsulation frame-relay
frame-relay lmi-type cisco
clock rate 115200
ip address 4.0.0.1 255.0.0.0
no lat enabled
no vines metric
no mop enabled
!
interface Serial1/1
physical-layer async
ip address 5.0.0.1 255.0.0.0
no lat enabled
no vines metric
no mop enabled
!
interface Serial1/2
physical-layer sync
encapsulation x25 dte
x25 address 1234
x25 map ip 1.0.0.1 4321
x25 map ipx 6.0.0.1 -2132065964
```

```
x25 ltc 1
x25 htc 64
x25 win 7
x25 wout 7
x25 threshold 2
x25 ips 128
x25 ops 128
clock rate 115200
ip address 6.0.0.1 255.0.0.0
no lat enabled
no vines metric
no mop enabled
!
interface Serial1/3
physical-layer sync
encapsulation smds
smds address c141.5556.1415
no keepalive
smds static-map ip 2.0.0.1 c141.5556.1414
smds static-map ipx 2.0.0.1 c141.5556.1414
clock rate 115200
ip address 172.22.50.10 255.255.0.0
no lat enabled
no vines metric
no mop enabled
dialer-list 1 protocol ip permit
dialer-list 1 protocol ipx permit
!
router igrp 1
redistribute connected
network 172.21.0.0
!
end
```

Following is an example of a configuration on the Cisco 2691 router.

```
C2691#show running-config
Building configuration...

Current configuration : 1143 bytes
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname C2691
!
enable password lab
!
voice-card 1
!
ip subnet-zero
!
!
no ip domain-lookup
ip host rtplab-dev 172.18.207.10
!
!
!
!
fax interface-type fax-mail
mta receive maximum-recipients 0
!
```

```
controller T1 1/0
 framing esf
 linecode b8zs
 ds0-group 1 timeslots 1-24 type e&m-wink-start
!
controller T1 1/1
 framing sf
 linecode ami
!
!
!
!
interface FastEthernet0/0
 ip address 172.18.193.171 255.255.255.0
 speed 100
 full-duplex
!
interface FastEthernet0/1
 ip address 50.0.0.4 255.0.0.0
 speed 100
 full-duplex
!
ip classless
ip route 172.18.207.0 255.255.255.0 172.18.193.1
ip http server
ip pim bidir-enable
!
!
!
call rsvp-sync
!
voice-port 1/0:1
 output attenuation 3
!
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 919 pots
 destination-pattern 919
 port 1/0:1
 prefix 919
!
dial-peer voice 408 voip
 destination-pattern 408
 session target ipv4:50.0.0.3
 dtmf-relay h245-alphanumeric
 codec g711alaw
!
!
line con 0
 exec-timeout 0 0
line aux 0
line vty 0 4
 password lab
 login
!
end
```

Following is an example of a configuration on the Cisco 2620XM router:

```
Building configuration...

Current configuration : 588 bytes
!
version 12.2
no service pad
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname c2620xm
!
!
ip subnet-zero
!
!
!
!
!
!
!
!
!
!
fax interface-type fax-mail
mta receive maximum-recipients 0
!
!
!
!
interface FastEthernet0/0
 ip address 111.0.0.29 255.255.255.0
 duplex auto
 speed auto
 no cdp enable
!
ip classless
ip route 0.0.0.0 0.0.0.0 FastEthernet0/0
no ip http server
ip pim bidir-enable
!
!
no cdp run
!
!
call rsvp-sync
!
!
mgcp profile default
!
dial-peer cor custom
!
!
!
!
line con 0
line aux 0
line vty 0 4
 login
!
!
end
```

Cisco 3631 Router Configuration Example

Following is an example of the configuration on the Cisco 3631 router equipped with the following modules:

- IMA-8T1 in
- NM-4A/S
- WIC-2A/S
- WIC-1DSU-56k4

```
Building configuration...
00:45:06: %SYS-5-CONFIG_I: Configured from console by console
Current configuration : 3095 bytes
!
! Last configuration change at 12:12:59 PDT Tue Dec 4 2001
! NVRAM config last updated at 12:12:26 PDT Tue Dec 4 2001
!
version 12.2
service timestamps debug uptime
service timestamps log uptime
service password-encryption
!
hostname cisco3631
!
enable secret 5 $1$6UL.$w0aJJ5oZmIv1zRDl1RMvo/
!
username USER password 7 01030717481C091D25
memory-size iomem 10
clock timezone PDT -8
ip subnet-zero
no ip domain-lookup
!
x29 profile linemode 2:1 3:2 15:1
x25 routing
!
chat-script test "" "ATDT\T" TIMEOUT 120 CONNECT \c
!
!
!
!
!
!
!
!
!
!
!
interface FastEthernet0/0
description FAST ETHERNET INTERFACE
ip address x.x.x.x x.x.x.x
duplex auto
speed auto
!
interface Serial0/0
description WIC-1DSU-56k4
ip address x.x.x.x x.x.x.x
encapsulation ppp
!
interface Serial0/1
description WIC-2A/S
physical-layer async
```

```
no ip address
encapsulation ppp
dialer in-band
dialer rotary-group 3
dialer-group 1
async mode dedicated
no fair-queue
!
interface Serial0/2
description WIC-2A/S
physical-layer async
no ip address
encapsulation ppp
no ip route-cache
no ip mroute-cache
dialer in-band
dialer rotary-group 3
dialer-group 1
async default routing
async mode dedicated
no fair-queue
!
interface Serial1/0
description NM-4A/S
no ip address
encapsulation x25
x25 htc 8
!
interface Serial1/1
description NM-4A/S
no ip address
encapsulation x25 dce
x25 ips 256
x25 ops 256
clockrate 9600
!
interface Serial1/2
no ip address
shutdown
!
interface Serial1/3
no ip address
shutdown
!
interface ATM2/0
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/1
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/2
description ATM T1
ip address x.x.x.x x.x.x.x
no ip route-cache
no ip mroute-cache
no atm ilmi-keepalive
pvc atm71 0/71
protocol clns 47.0004.004d.0056.0000.0c00.0003.00 broadcast
```

```
protocol ip 12.0.0.2 broadcast
encapsulation aal5snap
!
scrambling-payload
impedance 120-ohm
!
interface ATM2/3
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/4
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/5
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/6
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/7
no ip address
shutdown
no atm ilmi-keepalive
no scrambling-payload
!
interface ATM2/IMA0
description ATM-IMA GROUP
ip address x.x.x.x x.x.x.x
no ip route-cache
no ip mroute-cache
no atm ilmi-keepalive
pvc atm71 0/71
protocol clns 47.0004.004d.0056.0000.0c00.0002.00 broadcast
protocol ip 12.0.0.1 broadcast
encapsulation aal5snap
!
interface Dialer3
ip address x.x.x.9 x.x.x.x
encapsulation ppp
no ip route-cache
no ip mroute-cache
dialer in-band
dialer idle-timeout 500
dialer map ip x.x.x.10 name USER modem-script test broadcast
9,5551122
dialer map ip x.x.x.10 name USER modem-script test broadcast
9,5551123
dialer hold-queue 15
dialer load-threshold 5 either
dialer-group 1
no fair-queue
no cdp enable
ppp authentication chap
```

```
ppp multilink
group-range 4 5
!
router ospf 1
redistribute connected subnets
network X.X.X.X 0.0.0.X area 3
!
!
ip classless
no ip http server
ip pim bidir-enable
!
!
!
!
!
!
!
!
!
!
!
!
snmp-server view cutdown internet included
snmp-server view cutdown at excluded
snmp-server community public view cutdown RO
snmp-server community private view cutdown RW
!
call rsvp-sync
!
!
mgcp profile default
!
dial-peer cor custom
!
!
!
!
line con 0
line 3
modem InOut
transport input all
autohangup
stopbits 1
rxspeed 115200
txspeed 115200
flowcontrol hardware
line 5
modem InOut
transport input all
autohangup
stopbits 1
rxspeed 115200
txspeed 115200
flowcontrol hardware
line 6
line aux 0
password 7 08314D5D1A0E0A0516
login
modem InOut
transport input all
line vty 0 4
password 7 00141215174C04140B
login
```

```
!
end
```

Cisco 3725 Router Configuration Example

Following example shows the configurationon the Cisco 3725 router.

```
version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname pipertdm
!
no logging buffered
logging rate-limit console 10 except errors
no logging console
!
!
!
ip subnet-zero
!
!
no ip finger
ip host rtplab-tftp2 172.18.207.16
ip host rtplab-dev 172.18.207.10
!
no ip dhcp-client network-discovery
no mgcp timer receive-rtcp
call rsvp-sync
!
!
!
!
!
fax interface-type modem
mta receive maximum-recipients 0
!
!
!
!
interface FastEthernet0/0
ip address 172.18.197.74 255.255.255.252
no keepalive
duplex auto
speed auto
no cdp enable
!
interface FastEthernet0/1
ip address 2.2.2.2 255.0.0.0
no keepalive
duplex auto
speed auto
no cdp enable
!
interface BRI1/0
no ip address
shutdown
!
interface FastEthernet1/0
```

```
ip address 1.1.1.1 255.0.0.0
no keepalive
duplex auto
speed auto
no cdp enable
!
interface Serial1/0
no ip address
shutdown
no fair-queue
clockrate 125000
!
interface FastEthernet1/1
ip address 3.3.3.3 255.0.0.0
no keepalive
shutdown
duplex auto
speed auto
no cdp enable
!
interface Serial1/1
no ip address
shutdown
clockrate 125000
!
ip kerberos source-interface any
ip classless
ip route 172.18.0.0 255.255.0.0 FastEthernet0/0
ip http server
!
!
!
!
snmp-server packetsize 4096
snmp-server chassis-id
snmp-server manager
!
!
dial-peer cor custom
!
!
!
!
line con 0
exec-timeout 0 0
transport input none
line 1 32
line 35 96
line aux 0
line vty 0 4
!
end
```

1-Port ADSL WAN Interface Card Configuration Examples

Following configuration examples are shown below:

VoATM over AAL2 on the ATM Interface Configuration Example

The following example shows VoATM over AAL2 on the ATM interface with an ADSL card:

```
Router#
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname host1
!
memory-size iomem 10
voice-card 1
!
ip subnet-zero
ip host host2 225.255.255.224
!
no mgcp timer receive-rtcp
call rsvp-sync
!
!
controller T1 1/0
 framing esf
 linecode b8zs
 ds0-group 0 timeslots 1 type e&m-wink-start
 ds0-group 1 timeslots 2 type e&m-wink-start
.
.
.
ds0-group 23 timeslots 24 type e&m-wink-start
!
controller T1 1/1
 framing esf
 linecode b8zs
!
interface Ethernet0/0
 ip address 1.6.46.119 255.255.255.224
 half-duplex
 no cdp enable
!
interface Serial0/0
 no ip address
 shutdown
!
interface ATM0/1
 ip address 10.1.1.1 255.0.0.0
 load-interval 30
 atm vc-per-vp 256
 no atm ilmi-keepalive
 pvc 10/100
  vbr-rt 672 672 512
  encapsulation aal2
```

```
 !
 pvc 10/200
  protocol ip 10.1.1.2 broadcast
  encapsulation aal5snap
 !
 dsl operating-mode ansi-dmt
 no fair-queue
!
interface Ethernet0/1
 no ip address
 shutdown
!
ip classless
ip route 223.255.254.254 255.255.255.224 Ethernet0/0
no ip http server
!
!
snmp-server engineID local 000000090200003080477F20
snmp-server manager
!
voice-port 1/0:0
 local-alerting
 timeouts wait-release 3
 connection trunk 3001
!
voice-port 1/0:1
 local-alerting
 timeouts wait-release 3
 connection trunk 3002
.
.
.
voice-port 1/0:23
 local-alerting
 timeouts wait-release 3
 connection trunk 3024
 shutdown
!
dial-peer cor custom
!
dial-peer voice 3001 voatm
 destination-pattern 3001
 called-number 4001
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 31
 codec aal2-profile ITUT 1 g711ulaw
 no vad
!
dial-peer voice 3002 voatm
 destination-pattern 3002
 called-number 4002
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 32
 codec aal2-profile custom 100 g726r32
 no vad
!
dial-peer voice 3003 voatm
 destination-pattern 3003
 called-number 4003
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 33
 codec aal2-profile ITUT 7 g729abr8
 no vad
.
```

```
.
.
dial-peer voice 3024 voatm
 destination-pattern 3024
 called-number 3024
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 54
 codec aal2-profile ITUT 7 g729abr8
 no vad
!
dial-peer voice 1 pots
 destination-pattern 4001
 port 1/0:0
!
dial-peer voice 2 pots
 destination-pattern 4002
 port 1/0:1
.
.
.
dial-peer voice 24 pots
 destination-pattern 4024
 port 1/0:23
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
no scheduler allocate
end
```

VoATM over AAL5 on the ATM Interface Configuration Example

The following example shows a Cisco 2600 series router configured for VoATM over AAL5 on the ATM interface with an ADSL card.

```
Router#
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname u2621
!
no logging buffered
no logging buffered
logging rate-limit console 10 except errors
!
memory-size iomem 15
voice-card 1
!
ip subnet-zero
!
no ip finger
no ip domain-lookup
!
no mgcp timer receive-rtcp
call rsvp-sync
```

```
!
controller T1 1/0
 framing esf
 linecode b8zs
 ds0-group 0 timeslots 1-24 type e&m-wink-start
!
controller T1 1/1
!
!
interface ATM0/0
 ip address 12.0.0.1 255.255.255.224
 load-interval 30
 atm vc-per-vp 256
 no atm ilmi-keepalive
 dsl operating-mode auto
 no fair-queue
!
!
interface FastEthernet0/0
 ip address 1.7.73.1 255.255.255.224
 duplex auto
 speed auto
!
!
interface FastEthernet0/1
 ip address 192.168.2.1 255.255.255.224
 load-interval 30
 duplex auto
 speed auto
!
ip classless
ip route 223.255.254.0 255.255.255.224 FastEthernet0/0
no ip http server
!
!
snmp-server engineID local 0000000902000002163DB260
snmp-server packetsize 4096
snmp-server manager
!
voice-port 1/0:0
!
dial-peer cor custom
!
!
dial-peer voice 5 pots
 destination-pattern 777...
 port 1/0:0
 prefix 777
!
!
dial-peer voice 100 voatm
 destination-pattern 888....
 session target atm0/0 pvc 0/72
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
end
```

NM-AIC-64, Contact Closure NetworkConfiguration Examples

The following examples are documented below:

AIC IP Address Configuration Example

The following example shows a Cisco 3600 router configured for AIC IP address:

```
version 12.2
no service single-slot-reload-enable
service tcp-keepalives-in
service tcp-keepalives-out
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname 3600-top
!
logging rate-limit console 10 except errors
!
memory-size iomem 15
ip subnet-zero
!
!
no ip finger
no ip domain-lookup
ip host moe 172.31.10.2
ip host mickey 10.1.1.2
!
no ip dhcp-client network-discovery
frame-relay switching
x25 routing
!
!
call-history-mib max-size 50
!
interface Ethernet0/0
 ip address 10.5.37.13 255.255.0.0
 ip helper-address 223.255.254.254
 no keepalive
 half-duplex
!
interface Serial0/0
 ip address 10.5.5.1 255.255.255.0
 encapsulation frame-relay
 no ip mroute-cache
 clockrate 500000
 frame-relay class voice-vc
 frame-relay traffic-shaping
 frame-relay map ip 10.5.5.2 990 broadcast
 frame-relay interface-dlci 990
 frame-relay intf-type dce
```

```
!
interface Ethernet0/1
 no ip address
 half-duplex
 no cdp enable
!
interface Serial0/1
 ip address 10.11.11.1 255.255.255.0
 encapsulation frame-relay
 no ip mroute-cache
 clockrate 256000
 frame-relay class voice-vc
 frame-relay traffic-shaping
 frame-relay interface-dlci 991
 frame-relay intf-type dce
!
interface Serial1/0
 ip address negotiated
!
router mobile
!
ip kerberos source-interface any
ip classless
ip route 223.255.254.254 255.255.255.255 10.5.0.1
ip route 223.255.254.254 255.255.255.255 Ethernet0/0
no ip http server
!
!
map-class frame-relay voice-vc
 frame-relay cir 800000
 frame-relay bc 512000
 no frame-relay adaptive-shaping
 frame-relay fair-queue
 frame-relay voice bandwidth 500000
 frame-relay fragment 100
 frame-relay ip rtp priority 16384 16383 512
!
map-class frame-relay fr1
 frame-relay cir 1000000
 frame-relay bc 1000
 no frame-relay adaptive-shaping
 frame-relay fair-queue
 frame-relay voice bandwidth 1000000
 frame-relay fragment 100
!
map-class frame-relay voice-vc2
 frame-relay cir 800000
 frame-relay bc 512000
 no frame-relay adaptive-shaping
 frame-relay voice bandwidth 800000
!
map-class frame-relay voice-data
access-list 1 deny   192.200.1.20
access-list 2 deny   10.10.1.10
dialer-list 1 protocol ip permit
dialer-list 1 protocol ipx permit
!
snmp-server packetsize 4096
snmp-server manager
!
alarm-interface 1
 ip address 10.4.3.2
call rsvp-sync
!
```

```
mgcp modem passthrough voip mode ca
no mgcp timer receive-rtcp
!
mgcp profile default
!
dial-peer cor custom
!
dial-peer voice 1 pots
 destination-pattern 3
 direct-inward-dial
 forward-digits all
!
dial-peer voice 100 voip
 shutdown
 destination-pattern 3
 session target ipv4:10.2.81.1
 playout-delay maximum 300
!
dial-peer voice 2 pots
 shutdown
 destination-pattern 3002
!
dial-peer voice 3 pots
 shutdown
 destination-pattern 3003
!
dial-peer voice 4 pots
 shutdown
 destination-pattern 3004
!
dial-peer voice 2000 voip
 shutdown
 destination-pattern 2...
 session target ipv4:5.5.5.2
 playout-delay maximum 300
!
dial-peer voice 110 voip
 shutdown
 destination-pattern 1...
 session target ipv4:10.2.83.30
 playout-delay maximum 300
!
dial-peer voice 922 pots
 shutdown
 destination-pattern 9..
!
dial-peer voice 22 pots
 shutdown
 destination-pattern 22
!
dial-peer voice 6001 pots
 shutdown
 destination-pattern 6001
!
dial-peer voice 333 voip
 shutdown
 destination-pattern 1
 session target ipv4:10.2.79.55
 playout-delay maximum 300
!
dial-peer voice 200 vofr
 shutdown
 destination-pattern 1
!
```

```
dial-peer voice 7001 pots
 shutdown
 destination-pattern 7001
!
dial-peer voice 5000 voip
 shutdown
 destination-pattern 5...
 session target ipv4:10.11.11.2
 playout-delay maximum 300
!
dial-peer voice 20 voip
 shutdown
 destination-pattern 1
 session target ipv4:10.11.11.2
 playout-delay maximum 300
!
dial-peer voice 2001 voip
 preference 2
 shutdown
 destination-pattern 2...
 session target ipv4:10.2.79.7
 playout-delay maximum 300
!
dial-peer voice 1000 voip
 destination-pattern 1...
 session target ipv4:10.2.81.6
 playout-delay maximum 300
 no vad
!
dial-peer voice 1001 voatm
 shutdown
 destination-pattern 1...
!
dial-peer voice 1100 vofr
 shutdown
 destination-pattern 1...
 session target Serial0/0 990
 no vad
!
gateway
!
gateway
!
gatekeeper
 shutdown
!
!
line con 0
 exec-timeout 0 0
 transport input none
line 33
 no exec
 transport preferred none
 transport input telnet
 transport output none
 stopbits 1
line aux 0
line vty 0 4
 login
!
end
```

IP Route to the AIC Configuration Examples

Following examples show the configuration of an IP route to the AIC with an unnumbered and numbered IP address.

With an Unnumbered IP Address

The following example shows a Cisco 3660 router, with an IP route to an AIC, is configured with an unnumbered IP address:

```
version 12.1
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uut2-3660
!
logging rate-limit console 10 except errors
no logging console
!
ip subnet-zero
!
!
no ip finger
no ip domain-lookup
!
call rsvp-sync
cns event-service server
!
interface FastEthernet0/0
 ip address 10.2.130.2 255.255.0.0
 duplex auto
 speed auto
no cdp enable
!
interface Serial5/0
 ip unnumbered FastEthernet0/0
!
ip kerberos source-interface any
ip classless
ip route 0.0.0.0 0.0.0.0 10.2.0.1
ip route 10.2.130.102 255.255.255.255 Serial5/0
ip http server
!
no cdp run
!
alarm-interface 5
 ip address 10.2.130.102
!
dial-peer cor custom
!
!
!
line con 0
 exec-timeout 0 0
 transport input none
line 161
 no exec
 transport preferred none
 transport input telnet
```

```
 transport output none
 stopbits 1
line aux 0
line vty 0 4
 password lab
 login
!
end
```

Without an Unnumbered IP Address

The following example shows a Cisco 2621 router configured without an unnumbered IP address:

```
uut5-2621#s run
Building configuration...

Current configuration :1318 bytes
!
version 12.2
no service single-slot-reload-enable
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname uut5-2621
!
logging rate-limit console 10 except errors
no logging console
!
ip subnet-zero
!
no ip finger
no ip domain-lookup
!
no ip dhcp-client network-discovery
!
interface FastEthernet0/0
 ip address 10.2.130.5 255.255.0.0
 duplex auto
 speed auto
 no cdp enable
!
interface Serial1/0
 ip address 172.128.12.1 255.255.255.252
!
router rip
 network 10.0.0.0
!
ip kerberos source-interface any
ip classless
ip route 0.0.0.0 0.0.0.0 10.2.0.1
no ip http server
!
no cdp run
!
snmp-server packetsize 4096
snmp-server manager
!
!
alarm-interface 1
 ip address 172.128.12.2
call rsvp-sync
```

```
!
dial-peer cor custom
!
line con 0
 exec-timeout 0 0
 transport input none
line 33
 no exec
 transport preferred none
 transport input telnet
 transport output none
 stopbits 1
line aux 0
line vty 0 4
 password lab
 login
!
no scheduler allocate
!
end
```

AIC CLI Configuration for Alarms

These examples are output from the **show alarm config #** command.

Discrete Alarm

```
description:west door
normally closed
normal state description:door closed
alarm state description:door open
SNMP trap:enabled
```

Analog Alarm Monitoring Current

```
description:thermostat
high-high state description:very hot
high state description:hot
normal state description:just right
low state description:cold
low-low state description:very cold
current-loop -5.2 5.4 15.0 25.0 35.1 45.6
SNMP trap:enabled
```

Analog Alarm Monitoring Current Configured as a Discrete

```
description:east door
configured as discrete
normal state description:door closed
alarm description:door open
current-loop 0.0 3.2 5.9
```
SNMP trap:enabled

Cisco 3640 Central Site Configuration to Support ISDN and Modem Calls

The following configuration allows remote LANs and standalone remote users with modems to dial in to a central site.

The following configuration example shows a Cisco 3640 router with the following hardware configuration:

- One 2-port ISDN-PRI network module installed in slot 1
- One digital modem network module installed in slot 2 and slot 3
- One 1-port Ethernet network module installed in slot 0

Note Each MICA digital modem card has its own group async configuration. Additionally, a single range of async lines is used for each modem card. For additional interface numbering information, refer to the *Digital Modem Network Module Configuration Note.*

```
!
version 11.2
service timestamps debug datetime msec
service timestamps log datetime msec
service password-encryption
no service udp-small-servers
no service tcp-small-servers
!
hostname NAS
!
aaa new-model
aaa authentication login default local
aaa authentication login console enable
aaa authentication login vty local
aaa authentication login dialin local
aaa authentication ppp default local
aaa authentication ppp dialin if-needed local
enable secret cisco
!
username admin password cisco
username remotelan1 password dialpass1
username remotelan2 password dialpass2
username PCuser1 password dialpass3
username PCuser2 password dialpass4
async-bootp dns-server 10.1.3.1 10.1.3.2
isdn switch-type primary-5ess
!
controller T1 1/0
 framing esf
 clock source line
 linecode b8zs
 pri-group timeslots 1-24
!
controller T1 1/1
 framing esf
 clock source line
 linecode b8zs
 pri-group timeslots 1-24
!
interface Loopback0
 ip address 10.1.2.254 255.255.255.0
```

```
!
interface Ethernet0/0
 ip address 10.1.1.10 255.255.255.0
 ip summary address eigrp 10 10.1.2.0 255.255.255.0
!
interface Serial 1/0:23
 no ip address
 encapsulation ppp
 no keepalive
 isdn incoming-voice modem
 dialer rotary-group 0
 dialer-group 1
 no fair-queue
 no cdp enable
!
interface Serial 1/1:23
 no ip address
 encapsulation ppp
 no keepalive
 isdn incoming-voice modem
 dialer rotary-group 0
 dialer-group 1
 no fair-queue
 no cdp enable
!
interface Group-Async1
 ip unnumbered Loopback0
 encapsulation ppp
 async mode interactive
 peer default ip address pool dialin_pool
 no cdp enable
 ppp authentication chap pap dialin
 group-range 65 88
!
interface Group-Async2
 ip unnumbered Loopback0
 encapsulation ppp
 async mode interactive
 peer default ip address pool dialin_pool
 no cdp enable
 ppp authentication chap pap dialin
 group-range 97 120
!
interface Dialer0
 ip unnumbered Loopback0
 no ip mroute-cache
 encapsulation ppp
 peer default ip address pool dialin_pool
 dialer in-band
 dialer-group 1
 no fair-queue
 no cdp enable
 ppp authentication chap pap dialin
 ppp multilink
!
router eigrp 10
 network 10.0.0.0
 passive-interface Dialer0
 no auto-summary
!
ip local pool dialin_pool 10.1.2.1 10.1.2.50
ip default-gateway 10.1.1.1
ip classless
!
```

```
dialer-list 1 protocol ip permit
!
line con 0
 login authentication console
line 65 88
 autoselect ppp
 autoselect during-login
 login authentication dialin
 modem DialIn
line 97 120
 autoselect ppp
 autoselect during-login
 login authentication dialin
 modem DialIn
line aux 0
 login authentication console
line vty 0 4
 login authentication vty
 transport input telnet rlogin
!
end
```

Configuration in CPE Mode Example

The following example shows a G.SHDSL configuration of VoATM over AAL2, operating in customer premises equipment (CPE) mode, on a Cisco 2600 series router. This router in CPE mode can be linked to either a DSLAM or to another router that is configured to operate in central office (CO) mode.

```
Router#
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname host1
!
memory-size iomem 10
voice-card 1
!
ip subnet-zero
ip host host2 225.255.255.224
!
no mgcp timer receive-rtcp
call rsvp-sync
!
!
controller T1 1/0
 framing esf
 linecode b8zs
 ds0-group 0 timeslots 1 type e&m-wink-start
 ds0-group 1 timeslots 2 type e&m-wink-start
.
.
.
ds0-group 23 timeslots 24 type e&m-wink-start
!
controller T1 1/1
 framing esf
 linecode b8zs
!
```

```
interface Ethernet0/0
 ip address 209.165.202.128 255.255.255.224
 half-duplex
 no cdp enable
!
interface Serial0/0
 no ip address
 shutdown
!
interface ATM0/1
 ip address 209.165.201.1 255.255.255.224
 dsl operating-mode gshdsl symmetric annex A
 dsl equipment-type cpe
 dsl linerate auto
 load-interval 30
 atm vc-per-vp 256
 no atm ilmi-keepalive
 pvc 10/100
  vbr-rt 672 672 512
  encapsulation aal2
 !
 pvc 10/200
  protocol ip 209.165.202.159 broadcast
  encapsulation aal5snap
 !
 no fair-queue
!
interface Ethernet0/1
 no ip address
 shutdown
!
ip classless
ip route 209.165.202.128 255.255.255.224 Ethernet0/0
no ip http server
!
!
snmp-server engineID local 000000090200003080477F20
snmp-server manager
!
voice-port 1/0:0
 local-alerting
 timeouts wait-release 3
 connection trunk 3001
!
voice-port 1/0:1
 local-alerting
 timeouts wait-release 3
 connection trunk 3002
.
.
.
voice-port 1/0:23
 local-alerting
 timeouts wait-release 3
 connection trunk 3024
 shutdown
!
dial-peer cor custom
!
dial-peer voice 3001 voatm
 destination-pattern 3001
 called-number 4001
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 31
```

```
 codec aal2-profile ITUT 1 g711ulaw
 no vad
!
dial-peer voice 3002 voatm
 destination-pattern 3002
 called-number 4002
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 32
 codec aal2-profile custom 100 g726r32
 no vad
!
dial-peer voice 3003 voatm
 destination-pattern 3003
 called-number 4003
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 33
 codec aal2-profile ITUT 7 g729abr8
 no vad
.
.
.
dial-peer voice 3024 voatm
 destination-pattern 3024
 called-number 3024
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 54
 codec aal2-profile ITUT 7 g729abr8
 no vad
!
dial-peer voice 1 pots
 destination-pattern 4001
 port 1/0:0
!
dial-peer voice 2 pots
 destination-pattern 4002
 port 1/0:1
.
.
.
dial-peer voice 24 pots
 destination-pattern 4024
 port 1/0:23
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
no scheduler allocate
end
```

Configuration in CO Mode Example

The following example shows a G.SHDSL configuration of VoATM over AAL2, operating in central office (CO) mode, on a Cisco 2600 series router. This router in CO mode can be linked to another router that is configured to operate in CPE mode.

```
Router#
```

```
version 12.2
service timestamps debug uptime
service timestamps log uptime
no service password-encryption
!
hostname host2
!
memory-size iomem 10
voice-card 1
!
ip subnet-zero
ip host host2 225.255.255.224
!
no mgcp timer receive-rtcp
call rsvp-sync
!
!
controller T1 1/0
 framing esf
 linecode b8zs
 ds0-group 0 timeslots 1 type e&m-wink-start
 ds0-group 1 timeslots 2 type e&m-wink-start
.
.
.
ds0-group 23 timeslots 24 type e&m-wink-start
!
controller T1 1/1
 framing esf
 linecode b8zs
!
interface Ethernet0/0
 ip address 209.165.202.128 255.255.255.224
 half-duplex
 no cdp enable
!
interface Serial0/0
 no ip address
 shutdown
!
interface ATM0/1
 ip address 209.165.201.1 255.255.255.224
 dsl operating-mode gshdsl symmetric annex A
 dsl equipment-type co
 dsl linerate auto
 load-interval 30
 atm vc-per-vp 256
 no atm ilmi-keepalive
 pvc 10/100
  vbr-rt 672 672 512
  encapsulation aal2
 !
 pvc 10/200
  protocol ip 209.165.202.159 broadcast
  encapsulation aal5snap
 !
 no fair-queue
!
interface Ethernet0/1
 no ip address
 shutdown
!
ip classless
ip route 209.165.202.128 255.255.255.224 Ethernet0/0
```

```
no ip http server
!
!
snmp-server engineID local 0000000902000003080477F20
snmp-server manager
!
voice-port 1/0:0
 local-alerting
 timeouts wait-release 3
 connection trunk 3001
!
voice-port 1/0:1
 local-alerting
 timeouts wait-release 3
 connection trunk 3002
.
.
.
voice-port 1/0:23
 local-alerting
 timeouts wait-release 3
 connection trunk 3024
 shutdown
!
dial-peer cor custom
!
dial-peer voice 3001 voatm
 destination-pattern 3001
 called-number 4001
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 31
 codec aal2-profile ITUT 1 g711ulaw
 no vad
!
dial-peer voice 3002 voatm
 destination-pattern 3002
 called-number 4002
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 32
 codec aal2-profile custom 100 g726r32
 no vad
!
dial-peer voice 3003 voatm
 destination-pattern 3003
 called-number 4003
 session protocol aal2-trunk
 session target ATM0/1 pvc 10/100 33
 codec aal2-profile ITUT 7 g729abr8
 no vad
.
.
.
dial-peer voice 3024 voatm
 destination-pattern 3024
 called-number 3024
 session protocol aal2-trunk
session target ATM0/1 pvc 10/100 54
 codec aal2-profile ITUT 7 g729abr8
 no vad
!
dial-peer voice 1 pots
 destination-pattern 4001
 port 1/0:0
!
```

```
dial-peer voice 2 pots
 destination-pattern 4002
 port 1/0:1
.
.
.
dial-peer voice 24 pots
 destination-pattern 4024
 port 1/0:23
!
!
line con 0
 exec-timeout 0 0
 transport input none
line aux 0
line vty 0 4
 login
!
no scheduler allocate
end
```

Formatting the Compact Flash Memory Cards

This appendix describes how to format the compact Flash memory into a Class B Flash file system, known as the low-end file system (LEFS), or into a Class C Flash file system, which is similar to DOS. It also describes how to perform file and directory operations in each file system.

Formatting Procedures for Compact Flash Memory Cards

The following sections describe formatting procedures for internal and external compact Flash memory cards.

Formatting Procedures

Cisco recommends that you erase (Class B) or format (Class C) new compact Flash memory cards to initialize them with either a Class B or Class C Flash file system. This ensures proper formatting and enables the ROM monitor to recognize and boot the Flash.

The Class B Flash file system is also known as the low end file system (LEFS).

The Class C Flash file system is similar to the standard DOS file system.

Note A compact Flash memory card formatted with the standard DOS file system does not support booting from the ROM monitor.

Determining the File System on a Compact Flash Memory Card

To determine the file system of an external compact Flash memory card, enter the **show slot0: all** command. To determine the file system of an internal compact Flash memory card, enter the **show flash: all** command.

- If geometry and format information is not displayed, the card is formatted with a Class B Flash file system.
- If geometry and format information is displayed, the card is formatted with a Class C Flash file system.

The following examples show outputs for Class B and Class C Flash file systems:

External Card with Class B Flash File System:

The geometry and format information is not displayed for this format.

```
Router#show slot0: all

Partition   Size    Used      Free      Bank-Size  State          Copy
Mode
  1        31360K   6502K    24857K        0K      Read/Write     Direct

Slot0 CompactFlash directory:
File  Length   Name/status
        addr      fcksum  ccksum
  1   6658376  c3725-i-mz
        0x40      0xE0FF  0xE0FF
[6658440 bytes used, 25454200 available, 32112640 total]
31360K bytes of ATA Slot0 CompactFlash (Read/Write)

 Chip information NOT available.
```

External Card with Class C Flash File System:

The geometry and format information is displayed in this format.

```
Router#show slot0:all

-#- --length-- -----date/time------ path
1      6658376 Mar 01 1993 04:27:46 c3725-i-mz

25268224 bytes available (6664192 bytes used)

******** ATA Flash Card Geometry/Format Info ********

ATA CARD GEOMETRY
   Number of Heads:      4
   Number of Cylinders    490
   Sectors per Cylinder   32
   Sector Size            512
   Total Sectors          62720

ATA CARD FORMAT
   Number of FAT Sectors  31
   Sectors Per Cluster    8
   Number of Clusters     7796
   Number of Data Sectors 62560
   Base Root Sector       155
   Base FAT Sector        93
   Base Data Sector       187
```

Internal Card with Class B Flash File System:

The geometry and format information is not displayed for this format.

```
Router# show flash: all

Partition   Size    Used      Free      Bank-Size  State          Copy
Mode
  1        125184K  20390K    104793K        0K      Read/Write
Direct

System CompactFlash directory:
File  Length   Name/status
        addr      fcksum  ccksum
  1   6658376  c3725-i-mz
        0x40      0xE0FF  0xE0FF
  2   14221136  c3631-telcoent-mz
```

```
        0x6599C8  0x5C3D  0x5C3D
[20879640 bytes used, 107308776 available, 128188416 total]
125184K bytes of ATA System CompactFlash (Read/Write)

 Chip information NOT available.
```

Internal card with Class C Flash file system:

The geometry and format information is displayed in this format.

```
Router#show flash: all

-#- --length-- -----date/time------ path
1      6658376 Mar 01 1993 04:27:46 c3725-i-mz

25268224 bytes available (6664192 bytes used)

******** ATA Flash Card Geometry/Format Info ********

ATA CARD GEOMETRY
   Number of Heads:      4
   Number of Cylinders    490
   Sectors per Cylinder   32
   Sector Size            512
   Total Sectors          62720

ATA CARD FORMAT
   Number of FAT Sectors  31
   Sectors Per Cluster    8
   Number of Clusters     7796
   Number of Data Sectors 62560
   Base Root Sector       155
   Base FAT Sector        93
   Base Data Sector       187
```

Formatting Compact Flash Memory as a Class B Flash File System

Use these formatting commands to:

- Format compact Flash memory cards with a Class B Flash file system (LEFS)
- Remove the files from a compact Flash memory card previously formatted with a Class B Flash file system

For external compact Flash memory cards, enter the **erase slot0:** command.

For internal compact Flash memory cards, enter the **erase flash:** command.

The following example shows output for formatting an external compact Flash memory card with a Class B Flash file system:

```
Router# erase slot0:
Erasing the slot0 filesystem will remove all files! Continue? [confirm]
Current DOS File System flash card in slot0: will be formatted into Low
End File System flash card!  Continue? [confirm]
Erasing device...
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
...erased
Erase of slot0: complete
```

Formatting Compact Flash Memory as a Class C File System

Use these formatting commands to:

- Format compact Flash memory cards with a Class C Flash file system
- Remove the files from a compact Flash memory card previously formatted with a Class C Flash file system

For external compact Flash memory cards, enter the **format slot0:** command.

For internal compact Flash memory cards, enter the **format flash:** command.

The following example shows output for formatting an internal compact Flash memory card with a Class C Flash file system:

```
Router# format flash:
Format operation may take a while. Continue? [confirm]
Format operation will destroy all data in "flash:".  Continue? [confirm]
Enter volume ID (up to 64 chars)[default flash]:
Current Low End File System flash card in flash will be formatted into DOS
File System flash card!  Continue? [confirm]
Format:Drive communication & 1st Sector Write OK...
Writing Monlib sectors ...................................................................
Monlib write complete
..
Format:All system sectors written. OK...

Format:Total sectors in formatted partition:250592
Format:Total bytes in formatted partition:128303104
Format:Operation completed successfully.

Format of flash complete
```

File and Directory Operations

The following sections describe file and directory operations for internal and external Cisco Flash memory cards. File and directory operations vary according to the formatted file system—Class B or Class C.

Operations for Use With Class B Flash File System

The following file operations are useful for compact Flash memory cards formatted with a Class B Flash file system.

Copy Files

To copy files to another location, enter the **copy** {**flash:** | **slot0:**} command.

The following example shows output for copying a Cisco IOS file from an internal compact Flash memory card (**flash:**) to an external compact Flash memory card (**slot0:**):

```
Router# copy flash:c3725-i-mz.tmp slot0:

Destination filename [c3725-i-mz.tmp]?
Erase slot0:before copying?
[confirm]nCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

```
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Verifying checksum...  OK (0xC68E)
6458584 bytes copied in 67.788 secs (96396 bytes/sec)
```

The following example shows output for copying a configuration file to the startup configuration in an internal compact Flash memory card (**flash:**):

```
Router# copy flash:my-config1 startup-config

Destination filename [startup-config]?
[OK]
517 bytes copied in 4.188 secs (129 bytes/sec)
```

The following example shows output for copying a configuration file to the running configuration in an internal compact Flash memory card (**flash:**):

```
Router# copy flash:my-config2 running-config

Destination filename [running-config]?
709 bytes copied in 0.72 secs
```

Display the Contents of a Compact Flash Memory Card

To display the contents (directories and files) of a compact Flash memory card formatted with a Class B Flash file system, enter the **dir** {**flash:** | **slot0:**} command or the **show** {**flash:** | **slot0:**} command.

The following example shows output for displaying the contents of an internal compact Flash memory card using the **dir flash:** command:

```
Router# dir flash:

Directory of flash:/

     1  -rw-     5190020              <no date>  c3631-i-mz
     2  -rw-     6458584              <no date>  c3725-i-mz
     3  -rw-    16535740              <no date>  c3631-telcoent-mz

128450560 bytes total (100266024 bytes free)
```

The following example shows output for displaying the contents of an external compact Flash memory card using the **show slot0:** command:

```
Router# show slot0:

System CompactFlash directory:
File  Length   Name/status
   1   5190020  c3631-i-mz
   2   6458584  c3725-i-mz
   3   16535740  c3631-telcoent-mz
[28184536 bytes used, 100266024 available, 128450560 total]
125440K bytes of ATA System CompactFlash (Read/Write)
```

Delete Files from Compact Flash Memory

To delete a file from compact Flash memory, enter the **delete** {**flash: | slot0:**} command, followed by the **squeeze** {**flash:** | **slot0:**} command.

When a file is deleted in the Class B Flash file system, the memory space occupied by the deleted file is not released until you enter the **squeeze** {**flash:** | **slot0:**} command. Although the memory space once occupied by the deleted file remains, the deleted file cannot be recovered. To release the memory space occupied by a deleted file, enter the **squeeze** {**flash:** | **slot0:**} command.

Note The **dir** {**flash:** | **slot0:**} command does not show deleted files; the **show** {**flash:** | **slot0:**} command shows all files, including any deleted files if the **squeeze** {**flash:** | **slot0:**} command has not been entered.

The following example shows output for deleting a Cisco IOS file from an external compact Flash memory card, and then releasing the memory space originally occupied by the file:

```
Router# dir slot0:

Directory of slot0:/

     1  -rw-     6458208              <no date>  c3725-i-mz.tmp
     2  -rw-     6458208              <no date>  c3725-i-mz

16056320 bytes total (3139776 bytes free)
Router# delete slot0:c3725-i-mz.tmp

Delete filename [c3725-i-mz.tmp]?
Delete slot0:c3725-i-mz.tmp? [confirm]
Router# dir slot0:

Directory of slot0:/

     2  -rw-     6458208              <no date>  c3725-i-mz

16056320 bytes total (3139776 bytes free)
Router# show slot0:

Slot0 CompactFlash directory:
File  Length   Name/status
   1   6458208  c3725-i-mz.tmp [deleted]
   2   6458208  c3725-i-mz
[12916544 bytes used, 3139776 available, 16056320 total]
15680K bytes of ATA Slot0 CompactFlash (Read/Write)

Router# squeeze slot0:

Squeeze operation may take a while. Continue? [confirm]
squeeze in progress...
sssssssssssssssssssssssssseeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
Rebuild file system directory...
Squeeze of slot0 complete
```

Display File Content

To display the content of a file in compact Flash memory, use the **more** {**flash: | slot0:**} command.

The following example shows output from the **more** {**flash: | slot0:**} command on an external Cisco Flash memory card:

```
Router# more slot0:c3725-i-mz

00000000: 7F454C46 01020100 00000000 00000000    .ELF .... .... ....
```

```
00000010: 00020061 00000001 80008000 00000034    ...a .... .... ...4
00000020: 00000054 20000001 00340020 00010028    ...T  ... .4.  ...(
00000030: 00050008 00000001 0000011C 80008000    .... .... .... ....
00000040: 80008000 00628A44 00650EEC 00000007    .... .b.D .e.l ....
00000050: 0000011C 0000001B 00000001 00000006    .... .... .... ....
00000060: 80008000 0000011C 00004000 00000000    .... .... ..@. ....
00000070: 00000000 00000008 00000000 00000021    .... .... .... ...!
00000080: 00000001 00000002 8000C000 0000411C    .... .... ..@. ..A.
00000090: 00000700 00000000 00000000 00000004    .... .... .... ....
000000A0: 00000000 00000029 00000001 00000003    .... ...) .... ....
000000B0: 8000C700 0000481C 00000380 00000000    ..G. ..H. .... ....
000000C0: 00000000 00000004 00000000 0000002F    .... .... .... .../
000000D0: 00000001 10000003 8000CA80 00004B9C    .... .... ..J. ..K.
000000E0: 00000020 00000000 00000000 00000008    ...  .... .... ....
000000F0: 00000000 0000002F 00000001 10000003    .... .../ .... ....
00000100: 8000CAA0 00004BBC 00623FA4 00000000    ..J  ..K< .b?$ ....
00000110: 00000000 00000008 00000000 3C1C8001    .... .... .... <...
00000120: 679C4A80 3C018001 AC3DC70C 3C018001    g.J. <... ,=G. <...
00000130: AC3FC710 3C018001 AC24C714 3C018001    ,?G. <... ,$G. <...
00000140: AC25C718 3C018001 AC26C71C 3C018001    ,%G. <... ,&G. <...
00000150: AC27C720 3C018001 AC30C724 3C018001    ,'G  <... ,0G$ <...
00000160: AC31C728 3C018001 AC32C72C 3C018001    ,1G( <... ,2G, <...
--More-- q
```

Operations for Use with Class C Flash File System

The following file and directory operations are useful for compact Flash memory cards formatted with a Class C Flash file system.

File Operations for Class C Flash File System

Copy Files

To copy files to another location, enter the **copy** {**flash:** | **slot0:**} command.

The following example shows output for copying a Cisco IOS file from an external compact Flash memory card to an internal compact Flash memory card:

```
Router# copy slot0:c3725-i-mz.tmp flash:

Destination filename [c3725-i-mz.tmp]?
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
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CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
6458584 bytes copied in 202.940 secs (31973 bytes/sec)
```

The following example shows output for copying a configuration file to the startup configuration in an internal compact Flash memory card (`flash:`):

```
Router# copy flash:my-config1 startup-config

Destination filename [startup-config]?
[OK]
517 bytes copied in 4.188 secs (129 bytes/sec)
```

The following example shows output for copying a configuration file to the running configuration in an internal compact Flash memory card (`flash:`):

```
Router# copy flash:my-config2 running-config

Destination filename [running-config]?
709 bytes copied in 0.72 secs
```

Display the Contents of a Compact Flash Memory Card

To display the contents (directories and files) of a compact Flash memory card formatted with a Class C Flash file system, use the **dir**{**flash:** | **slot0:**} or **show** {**flash:** | **slot0:**} command.

The following examples show outputs for displaying the contents of an external compact Flash memory card with a Class C Flash file system:

```
Router# show slot0:

-#- --length-- -----date/time------ path
1      6658376 Mar 01 1993 00:29:52 c3725-i-mz
2         2124 Mar 01 1993 00:34:38 running-config
3         2622 Mar 01 1993 00:34:44 startup-config

25260032 bytes available (6672384 bytes used)

Router# dir slot0:

Directory of slot0:/

   3  -rw-     6455048   Mar 01 2001 00:04:06  c3725-i-mz
1579  -rw-     6458584   Mar 01 2001 00:24:38  c3725-i-mz.new

15912960 bytes total (2998272 bytes free)
```

Display Geometry and Format Information

To display the geometry and format information of a compact Flash memory card formatted with a Class C Flash file system, use the **show** {**flash:** | **slot0:**} **filesys** command.

The following example shows output for displaying the geometry and format information of an external Cisco Flash memory card:

```
Router# show slot0: filesys

******** ATA Flash Card Geometry/Format Info ********

ATA CARD GEOMETRY
   Number of Heads:      4
   Number of Cylinders    490
   Sectors per Cylinder   32
   Sector Size            512
   Total Sectors          62720

ATA CARD FORMAT
   Number of FAT Sectors  31
```

```
   Sectors Per Cluster    8
   Number of Clusters     7796
   Number of Data Sectors 62560
   Base Root Sector       155
   Base FAT Sector        93
   Base Data Sector       187
```

Delete Files from Compact Flash Memory

To delete a file from a compact Flash memory card, use the **delete** {**flash: | slot0:**} command.

The following example shows output for deleting a Cisco IOS file from an internal compact Flash memory card:

```
Router# delete flash:c3725-i-mz.tmp

Delete filename [c3725-i-mz.tmp]?
Delete flash:c3725-i-mz.tmp? [confirm]
Router# dir flash:

Directory of flash:/

No files in directory

128094208 bytes total (128094208 bytes free)
```

Rename a File

To rename a file in a compact Flash memory card, use the **rename** {**flash: | slot0:**} command.

The following example shows output for renaming a Cisco IOS file in an internal compact Flash memory card:

```
Router# dir flash:

Directory of flash:/

    3  -rw-     6458388   Mar 01 1993 00:00:58  c3725-i-mz.tmp
 1580  -rw-     6462268   Mar 06 1993 06:14:02  c3725-i-mz.3600ata

63930368 bytes total (51007488 bytes free)
Router# rename flash:c3725-i-mz.tmp flash:c3725-i-mz

Destination filename [c3725-i-mz]?
Router# dir flash:

Directory of flash:/

 1580  -rw-     6462268   Mar 06 1993 06:14:02  c3725-i-mz.3600ata
    3  -rw-     6458388   Mar 01 1993 00:01:24  c3725-i-mz

63930368 bytes total (51007488 bytes free)
```

Display File Content

To display the content of a file in a compact Flash memory card, use the **more** {**flash: | slot0:**} command.

The following example shows output from the **more** {**flash: | slot0:**} command on an internal Compact Flash card:

```
Router# more flash:c3725-i-mz.tmp

00000000: 7F454C46 01020100 00000000 00000000    .ELF .... .... ....
00000010: 00020061 00000001 80008000 00000034    ...a .... .... ...4
```

```
00000020: 00000054 20000001 00340020 00010028    ...T  ... .4.  ...(
00000030: 00050008 00000001 0000011C 80008000    .... .... .... ....
00000040: 80008000 00628A44 00650EEC 00000007    .... .b.D .e.l ....
00000050: 0000011C 0000001B 00000001 00000006    .... .... .... ....
00000060: 80008000 0000011C 00004000 00000000    .... .... ..@. ....
00000070: 00000000 00000008 00000000 00000021    .... .... .... ...!
00000080: 00000001 00000002 8000C000 0000411C    .... .... ..@. ..A.
00000090: 00000700 00000000 00000000 00000004    .... .... .... ....
000000A0: 00000000 00000029 00000001 00000003    .... ...) .... ....
000000B0: 8000C700 0000481C 00000380 00000000    ..G. ..H. .... ....
000000C0: 00000000 00000004 00000000 0000002F    .... .... .... .../
000000D0: 00000001 10000003 8000CA80 00004B9C    .... .... ..J. ..K.
000000E0: 00000020 00000000 00000000 00000008    ...  .... .... ....
000000F0: 00000000 0000002F 00000001 10000003    .... .../ .... ....
00000100: 8000CAA0 00004BBC 00623FA4 00000000    ..J  ..K< .b?$ ....
00000110: 00000000 00000008 00000000 3C1C8001    .... .... .... <...
00000120: 679C4A80 3C018001 AC3DC70C 3C018001    g.J. <... ,=G. <...
00000130: AC3FC710 3C018001 AC24C714 3C018001    ,?G. <... ,$G. <...
00000140: AC25C718 3C018001 AC26C71C 3C018001    ,%G. <... ,&G. <...
00000150: AC27C720 3C018001 AC30C724 3C018001    ,'G  <... ,0G$ <...
00000160: AC31C728 3C018001 AC32C72C 3C018001    ,1G( <... ,2G, <...
--More-- q
```

Directory Operations for Class C Flash File System

Create a New Directory

To create a directory in compact Flash memory, use the **mkdir** {**flash: | slot0:**} command.

The following example shows output for first displaying the contents of an internal compact Flash card, and then creating a directory named **config** and a subdirectory named **test-config**:

```
Router# dir flash:

Directory of flash:/

  3  -rw-     6458208   Mar 01 1993 00:04:08  c3725-i-mz.tmp

128094208 bytes total (121634816 bytes free)
Router# mkdir flash:/config

Create directory filename [config]?
Created dir flash:/config
Router# mkdir flash:/config/test-config

Create directory filename [/config/test-config]?
Created dir flash:/config/test-config
Router# dir flash:

Directory of flash:/

  3  -rw-     6458208   Mar 01 1993 00:04:08  c3725-i-mz.tmp
 1580  drw-           0   Mar 01 1993 23:48:36  config

128094208 bytes total (121626624 bytes free)
Router# cd flash:/config
Router# dir flash:
Directory of flash:/config/

 1581  drw-           0   Mar 01 1993 23:50:08  test-config

128094208 bytes total (121626624 bytes free)
```

Remove a Directory

To remove a directory from compact Flash memory, use the **rmdir** {**flash:** | **slot0:**} command.

Before you can remove a directory, all files and subdirectories must be removed from the directory.

The following example shows output for displaying the contents of an internal compact Flash card, then removing the subdirectory named **test-config**:

```
Router# dir flash:

Directory of flash:/config/

  1581  drw-           0   Mar 01 1993 23:50:08  test-config

128094208 bytes total (121626624 bytes free)
Router# rmdir flash:/config/test-config

Remove directory filename [/config/test-config]?
Delete flash:/config/test-config? [confirm]
Removed dir flash:/config/test-config
Router# dir flash:

Directory of flash:/config/

No files in directory

128094208 bytes total (121630720 bytes free)
```

Enter a Directory and Determine Which Directory You Are In

To enter a directory in compact Flash memory, use the **cd** command.

To determine which directory you are in, use the **pwd** command.

If you enter only **cd**, the router will enter the default home directory, which is **flash:**/.

The following example shows output for the following actions:

- Entering the home directory of a compact Flash memory card in an internal slot (**flash:**/)
- Verifying that you are in the home directory
- Displaying the contents of the home directory
- Entering the **/config** directory
- Verifying that you are in the **/config** directory
- Entering the home directory of a compact Flash memory card in an external slot (**slot0:/**)
- Verifying that you are in the **slot0:/** directory
- Returning to the home directory (**flash:**/)
- Verifying that you are in the home directory

```
Router# cd

Router# pwd
flash:
Router# dir

Directory of flash:/

     3  -rw-     6458208   Mar 01 1993 00:04:08  c3725-i-mz.tmp
  1580  drw-           0   Mar 01 1993 23:48:36  config

128094208 bytes total (121630720 bytes free)
```

```
Router# cd config

Router# pwd

flash:/config/
Router# cd slot0:

Router# pwd
slot0:/
Router# cd

Router# pwd
flash:
```

Using the ROM Monitor

This appendix describes the ROM monitor (also called the bootstrap program), which is the firmware that runs when you power on or restart the Cisco 2600 series, Cisco 3600 series, and Cisco 3700 series router. During normal operation, the ROM monitor helps to initialize the processor hardware and boot the operating system software. You can also use the ROM monitor to help you isolate or rule out hardware problems encountered when installing your router.

This appendix contains the following sections:

Entering the ROM Monitor Mode

To use the ROM monitor, you must have access to the console port. See the *Cisco 2600 Series Cabling and Setup Quick Start Guide* for information on connecting the console cable.

To enter ROM monitor mode, do the following:

Configure

	Command or Action	Purpose
Step 1	`2600> reload`	Restarts the router.
Step 2	Press the **Break** key during the first 60 seconds while the system is starting up	Forces the router to stop booting and enter the ROM monitor mode.

Verify

To verify that you are in the ROM monitor mode, check that the prompt displayed on your screen is the ROM monitor mode prompt:

```
rommon # >
```

The # is the line number and increases incrementally at each prompt.

Tip From the Cisco IOS software, you can configure the router to automatically enter the ROM monitor mode the next time the router boots by setting virtual configuration register bits 3, 2, 1, and 0 to zero. From the console, enter the following configuration command:

```
configuration-register 0x0
```

The new configuration register value, 0x0, is effective after the router is rebooted with the **reload** command. The router remains in the ROM monitor and does not boot the operating system.

As long as the configuration register value remains 0x0, you must manually boot the operating system from the console. Refer to the **boot** command in the section "Command Descriptions" later in this appendix.

ROM Monitor Commands

Enter **?** or **help** at the ROM monitor mode prompt to display a list of available commands. For example:

```
rommon 1 >  ?
alias       set and display aliases command
boot        boot up an external process
break       set/show/clear the breakpoint
confreg     configuration register utility
cont        continue executing a downloaded image
context     display the context of a loaded image
cookie      display contents of cookie PROM in hex
dev         list the device table
dir         list files in the file system
dis         display instruction stream
dnld        serial download a program module
frame       print out a selected stack frame
help        monitor builtin command help
history     monitor command history
meminfo     main memory information
repeat      repeat a monitor command
reset       system reset
set         display the monitor variables
stack       produce a stack trace
sync        write monitor environment to NVRAM
sysret      print out info from last system return
tftpdnld    tftp image download
unalias     unset an alias
unset       unset a monitor variable
xmodem      x/ymodem image download
rommon 2 >
```

Note You can abort any command by pressing the Break key at the console.

Note The command **tftpdnld** is present in the Cisco 2600 series routers only.

Note The command **upgrade rom-monitor** is present in the Cisco 3700 series routers only.

ROM Monitor Syntax Conventions

The ROM monitor syntax in this appendix uses the following conventions:

- Square brackets [ ] denote an optional element. In the following example, the element abc is not required, but you can specify it if you choose:

  command [abc]

- If a minus option is followed by a colon (for example, [-s:]) you must provide an argument for the option.
- A term in italics means that you must fill in the appropriate information. In the following example, you replace the term in italics with the interface type you are using:

  command *type interface*

Command Descriptions

This section lists some useful ROM monitor commands. Refer to the Cisco IOS configuration guides and command references for more information on ROM monitor commands.

Note The commands **show rom-monitor, showmon, upgrade rom-monitor , upgrade rom-monitor preference, rommon-pref** are present in the Cisco 3700 series routers only. The command **tftpdnld** is present in the Cisco 2600 series routers only.

- **boot** or **b**—Boots an image.
  - Boots from the first IOS image in flash memory.
  - *flash*:[*name*] boots the Cisco IOS software from the flash memory.
  - *filename tftpserver* boots from the specified file over the network from the specified TFTP server. For example:

    ```
    boot c2600-i-mz 172.15.19.11
    ```

  - *filename* boots from the boothelper image, because it does not recognize the device ID. This form of the command is used to netboot the image named *filename*.
  - The Cisco 2600 series router does not have a dedicated boothelper image ([rx]boot) as used by some other Cisco routers. With the Cisco 2600 series router, the first image in flash memory is invoked as the default boothelper image anytime the ROM monitor does not recognize the device ID in the **boot** command.
  - You can override the default boothelper image setting by setting the BOOTLDR Monitor environment variable to point to another image. Any system image can be used for this purpose.
  - Options to the boot command are **-x**, load image but do not execute, and **-v**, verbose.
  - Use the Cisco IOS commands **show version** and **show hardware** to display the source of the currently running image.
  - **dir** *device:*[*partition:*]—Lists the files on the named device. For example:

    ```
    rommon 8 > dir flash:

      File size              Checksum   File name
    2229799 bytes (0x220627)   0x469e    C2600-j-m2.113-4T
    ```

  - **help**—Displays a summary of ROM monitor commands (equivalent to **?**).
  - **meminfo**—Displays size in bytes, starting address, available range of main memory, the starting point and size of packet memory, and size of nonvolatile memory (NVRAM). The following example shows the **meminfo** command:

```
rommon 9 > meminfo

Main memory size: 32 MB.
Available main memory starts at 0xa000e000, size 32704KB
IO (packet) memory size: 25 percent of main memory.
NVRAM size: 32KB
```

- **meminfo [-l]**—The **meminfo** command with the **-l** option displays supported DRAM configurations. The following example shows an example of the **meminfo -l** command:

```
rommon 10 > meminfo -l

Supported memory configurations:

DIMM 0       DIMM 1
-------------------
             4M
             8M-DUAL
             16M
              32M-DUAL
4M
4M           4M
4M           8M-DUAL
4M           16M
4M           32M-DUAL
8M-DUAL
8M-DUAL      4M
8M-DUAL      8M-DUAL
8M-DUAL      16M
8M-DUAL      32M-DUAL
16M
16M          4M
16M          8M-DUAL
16M          16M
16M          32M-DUAL
32M-DUAL
32M-DUAL     4M
32M-DUAL     8M-DUAL
32M-DUAL     16M
32M-DUAL     32M-DUAL
```

- **reset** or **i**—Resets and initializes the router, similar to power on.
- show rom-monitor— Shows version of read-only ROMMON, and if present, the upgrade version of ROMMON. It also shows the current version of ROMMON, which version will be selected for execution when the Cisco IOS software is booted again. This command isavailable in the Cisco IOS exec mode.
  - **showmon**—Available in the ROMMON command mode. Provides the same information as the **show rom-monitor** command in the Cisco IOS exec mode.
- upgrade rom-monitor <file<URL>|preference<readonly|upgrade>>—Installs and reloads a new version of ROMMON in the Cisco IOS exec mode. URL refers to the path where the new ROMMON image is stored. Prompts the user to save the configuration.

– **upgrade rom-monitor preference<readonly|upgrade>**—Selects the version of ROMMON to be loaded the next time the router is reloaded. This command is used in the Cisco IOS exec mode.

– **rommon-pref**—Used in ROMMON command mode. Provides the same information as **upgrade rom-monitor preference** command in the Cisco IOS exec mode.

Debugging Commands

Most debugging commands are functional only when Cisco IOS software has crashed or is aborted. If you enter a debugging command and Cisco IOS crash information is not available, the following error message appears:

```
"xxx: kernel context state is invalid, can not proceed."
```

- **stack** or **k**—Produces a stack trace.
- **context**—Displasy processor context.
- **frame**—Displays an individual stack frame.
- **sysret**—Displays return information from the last booted system image. This information includes the reason for terminating the image, a stack dump of up to eight frames, and, if an exception is involved, the address where the exception occurred. For example:

```
rommon 8 > sysret

System Return Info:
count: 19,  reason: a SegV exception
pc:0x802b1040,  error address: 0x802b1040
Stack Trace:
FP: 0x80908398, PC: 0x802b102c
FP: 0x809083b0, PC: 0x802b0b88
FP: 0x809083d8, PC: 0x8017039c
FP: 0x809083e8, PC: 0x8016f764
```

Configuration Register Commands

The virtual configuration register resides in NVRAM. You can display or modify the virtual configuration register from either the ROM monitor or the operating system software.

To change the virtual configuration register from the ROM monitor, enter the **confreg** command by itself for menu mode, or enter the new value of the register in hexadecimal.

- **confreg** [*hexnum*]—Changes the virtual configuration register to the value specified. The value is always interpreted as hexadecimal.

Note Entering **confreg** without an argument displays the contents of the virtual configuration register and prompts you to alter the contents by describing the meaning of each bit. In either case, the new virtual configuration register value is written into NVRAM, but is not effective until you reset or power-cycle the router.

The following display shows an example of the **confreg** command:

```
rommon 7 > confreg


    Configuration Summary
enabled are:
```

```
break/abort has effect
console baud: 9600
boot: the ROM Monitor

do you wish to change the configuration? y/n  [n]:  y
enable  "diagnostic mode"? y/n  [n]:  y
enable  "use net in IP bcast address"? y/n  [n]:
enable  "load rom after netboot fails"? y/n  [n]:
enable  "use all zero broadcast"? y/n  [n]:
disable "break/abort has effect"? y/n  [n]:
enable  "ignore system config info"? y/n  [n]:
change console baud rate? y/n  [n]:  y
enter rate: 0 = 9600,  1 = 4800,  2 = 1200,  3 = 2400
            4 = 19200, 5 = 38400, 6 = 57600, 7 = 115200  [0]:  0
change the boot characteristics? y/n  [n]:  y
enter to boot:
 0 = ROM Monitor
 1 = the boot helper image
 2-15 = boot system
    [0]:  0


    Configuration Summary
enabled are:
diagnostic mode
break/abort has effect
console baud: 9600
boot: the ROM Monitor

do you wish to change the configuration? y/n  [n]:


You must reset or power cycle for new config to take effect
```

Using the show rom-monitor Command

Note The **show rom-monitor** command is present in the Cisco 3700 series routers only. The command **tftpdnld** is present in the Cisco 2600 series routers only.

The **show rom-monitor** command displays the current version of the read-only ROM monitor, and if present displays the upgrade version of the ROM monitor. The upgrade version is selected when the system is rebooted. This command runs in the Cisco IOS exec mode.

You get the following output, when the read-only ROM monitor is present:

```
Router# show rom-monitor
ReadOnly ROMMON version:
System Bootstrap, Version 12.2(4r)XT2, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
No upgrade ROMMON programmed or not yet run
Currently running ROMMON from ReadOnly region
ROMMON from ReadOnly region is selected for next boot
Router#
```

Following is an example of an output when both the read-only and the upgrade versions of the ROM moinitor are present:

```
Router# show rom-monitor
```

```
ReadOnly ROMMON version:
System Bootstrap, Version 12.2(4r)XT4, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
Upgrade ROMMON version:
System Bootstrap, Version 12.2(8r)T1, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2002 by cisco Systems, Inc.
Currently running ROMMON from Upgrade region
ROMMON from Upgrade region is selected for next boot
Router#
```

Note You can get the same information if you enter the **showmon** command in the ROMMON command mode.

Using the upgrade rom-monitor Command

Note The command **upgrade rom-monitor** is present in the Cisco 3700 series routers only.

To upgrade the ROM monitor to a new version, use the **upgrade rom-monitor** command. Depending on where the image is located, use the following commands to upgrade the ROM monitor:

- upgrade rom-monitor file <URL>
- upgrade rom-monitor preference <readonly | upgrade>

The **upgrade rom-monitors file <URL>** command installs the new version of ROM monitor on the router by taking the image from the location indicated in the URL. The image is in the form of ".srec' file. It then reloads the router.

Following is an example of the output when the upgrade version of ROM monitor is located at tftp://223.255.254.254/ajayhn/c3745_RM2.srec:, and the system configuration has not been saved:

```
Router# upgrade rom-monitor file tftp://223.255.254.254/ajayhn/C3745_RM2.srec

Loading ajayhn/C3745_RM2.srec from 223.255.254.254 (via FastEthernet0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 641719/1283072 bytes]
This command will reload the router. Continue? [yes/no]: y
System configuration has been modified. Save? [yes/no]: y
Building configuration...
Erasing boot flash eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
Programming boot flash pppp
Now Reloading
System Bootstrap, Version 12.2(4r)XT4, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
Running new upgrade for first time
System Bootstrap, Version 12.2(8r)T1, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2002 by cisco Systems, Inc.
c3745 processor with 196608 Kbytes of main memory
Main memory is configured to 64 bit mode with parity disabled

Upgrade ROMMON initialized
rommon 1 >
```

Following sample output shows a configuration that has been saved:

```
Router# upgrade rom-monitor file tftp://223.255.254.254/ajayhn/C3745_RM2.srec
Loading ajayhn/C3745_RM2.srec from 223.255.254.254 (via FastEthernet0/0):
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!
[OK - 641719/1283072 bytes]
This command will reload the router. Continue? [yes/no]: y
Erasing boot flash eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
Programming boot flash pppp
Now Reloading
System Bootstrap, Version 12.2(4r)XT4, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2001 by cisco Systems, Inc.
Running new upgrade for first time
System Bootstrap, Version 12.2(8r)T1, RELEASE SOFTWARE (fc1)
TAC Support: http://www.cisco.com/tac
Copyright (c) 2002 by cisco Systems, Inc.
c3745 processor with 196608 Kbytes of main memory
Main memory is configured to 64 bit mode with parity disabled

Upgrade ROMMON initialized
rommon 1 >
```

Note The **rommon-pref** command in the ROMMON command mode provides the same information as the **upgrade rom-monitor preference** command in the Cisco IOS Exec mod.

Procedures for Recovering Boot and System Images

If your router experiences difficulties and no longer contains a valid Cisco IOS software image in flash memory, you can recover the Cisco IOS image using one of the following ROM monitor commands:

- **xmodem**—Use this if the computer attached to your console has a terminal emulator that has xmodem capability.
- **tftpdnld**—Use this if you have a TFTP server directly connected to the Ethernet 0 port.

Note The command **tftpdnld** is present in the Cisco 2600 series routers only.

Using the xmodem Command

The **xmodem** command establishes a connection between a console and the router console port for disaster recovery if both the boot and system images are erased from flash memory.

xmodem [*filename*]—Establishes an xmodem connection between the console and the router. The optional parameter *filename* specifies the source file containing the Cisco IOS image.

Other options include the following:

- **-c**—Uses cyclic redundancy check (CRC-16)
- **-y**—Uses Ymodem transfer protocol
- **-r**—Copies the image to DRAM for launch
- **-x**—Does not launch image on completion of download

Using the tftpdnld Command

Note The command **tftpdnld** is present in the Cisco 2600 series routers only.

The **tftpdnld** command downloads a Cisco IOS software image from a remote server into flash memory using TFTP.

tftpdnld—Begins the TFTP copy command.

The following variables are required:

- IP_ADDRESS—IP address for the router you are using.
- IP_SUBNET_MASK—Subnet mask for the router you are using.
- DEFAULT_GATEWAY—Default gateway for the router you are using.
- TFTP_SERVER—IP address of the server from which you want to download the image file.
- TFTP_FILE—Name of the file that you want to download.
- The following variables are optional:
- TFTP_VERBOSE—Print setting. 0=quiet, 1=progress, 2=verbose. The default is 1.
- TFTP_RETRY_COUNT—Retry count for ARP and TFTP. The default is 7.
- TFTP_TIMEOUT—Overall timeout of the download operation in seconds. The default is 2400 seconds.
- TFTP_CHECKSUM—Performs a checksum test on the image. 0=no, 1=yes. The default is 1.

The syntax for specifying the variables is:

```
VARIABLE_NAME=value
```

After you specify the variables, you must reenter the **tftpdnld** command. For example:

```
rommon 1 > tftpdnld
rommon 2 > IP_ADDRESS=172.15.19.11
rommon 3 > IP_SUBNET_MASK=255.255.255.0
rommon 4 > DEFAULT_GATEWAY=172.15.19.1
rommon 5 > TFTP_SERVER=172.15.20.10
rommon 6 > TFTP_FILE=/tftpboot/c2600-i-mz
rommon 7 > TFTP_VERBOSE=1
rommon 8 > tftpdnld

     IP_ADDRESS=172.15.19.11
     IP_SUBNET_MASK=255.255.255.0
     DEFAULT_GATEWAY=172.15.19.1
     TFTP_SERVER=172.15.20.10
     TFTP_FILE=/tftpboot/2600-i-mz
     TFTP_VERBOSE=1

Invoke this command for disaster recovery only.
WARNING: all existing data in flash will be lost!
Do you wish to continue? y/n: [n]:
```

Enter **y** to begin downloading the Cisco IOS software image. When the process is complete, the ROM monitor mode prompt appears on your screen.

Numerics

A

B

C

D

E

F

G

H

I

L

M

N

P

R

S

T

U

V

W

X