Cisco IAD2430 Series Integrated Access Devices Software Configuration Guide

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C O N T E N T S

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Preface

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

This preface presents the following major topics:

Objectives

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

This guide does not provide complete configuration instructions. See the Cisco IOS configuration guides and command references for detailed configuration instructions.

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

Document Organization

The following table summarizes the major sections of this document.

Chapter	Title	Description
Chapter 1	Understanding Interface Numbering and Cisco IOS Software Basics	Provides an overview of the interface numbering conventions for the Cisco IAD2430 series IADs. Also provides a basic understanding of 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 digital recEive and transMit (E&M) over T1/E1 CAS, foreign exchange office (FXO), and foreign exchange station (FXS) interfaces for your router.
Appendix A	Cisco IAD2430 Series Configuration Examples	Provides a variety of configuration examples: • Cisco IAD2431-8FXS • Cisco IAD2431-16FXS • Cisco IAD2430-24FXS • Cisco IAD 2431-1T1/E1 with WIC-2T • Cisco IAD2432-24FXS with VIC2-4FXO and QoS • Cisco IAD2435-8FXS
Appendix B	Formatting the Flash Memory	Provides configuration information for the flash memory.
Appendix C	Using the ROM Monitor	Describes how the ROM monitor works in the Cisco IAD2430 series IAD.

Related and Referenced Documents

The documents described here are available online. 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 the PDF icon.

You can also order printed copies of documents. See the "Obtaining Documentation and Submitting a Service Request" section on page ix.

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<Chapter>

C H A P T E R 1

Understanding Interface Numbering and Cisco IOS Software Basics

This chapter provides an overview of interface numbering in the Cisco IAD2430 series integrated access devices (IADs). It also describes how to use the Cisco IOS software commands.

This chapter presents the following major topics:

Identifying Cisco IAD2430 Models

Figure 1-1 shows the front panel of the Cisco IAD2430 series IAD. Figure 1-2 shows the front panel of the Cisco IAD2435 IAD.

Cisco IAD2430-24FXS IAD

The Cisco IAD2430-24FXS provides 24 analog foreign exchange station (FXS) ports with two 10/100BASE-T ports. The chassis has the following interfaces:

- RJ-21 analog voice interface
- Two 10/100BASE-T ports
- External flash memory
- AC and DC power inputs

Figure 1-1   *Cisco IAD2430-24FXS Chassis—Front Panel*
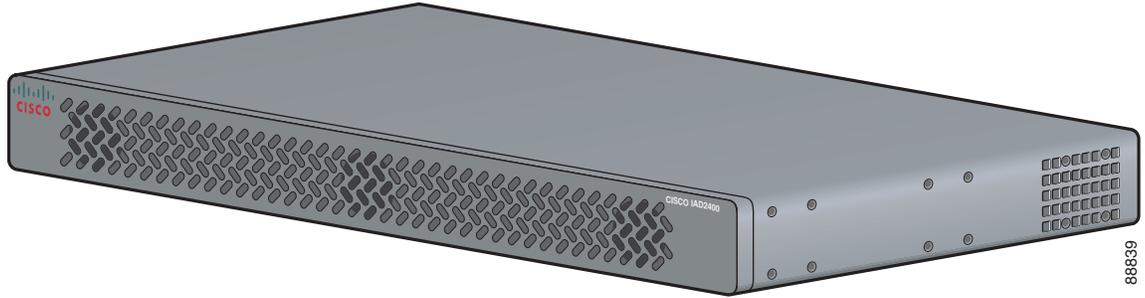
Figure 1-2   *Cisco IAD2435-8FXS Chassis—Front Panel*

Cisco IAD2431-8FXS IAD

The Cisco IAD2431-8FXS provides eight analog FXS ports, two 10/100BASE-T ports, and one T1/E1 WAN port. The chassis has the following interfaces (see Figure 1-3):

- RJ-21 analog voice interface
- One T1/E1 port
- One 10/100BASE-T port
- One WIC/VIC slot
- External flash memory
- AC and DC power adapter

Figure 1-3   *Cisco IAD2431-8FXS Chassis—Back Panel*
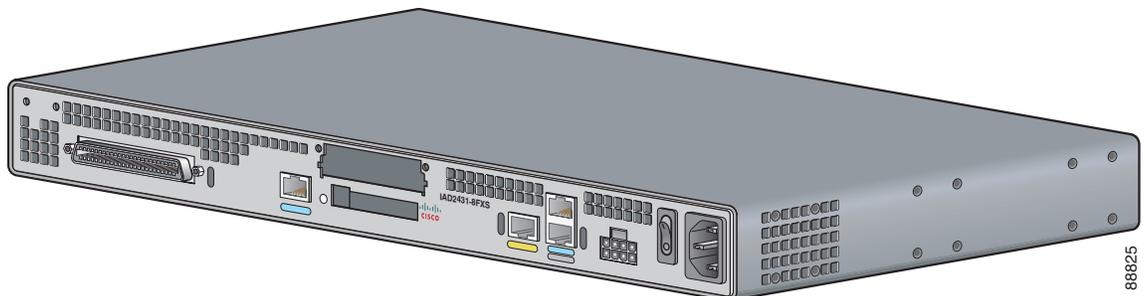
Cisco IAD2431-16FXS IAD

The Cisco IAD2431-16FXS provides 16 analog FXS ports with two 10/100BASE-T ports and one T1/E1 WAN ports. The chassis has the following interfaces (see Figure 1-4):

- RJ-21 analog voice interface
- One T1/E1 port
- Two 10/100BASE-T ports
- One WIC/VIC slot
- External flash memory
- AC and DC power inputs

Figure 1-4   Cisco IAD2431-16FXS Chassis—Back Panel
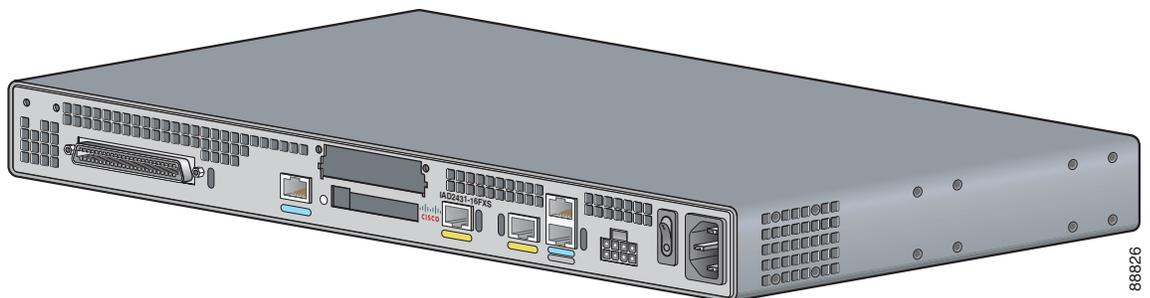
Cisco IAD2431-1T1E1 IAD

The Cisco IAD2431-1T1E1 provides one T1/E1 connection to a PBX, one T1/E1 WAN port, and two 10/100BASE-T ports. The chassis has the following interfaces (see Figure 1-5):

- One T1/E1 ports
- Two 10/100BASE-T ports
- One WIC/VIC slot
- External flash memory
- AC and DC power inputs

Figure 1-5   Cisco IAD2431-1T1E1 Chassis—Back Panel
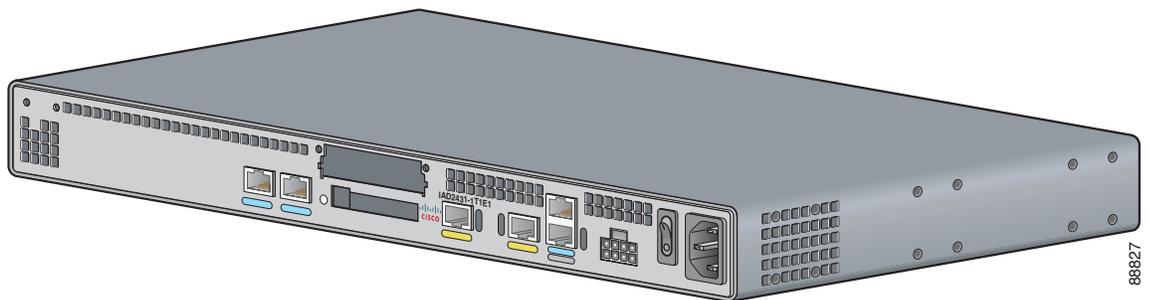
Cisco IAD2432-24FXS IAD

The Cisco IAD2432-24FXS provides 24 analog FXS ports, two 10/100BASE-T ports, and two T1/E1 WAN ports. The chassis has the following interfaces (see Figure 1-6):

- RJ-21 analog voice interface
- Two T1/E1 ports
- Two 10/100BASE-T ports
- One WIC/VIC slot
- External flash memory
- AC and DC power inputs

Figure 1-6   Cisco IAD2432-24FXS Chassis—Back Panel
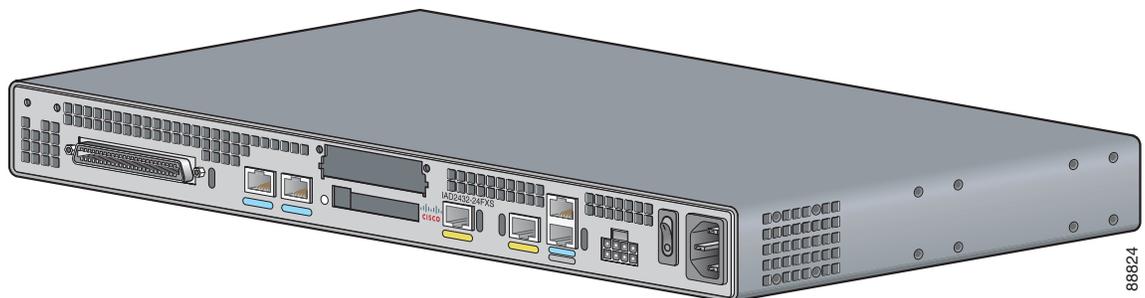
Cisco IAD2435-8FXS IAD

The Cisco IAD2435-8FXS provides eight analog FXS ports, two Fast Ethernet ports, and one T1/E1 WAN port. The chassis has the following interfaces (see Figure 1-7):

- RJ-21 analog voice interface
- One T1/E1 port
- Two Fast Ethernet ports
- AC and DC power inputs

Figure 1-7   Cisco IAD2435-8FXS Chassis—Back Panel

Port Numbering Conventions

Figure 1-8 shows the port numbers of the Cisco IAD2432-24FXS IAD. The figure is provided to show an example of the port numbering conventions.

Figure 1-8   Analog FXS User Interfaces with Metro Ethernet Interface
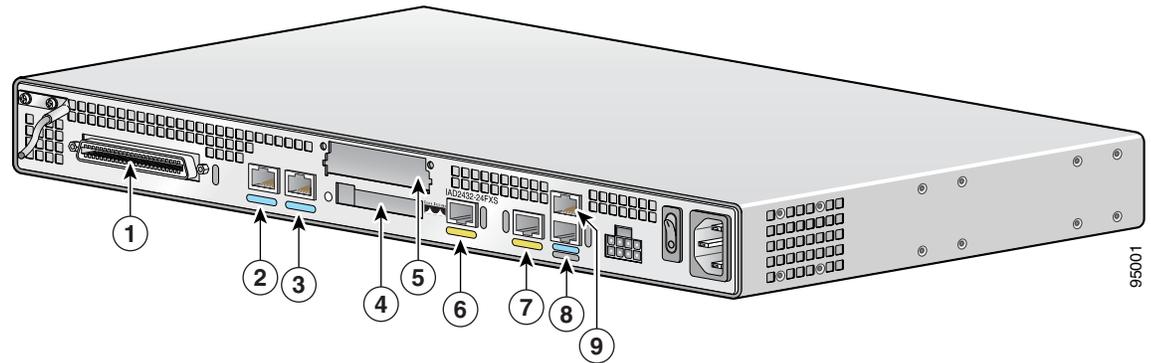
1	RJ-21 connector	**4**	Flash memory port	**7**	Fast Ethernet port 0
2	T1/E1 port 0	**5**	WIC/VIC slot	**8**	AUX port
3	T1/E1 port 1	**6**	Fast Ethernet port 1	**9**	Console port

Port numbering conventions for all the Cisco IAD2430 series IADs are as follows:

- Foreign Exchange Station (FXS) voice port numbering begins at 2/0 and extends to 2/7, 2/15, or 2/23, depending on the number of voice ports.
- T1/E1 ports are numbered T1 or E1 1/0 and T1 or E1 1/1, from right to left.
- The external flash memory port is numbered CF 0.
- The slot for WAN interface cards (WICs) and voice interface cards (VICs) is numbered slot 0. WIC and VIC interfaces are numbered by interface with this slot number and an interface number, beginning with 0, and running from right to left.
- 10/100BASE-T Fast Ethernet ports are numbered Fast Ethernet 0/0 and Fast Ethernet 0/1, from right to left.

Understanding Cisco IOS Software Basics

This section describes what you need to know about the Cisco IOS software before you configure the router by 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 Cisco IOS software or if you need a refresher, take a few minutes to read this chapter before you proceed to the next chapter.

> **Note** For a comprehensive view of Cisco IOS configuration fundamentals, see the *Cisco IOS Configuration Fundamentals Configuration Guide, Release 12.4* document.

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.

Command Modes

The Cisco IOS user interface involves 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 1-1 lists the most common command modes.

Table 1-1   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/E1 slot/port <---See second Note below
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 **Enter** 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.

Note In the Cisco IAD2430 series IADs, the controller port syntax is *x*/*y*, where

slot can be 0 (where 0 is the T1/E1 controller on a VWIC) or 1 (the onboard T1/E1), and

port can be 0 (the first port) or 1 (the second port).

See the .

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 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, see Appendix B, "Formatting the Flash Memory."

Note To simplify network operations and management of Cisco IOS software migration, see the *Basics of a Successful Cisco IOS Software Migration* document.

Cisco IAD2430 Series Deployment Scenarios

Figure 1-9 through Figure 1-9 on page 1-9 show some typical deployment scenarios for Cisco IAD2430 series IADs.

Figure 1-9   Analog FXS User Interface with Metro Ethernet Interface
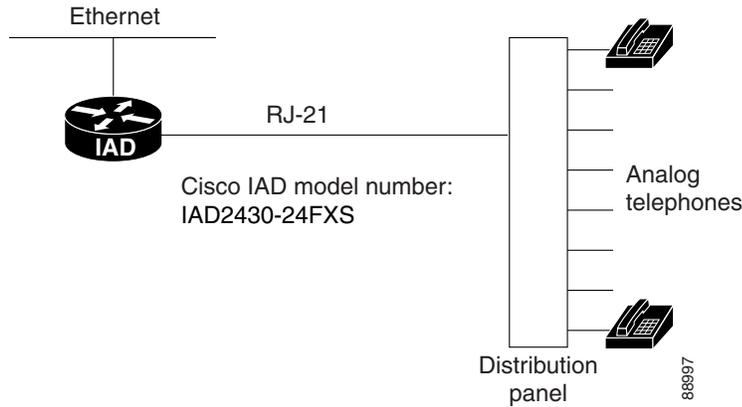
Figure 1-10   T1/E1 WAN Interface with Analog FXS User Interface
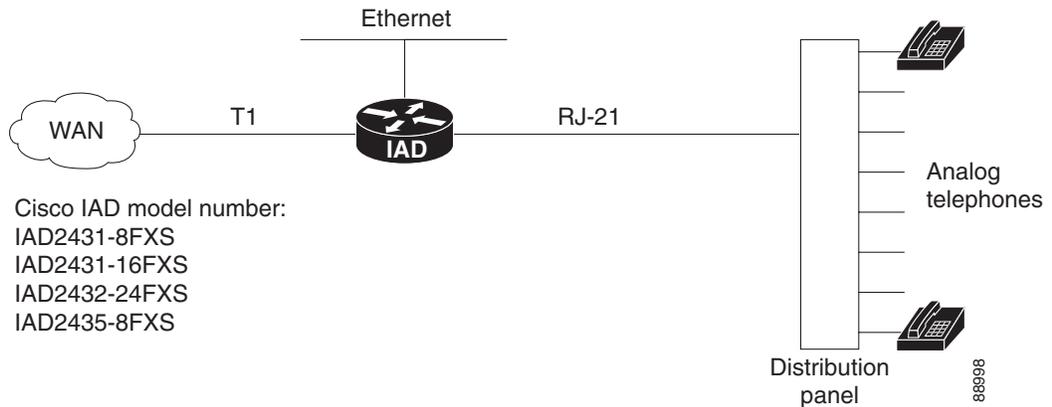
Figure 1-11   T1/E1 WAN Interface with Analog FXS and FXO User Interfaces
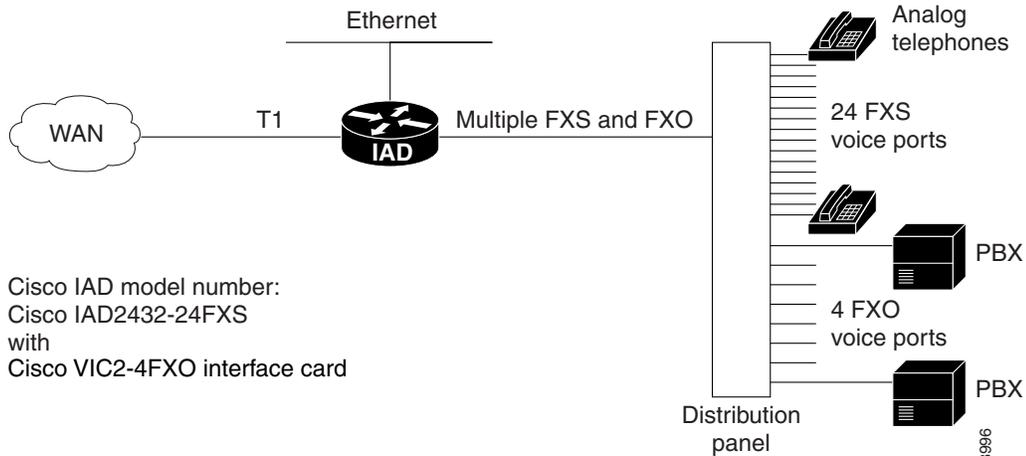
Figure 1-12   T1/E1 WAN Interface with T1 Interface to PBX User Interface
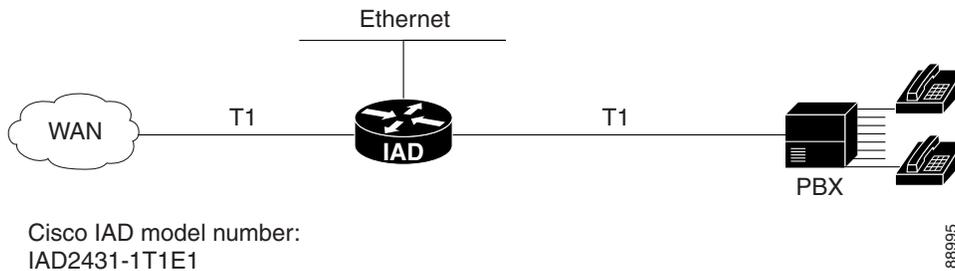
Where to Go Next

Now that you have learned some Cisco IOS software basics and seen some typical deployment scenarios, you can begin to configure the router by using the command-line interface (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 be using the wrong syntax.

- To disable a feature, generally enter the keyword **no** before the command; for example, **no ip routing**.

- You need to save your configuration changes to NVRAM so that the changes are not lost if there is a system reload or power outage.

Go to Chapter 2, "Using the setup Command Facility," to begin configuring the router.

C H A P T E R **2**

Using the setup Command Facility

This chapter describes how to use the setup command facility to configure your Cisco integrated access device (IAD). 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 LAN and WAN interfaces.

This chapter presents the following major topics:

- Before Powering On Your Cisco IAD, page 2-1
- The setup Command Facility, page 2-2
- Configuring Global Parameters, page 2-2
- Configuring Controller and Interface Parameters, page 2-5
- Completing the Configuration, page 2-13

If you prefer to configure the router manually or if 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.

If you prefer to configure the router by using AutoInstall, see the *Using AutoInstall to Remotely Configure Cisco Networking Devices* document.

Before Powering On Your Cisco IAD

Before you power on your Cisco IAD and begin to use the setup command facility, follow these steps:

Step 1   Set up the hardware as described in the hardware installation documents for your Cisco IAD.

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.

Step 4   Determine the following for each network protocol:

- Addressing plan
- Which WAN protocols you will run on each interface (for example, Frame Relay [FR], High-Level Data Link Control [HDLC], X.25, and so on)

The setup Command Facility

The setup command facility is displayed in your PC terminal emulation program window.

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

- Complete the steps in the "Configuring Global Parameters" section on page 2-2.
- Complete the steps in the "Configuring Controller and Interface Parameters" section on page 2-5 that apply to your Cisco IAD and network.
- Complete the steps in the "Completing the Configuration" section on page 2-13.

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

Configuring Global Parameters

Step 1 Power on the Cisco IAD.

Note To power on the Cisco IAD2435 IAD, plug in the external power supply.

Messages 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 Cisco IAD to power off and start over. It takes a few minutes for the messages to stop.

The messages look similar to the following example.

Note Much of the following example is largely for a Cisco IAD2431-1T1E1 IAD. The messages vary, depending on the Cisco IOS software release, the interface modules in your Cisco IAD, and the feature set you select. In addition, the word "`Router`" is the default prompt, and may appear elsewhere; interpret this word as meaning "Cisco IAD." The screen displays in this section are for reference only and might not exactly match the messages on your console.

Also, although you see the interfaces of onboard and installed T1 controllers and installed serial interface cards (such as the WIC-2T), you do not see the interfaces of installed voice interface cards.

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

```
System Bootstrap, Version 12.4(20080418:075150)
[BLD-iad.IAD_APRIL18_POST_SYNC_BUILD_UBLDIT-for_gopasaha 102], DEVELOPMENT SOFTWARE
Copyright (c) 1994-2008 by cisco Systems, Inc.

C2431 platform with 262144 Kbytes of main memory
```

```
Upgrade ROMMON initialized
program load complete, entry point: 0x80020000, size: 0x18d54b8
Self decompressing the image :
###########################################################################
###########################################################################
################################ [OK]


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Cisco IOS Software, C2435 Software (C2435-ADVIPSERVICESK9-M), Version
12.4(IAD_APRIL18_POST_SYNC_BUILD.2008-04-17) UBUILDIT Image, CISCO DEVELOPMENT TEST
VERSION
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Compiled Fri 18-Apr-08 01:58 by gopasaha


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States and local country laws governing import, export, transfer and
use. Delivery of Cisco cryptographic products does not imply
third-party authority to import, export, distribute or use encryption.
Importers, exporters, distributors and users are responsible for
compliance with U.S. and local country laws. By using this product you
agree to comply with applicable laws and regulations. If you are unable
to comply with U.S. and local laws, return this product immediately.

A summary of U.S. laws governing Cisco cryptographic products may be found at:
http://www.cisco.com/wwl/export/crypto/tool/stqrg.html

If you require further assistance please contact us by sending email to
export@cisco.com.

Cisco IAD2435 (MPC8323E) processor (revision 0x100) with 249856K/12288K bytes of memory.
Processor board ID FOC11375MBF
MPC8300 CPU Rev: Part Number 0x8062, Revision ID 0x11
2 FastEthernet interfaces
8 Voice FXS interfaces
256K bytes of non-volatile configuration memory.
126000K bytes of ATA Flash (Read/Write)


        --- System Configuration Dialog ---

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

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 Cisco IAD based on the configuration of an existing Cisco IAD.
>
> If you terminate AutoInstall, you enter the Cisco IOS software CLI.

> **Note**   The number of interfaces shown depends on the Cisco IAD2430 series model.

Step 3   When the following message appears, press **Enter** 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
FastEthernet0/0        unassigned      NO  unset  up                       up
FastEthernet0/1        unassigned      NO  unset  up                       down
```

Step 4   Enter a hostname for the Cisco IAD:

```
Configuring global parameters:

  Enter hostname [Router]: IAD2435

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]: n
  Configure bridging? [no]:
Configure IP? [yes]:
    Configure RIP routing? [yes]: n
Configure CLNS? [no]:
```

> **Note** If you answer **no** to Interior Gateway Routing Protocol (IGRP), you are prompted to configure Routing Information Protocol (RIP).

Configuring Controller and Interface Parameters

From this point on in the setup process, the prompts you see vary, depending on the interface cards installed in your Cisco IAD.

> **Note** The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

The following sections provide examples of the setup steps for cards. See the sections appropriate to your Cisco IAD.

Configuration examples include the following:

- Configuring Controller Parameters, page 2-5
- Configuring Fast Ethernet and Serial Interface Parameters, page 2-5
- Configuring a 1-Port, 4-Wire 56-kbps DSU/CSU Card, page 2-11

When you complete the setup steps for your interface modules, go to the "Completing the Configuration" section on page 2-13 for directions on saving your configuration.

Configuring Controller Parameters

Controllers can be either built in or on an interface module.

```
Configuring controller parameters. Controllers are hardware on the router
that you connect directly to a T1 or E1 line from your Telco. Configure
controllers for such purposes as Primary Rate ISDN(PRI) and/or
Channelized T1 or Channelized E1.
Note: J1 controllers are not configurable in setup mode.

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

Configuring Fast Ethernet and Serial Interface Parameters

This section provides examples for the following:

- Fast Ethernet WAN Interface Configuration
- Serial Interface Configuration

Fast Ethernet WAN Interface Configuration

This section provides sample steps and configuration for the Fast Ethernet WAN interface.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface** *type/number*
4. **ip address** *ip address/subnet mask*
5. **no shutdown**
6. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.

Step 3	**interface** *type/number*
	
	Example:
	`Router(config)# interface fastethernet 2`
	`Router(config-if)#`
		Enters the configuration mode for a Fast Ethernet WAN interface on the router.

Step 4	**ip address** *ip address/subnet mask*
	
	Example:
	`Router(config-if)# ip address 192.168.12.2`
	`255.255.255.0`
	`Router(config-if)#`
		Sets the IP address and subnet mask for the specified Fast Ethernet interface.

Command or Action	Purpose

Step 5 `no shutdown`
 	
Example:
`Router(config-if)# no shutdown`
`Router(config-if)#`
	Enables the Fast Ethernet interface, changing its state from administratively down to administratively up.

Step 6 `exit`
 	
Example:
`Router(config-if)# exit`
`Router(config)#`
	Exits configuration mode for the Fast Ethernet interface and returns to global configuration mode.

Serial Interface Configuration

This section provides a sample configuration for the 1- or 2-port serial interface on a WAN interface card (WIC) when it is installed. Enter the values appropriate for your interface card and network.

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

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]:
```

The "Frame Relay Encapsulation" section on page 2-8 through "SMDS Encapsulation" section on page 2-9 show the prompts for each encapsulation type. For PPP and High-Level Data Link Control (HDLC) encapsulation, no further configuration is needed.

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

If no cable is plugged into your interface card, you must 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] : 255.255.255.0
    Class A network is 9.0.0.0, 24 subnet bits; mask is /24
```

Sample configurations for the following encapsulation types are provided in this section:

- Frame Relay Encapsulation
- LAPB Encapsulation
- X.25 Encapsulation
- SMDS Encapsulation

Frame Relay Encapsulation

The following is an example of a typical Frame Relay encapsulation configuration:

```
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 prompts for the data-link connection identifier (DLCI) number only 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
```

LAPB Encapsulation

The following is an example of a typical LAPB configuration:

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

X.25 Encapsulation

The following is an example of a typical X.25 encapsulation configuration:

```
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]:
```

SMDS Encapsulation

The following is an example of a typical SMDS configuration:

```
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
```

T1/E1 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]:
```

The "PPP Encapsulation" section on page 2-10 through the "SMDS Encapsulation" section on page 2-11 show the prompts and provide examples for configuring each encapsulation type. No further configuration is needed for HDLC encapsulation.

Sample configuration for the following encapsulation types are provided in this section:

- PPP Encapsulation
- Frame Relay Encapsulation
- LAPB Encapsulation
- SMDS Encapsulation

PPP Encapsulation

The following is an example of a typical PPP encapsulation configuration:

```
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 exactly match the remote router's password.

Frame Relay Encapsulation

The following is an example of a typical Frame Relay encapsulation configuration:

```
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 prompts for the data-link connection identifier (DLCI) number only 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
```

LAPB Encapsulation

The following is an example of a typical LAPB encapsulation configuration:

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

SMDS Encapsulation

The following is an example of a typical SMDS encapsulation configuration:

```
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
```

Configuring a 1-Port, 4-Wire 56-kbps DSU/CSU Card

This section describes using the setup command facility to configure a 1-port, 4-wire 56-kbps DSU/CSU WAN interface card (for example, the WIC-1DSU-T1/E1).

Note   The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

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
```

Note   The setup command facility asks for only one telephone number for both IP and IPX (if IPX is 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." Autosensing is allowed only when the clock source is **line**.

```
When in dds mode, the clock for sw56 module can either be 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 all the information that the setup command facility has prompted you for, the configuration appears.

Note   For sample configurations, see Appendix A, "Cisco IAD2430 Series Configuration Examples."

To complete your configuration, follow these steps:

Step 1   A setup command facility prompt asks if you want to save this configuration, with the following options:

```
[0] Go to the IOS command prompt without saving this config.
[1] Return back to the setup without saving this config.
[2] Save this configuration to nvram and exit.
```

If you answer **0**, the configuration information you entered is *not* saved, and you return to the Cisco IAD enable prompt (`Router#`). Enter **setup** to return to the System Configuration Dialog.

If you answer **1**, you return to setup without saving the configuration.

If you answer **2**, the configuration is saved and you are returned to the user EXEC prompt `(Router>)`.

Step 2   When the messages stop appearing on your screen, press **Enter** to get the `Router>` prompt.

Step 3   The `Router>` prompt indicates that you are now at the command-line interface (CLI) and you have just completed a basic Cisco IAD 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:

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

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

C H A P T E R 3

Configuring with the Command-Line Interface

This chapter describes how to use the Cisco IOS software command-line interface (CLI) to configure basic Cisco integrated access device (IAD) functionality.

This chapter presents the following major topics:

- Configuring the Hostname and Password, page 3-2
- Configuring Fast Ethernet Interfaces, page 3-4
- Configuring Network Clock, page 3-5
- Configuring T1/E1 Interfaces, page 3-7
- Configuring a WIC-1DSU-T1/E1 Serial WAN Interface Card, page 3-20
- Configuring a WIC-1T or WIC-2T Serial WAN Interface Card, page 3-24
- Configuring a VIC2-2FXO or VIC2-4FXO Voice Interface Card, page 3-24
- Configuring a VIC2-2FXS or VIC2-4FXS Voice Interface Card, page 3-26
- Configuring ATM T1-WAN Ports, page 3-28
- Configuring 1-Port ADSL/SHDSL WAN Interface Card, page 3-32
- Configuring a VIC2-2BRI-NT/TE Card, page 3-36
- Saving Configuration Changes, page 3-38

Follow the procedures in this chapter to configure the Cisco IAD manually or, if you wish, to change the configuration after you have run the setup command facility (see the "The setup Command Facility" section on page 2-2).

This chapter does not describe every configuration possible—only a small portion of the most commonly used configuration procedures. For advanced configuration topics, see the Cisco IOS configuration guide and command reference publications. See the "Obtaining Documentation and Submitting a Service Request" section on page -ix.

Note If you skipped Chapter 2, "Using the setup Command Facility," and you have never configured a Cisco IAD, return to Chapter 2, "Using the setup Command Facility," and read it now. The chapter contains important information that you need for configuring your Cisco IAD.

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

Configuring the Hostname and Password

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

Note   A hostname can be specified only when the router has a DNS server available for hostname resolution.

To configure the hostname and password, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **hostname**
4. **enable secret password**
5. **line-console**
6. **exec-timeout**
7. **exit**
8. **end**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**hostname** **Example:** `Router(config)# hostname IAD2430`	Changes the name of the Cisco IAD to a meaningful name.
Step 4	**enable secret password** **Example:** `Router(config)# enable secret guessme`	Enters an enable secret password. This password provides access to privileged EXEC mode. When you press **Enter** at the user EXEC prompt (`Router>`), you must enter the enable secret password to gain access to configuration mode. Substitute your enable secret password for `guessme`.

	Command or Action	Purpose

Step 5	`line console`
	
	Example:
	`Router(config)# line console 0`
		Enters line configuration mode to configure the console port. When you enter line configuration mode, the prompt changes to `Router(config-line)#`.

Step 6	`exec-timeout`
	
	Example:
	`Router(config-line)# exec-timeout 0 0`
		If no input is detected during the interval, the EXEC facility resumes the current connection. If no connections exist, the EXEC facility returns the terminal to the idle state and disconnects the incoming session.
		
		Note To specify no timeout, enter the **exec-timeout 0 0** command.

Step 7	`exit`
	
	Example:
	`Router(config-line)# exit`
		Exits to global configuration mode.

Step 8	`end`
	
	Example:
	`Router(config-if)# end`
		Returns you to privileged EXEC mode.

Verifying the Hostname and Password

To verify that you configured the correct hostname and password, follow these steps:

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

```
Router(config)# show config

Using 1888 out of 126968 bytes
!
version XX.X
.
.
.
!
hostname IAD2430
!
enable secret 5 $1$60L4$X2JYOwoDc0.kqa1loO/w8/
.
.
.
```

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

Step 2 Exit global configuration mode and attempt to reenter 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, ensure the following:

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

Configuring Fast Ethernet Interfaces

To configure a Fast Ethernet interface, use the configuration software provided with your Cisco IAD or network module, if any. Otherwise, for greatest power and flexibility, use configuration mode (manual configuration).

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

This section describes basic Fast Ethernet interface 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 to do the following:

- Connect a console to the Cisco IAD.
- Power on the Cisco IAD.

To configure Fast Ethernet interfaces, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip routing**
4. **interface** *type number*
5. **ip address** *ip address subnet mask*
6. **exit**
7. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ip routing** **Example:** Router(config)# ip routing	Enables routing protocols as required for your global configuration. This example uses IP routing.
Step 4	**interface** *type number* **Example:** Router(config)# interface fastethernet 0/0	Enters interface configuration mode. You have entered interface configuration mode when the prompt changes to Router(config-if)#.
Step 5	**ip address** *ip address subnet mask* **Example:** Router(config-if)# ip address 172.16.74.3 255.255.255.0	Assigns an IP address and subnet mask to the interface.
Step 6	**exit** **Example:** Router(config-if)# exit	Exits to global configuration mode. Repeat Step 4 through Step 6 if your Cisco IAD has more than one interface to configure.
Step 7	**Ctrl-z** **Example:** Router# Ctrl-z	Returns to enable mode when you finish configuring the interfaces.

Configuring Network Clock

At initialization, all controllers on the Cisco IAD2430 IAD, including onboard T1/E1 or VWIC T1/E1, participate in the system clock domain. The default network clock algorithm selects one of the controllers as a default network clock. The default network clock algorithm provides a best estimate of the clocking system. This is mainly for voice applications to be configured easily after power up.

Cisco recommends that when you power up the system, make sure that network clocks are configured properly for the applications to work, with consideration for the specific network system requirements.

To view the current primary clock, use the **show network-clocks** or **show run** command. Note that the **show network-clocks** and **show run** commands do not display the default network clock, which is selected by the default network clock algorithm.

To have the T1/E1 controller participate as a clock source for the Cisco IAD system clock domain and to make sure it is available as a candidate for a clock selection algorithm, use the following CLI configuration. If you have data applications that do not require clock participation, use the *no* form of the commands.

To configure the network clock, perform the following steps.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **network-clock-participate** *slot/port*

4. **controller** {**t1** | **e1** | **j1**} *slot/port*

5. **network-clock-participate** *slot/port*

6. **network-clock-select** *priority* **bri|atm|t1|e1** *slot/port*

7. **network-clock-select** *priority* **serial** *slot/port*

8. **exit**

9. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`network-clock-participate` *slot/port* **Example:** `Router(config)# network-clock-participate WIC 0`	Enters the controller into the system clock domain. **Note** The IAD2435 IAD is configured with **network-clock-participate** by default. You cannot remove or configure this default configuration.
Step 4	`controller t1` *slot/port* **Example:** `Router(config)# controller t1 0/2`	Enters the first part of the VWIC controller at slot 0 into the system clock domain.

Step 5	`network-clock-participate` *slot/port*
	
	Example:
	`Router(config-controller)# controller t1 0/2`
	`Router(config-controller)#`
	`network-clock-participate wic 0`
		Enters both parts of the VWIC controller at slot 0 into the system clock domain.

	Command or Action	Purpose
Step 6	**network-clock-select** *priority* **{bri|atm|t1|e1}** *slot/port* **Example:** Router(config)# network-clock-select 1 T1 1/0	Selects the controller as a candidate for the clock selection algorithm according to the priority entered. Use either slots 1/0 or 0/0.
Step 7	**network-clock-select** *priority* **serial** *slot/port* **Example:** Router(config)# network-clock-select 1 Serial 0/0	In case of a serial interface, selects the serial controller as a candidate for the clock selection algorithm according to the priority entered. This applies only when the serial interface is used for time-division multiplexing (TDM) connections.
Step 8	**exit** **Example:** Router(config-if)# exit	Exits to global configuration mode.
Step 9	**Ctrl-z** **Example:** Router#	Returns to enable mode when you finish configuring interfaces.

Configuring T1/E1 Interfaces

To configure an ISDN PRI, channel-associated signaling (CAS) interface, or a T1/E1 multiflex trunk interface, use the configuration software provided with your Cisco IAD 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 prompt.

This section covers the following topics:

- Configuring Channel Groups on T1/E1 to Support Data
- Configuring Channel Groups on T1/E1 to Support Data Under SHDSL Controller
- Configuring Digital Voice on T1/E1
- Configuring TDM Cross-Connect

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

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

Before you begin configuring the interfaces, make sure to do the following:

- Connect a console to the Cisco IAD.
- Power on the Cisco IAD.

Configuring Channel Groups on T1/E1 to Support Data

To support data, use the following procedure to configure a new T1/E1 interface for channelized T1/E1 (CT1) or PRI, or to change the configuration of an existing interface.

To configure channel groups on T1/E1 to support data, perform the following steps.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip routing**
4. **controller t1** *slot/port*
5. **clock source line**
6. **framing t1/e1 controller**
7. **framing t1/e1 controller**
8. **linecode {ami|b8zs|hdb3}**
9. **linecode {ami|b8zs|hdb3}**
10. **channel-group** *channel-group-number* **timeslots** *range*
11. **interface** *type number*
12. **ip address** *ip address subnet mask*
13. **exit**
14. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ip routing** **Example:** Router(config)# ip routing	Enables routing protocols as required for your global configuration. This example uses IP routing.
Step 4	**controller t1** *slot/port* **Example:** Router(config)# controller t1 0/2	Selects the CT1, CE1, PRI interface to configure. Controller numbers vary. See the "Port Numbering Conventions" section on page 1-5.

	Command or Action	Purpose

Step 5	`clock source line`
	
	Example:
	`Router(config-controller)# clock source line`
		Specifies 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/E1 line is used as the channel group. Only one end of the T1/E1 line should be set to internal.

Step 6	`framing T1/E1 controller`
	
	Example:
	`Router(config-controller)# framing esf`
		Specifies the framing type for T1.

Step 7	`framing T1/E1 controller`
	
	Example:
	`Router(config-controller)# framing crc-4`
		Specifies the framing type for E1.

Step 8	`linecode {ami|b8zs|hdb3}`
	
	Example:
	`Router(config-controller)# linecode b8zs`
		Specifies the line code format for E1 and the linecode format for T1.

Step 9	`linecode {ami|b8zs|hdb3}`
	
	Example:
	`Router(config-controller)# linecode hdb3`
		Specifies the line code format for E1 and the linecode format for T1.

Step 10	`channel-group` *channel-group-number* `timeslots` *range* **Example:** `Router(config-controller)# channel-group 0 timeslots 1,3-5,7`	Specifies the channel group and time slots to be mapped. For multiflex trunk interfaces, only channel 0 can be configured. **Note** Channel-group number should be different from DS0-group number and TDM-group number under the same controller.
Step 11	`interface` *type number* **Example:** `Router(config-controller)# interface serial 1/0:0`	Configures each channel group as a virtual serial interface. Specifies the T1/E1 interface, the unit number, and the channel group to modify.
Step 12	`ip address` *ip address subnet mask* **Example:** `Router(config-if)# ip address 10.1.15.1 255.255.255.0`	Assigns an IP address and subnet mask to the interface.

Step 13	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits to global configuration mode.

Step 14	`Ctrl-z`
	
	Example:
	`Router#`
		Returns to enable mode when you finish configuring interfaces.

Configuring Channel Groups on T1/E1 to Support Data Under SHDSL Controller

To support data under symmetric high bit-rate digital subscriber line (SHDSL) controller, use the following procedure either to configure a new T1/E1 interface for channelized T1/E1 (CT1) or PRI or to change the configuration of an existing interface.

Perform the following steps to configure channel groups on T1/E1 to support data under SHDSL controller.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip routing**
4. **controller dsl** *slot/port*
5. **mode {atm|t1|e1)**
6. **controller t1** *slot/port*
7. **channel-group** *channel-group-number* **timeslots** *range*
8. **interface** *type number*
9. **ip address** *ip address subnet mask*
10. **exit**
11. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**ip routing** **Example:** `Router(config)# ip routing`	Enables routing protocols as required for your global configuration. This example uses IP routing.
Step 4	**controller dsl** *slot/port* **Example:** `Router(config)# controller dsl 2/4`	Selects the DSL interface to configure. Controller numbers vary. See Port Numbering Conventions, page 1-5.

	Command or Action	Purpose
Step 5	**mode {atm|t1|e1}** **Example:** Router(config-controller)# mode t1	Specifies that the full T1/E1 line is used as the channel group mode.
Step 6	**controller t1** *slot/port* **Example:** Router(config)# controller t1 0/2	Specifies the T1 interface for control.
Step 7	**channel-group** *channel-group-number* **timeslots** *range* **Example:** Router(config-controller)# channel-group 1 timeslots 1-24	Specifies the channel group and time slots to be mapped.
Step 8	**interface** *type number* **Example:** Router(config-controller)# interface serial 1/0:0	Configures each channel group as a virtual serial interface. Specifies the T1/E1 interface, unit number, and channel group to modify.
Step 9	**ip address** *ip address subnet mask* **Example:** Router(config-if)# ip address 10.1.15.1 255.255.255.0	Assigns an IP address and subnet mask to the interface.
Step 10	**exit** **Example:** Router(config-if)# exit	Exits to global configuration mode.
Step 11	**Ctrl-z** **Example:** Router#	Returns to enable mode when you finish configuring interfaces.

Configuring Digital Voice on T1/E1

Digital voice is supported by both ISDN and PRI signaling. This section covers the following topics:

- Configuring Switch Types for ISDN PRI Q.931 Support
- Configuring DS0 Groups for CAS

For more information on configuring ISDN voice interfaces, see the *Basic ISDN Voice-Interface Configuration* document.

Configuring Switch Types for ISDN PRI Q.931 Support

Perform the following steps to configure Q Signalling (QSIG) signaling support on Cisco IAD2430 series IADs.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **isdn switch-type primary**

4. **controller t1/e1** *slot/port*

5. **pri-group timeslots** *range*

6. **isdn protocol-emulate {user|network}**

7. **no line-power**

8. **isdn incoming-voice** *voice*

9. **exit**

10. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**isdn switch-type primary** **Example:** Router(config)# isdn switch-type primary-net5	(Optional; see note.) Selects a service provider switch type that accommodates PRI. **Note** You can configure the ISDN switch type in either global or interface configuration mode. If you configure the switch type here, specify the switch type for all PRI ports. If you configure the switch type on a single interface, specify the switch type for that interface. The switch type specified for any individual interface overrides the globally specified switch type.
Step 4	**controller t1/e1** *slot/port* **Example:** Router(config)# controller t1 0/2	Enters controller configuration mode for the controller at the specified slot/port location. Valid values for slot and port are 0 and 1.

	Command or Action	Purpose
Step 5	`pri-group timeslots` *range* **Example:** `Router(config-if)# pri-group timeslots 2-6`	Configures the PRI group for T1 to carry voice traffic. For T1, available time slots are from 1 through 23. You can configure the PRI group to include all available time slots, or you can configure a select group of time slots for the PRI group. **Note** You can configure a maximum of 8 time slots in a PRI group on the IAD2435 IAD.

Step 6	`isdn protocol-emulate {user|network}`
	
	Example:
	`Router(config-if)# isdn protocol-emulate network`
		Configures the ISDN interface to serve as either the primary slave or the primary master. For this command, **user** specifies slave, and **network** specifies master.

Step 7	`no line-power`
	
	Example:
	`Router(config-if)# no line-power`
		Turns on or turns off the power supplied from an NT-configured port to a TE device. The default is **no line-power**.

Step 8	`isdn incoming-voice` *voice* **Example:** `Router(config-if)# isdn incoming-voice voice`	Routes incoming ISDN voice calls to the voice module.

Step 9	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits to global configuration mode.

Step 10	`Ctrl-z`
	
	Example:
	`Router#`
		Returns to enable mode when you finish configuring interfaces.

Example

The following example shows a typical ISDN PRI configuration:

```
controller T1 0/0
 channel-group 0 timeslots 1-20 speed 64
 pri-group timeslots 21-24
!
voice-port 0/0:23
!
voice-port 0/1/0 << FXS
!
dial-peer voice 1 pots
 direct-inward-dial
 description calls to PSTN - dial 9 from FXS
 destination-pattern 9T
 port 0/0:23
!
dial-peer voice 2 pots
 direct-inward-dial
 description calls to Analog phone from PSTN
 destination-pattern 4083333333
 port 0/1/0
```

Configuring DS0 Groups for CAS

The Cisco IAD2430 IAD supports as many as 24 voice lines (DS0s) for CAS, with *controller:DS0-group* identification of 1:0 through 1:23.

Perform the following steps to configure the basic T1 controller and digital voice port settings.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller t1/e1** *slot/port*
4. **mode css**
5. **ds0-group** *ds0-group-number* **timeslots** *timeslot-number*
6. **voice-port** *slot/port ds0-group-no*
7. **dial-type {pulse|dtmf}**
8. **compand-type {u-law|a-law}**
9. **no shutdown**
10. **exit**
11. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**controller t1/e1** *slot/port* **Example:** `Router(config)# controller t1 0/2`	Enters controller configuration mode for controller 1 (the trunk controller for the T1-PBX port). **Note** DS0-group number should be different from channel-group number and TDM-group number under the same controller.
Step 4	**mode css** **Example:** `Router(config-controller)# mode css`	Enters CAS configuration mode and configures the T1/E1 trunk to support signaling that matches the PBX signaling type: • **cas**—Channel-associated signaling • **Common channel signaling cross-connect**—CCS cross-connect for bearer channels • **ccs frame-forwarding**—CCS transparent signaling

	Command or Action	Purpose

Step 5	`ds0-group`
	ds0-group-number **timeslots** *timeslot-list*
	
	Example:
	`Router(config-controller-cas)# ds0-group 1`
	`timeslots 1-4`
		Creates a DS0 group on the T1/E1 trunk. A DS0 group can contain from 1 to 24 time slots numbered from 0 to 23 for T1, and 1 to 32 time slots numbered from 0 to 31 for E1.
		
		Note The maximum number of time slots available in a T1 DS0 group is 24. The maximum number of time slots available in an E1 DS0 group is 32.
		
		Note You can configure a maximum of 8 time slots in a DS0 group on the IAD2435 IAD.
		
		When configuring a DS0 group for a T1/E1 line to a PBX, make sure that the time slot numbers match the channels on the PBX. Contact the PBX administrator to determine which channels to use.
		
		Time slots with identical voice-port configuration can be assigned to one DS0 group.
		
		Time slots with nonidentical voice-port configurations must be assigned to different DS0 groups.
		
		Note The maximum number of time slots available in a T1/E1 is 24. The time slots can be assigned to one DS0 group, or they can be assigned to as many as 24 DS0 groups within the T1/E1.

Step 6	Repeat Step 3 for each additional DS0 group. After DS0 groups are defined, exit CAS configuration mode.	Configures additional DS0 groups on the T1/E1 interface to the PBX.
Step 7	`voice-port` *slot/port ds0-group-no* **Example:** `Router(config)# voice-port 1:D`	Enters voice-port configuration mode, and specifies the voice port that you want to configure. The logical slot for these voice ports is the same as for the T1 controller. (See Step 1). The logical port is 0 to 23 for T1 and 0 to 31 for E1, corresponding to the DS0 group.

Step 8	`dial-type {pulse|dtmf}`
	
	Example:
	`Router(config-voice-port)# dial-type dtmf`
		(FXO only) If this voice port supports rotary pulse dialing, changes the transmit dial type to pulse. The default is **dtmf**.

Step 9	`compand-type {u-law|a-law}`
	
	Example:
	`Router(config-voice-port)# compand-type a-law`
		Changes the companding, if necessary. The default is **u-law** (the North American mu-law ITU-T pulse code modulation (PCM) encoding standard). Specify **a-law** to use the European a-law ITU-T PCM encoding standard.

Step 10	`no shutdown`
	
	Example:
	`Router(config-voice-port)# no shutdown`
		Activates the voice port. You should activate only the voice ports that you plan to use.

Step 11	Exit voice-port configuration mode and repeat Step 5 through Step 8 for the remaining digital voice ports.	Configures any required digital voice ports.

	Command or Action	Purpose
Step 12	**exit** **Example:** Router(config-if)# exit	Exits to global configuration mode.
Step 13	**Ctrl-z** **Example:** Router#	Returns to enable mode when you finish configuring interfaces.

Example

The following example shows typical DS0 groups configuration:

```
controller T1 0/0
 channel-group 0 timeslots 1-20 speed 64
 ds0-group 1 timeslots 21-24 type fxo-loopstart
!
voice-port 0/0:1
!
voice-port 0/1/0 << FXS
!
dial-peer voice 1 pots
 description calls to PSTN - dial 9 from FXS
 destination-pattern 9T
 port 0/0:1
!
dial-peer voice 2 pots
 description calls to Analog phone from PSTN
 destination-pattern 4083333333
 port 0/1/0
0
```

Configuring TDM Cross-Connect

For multiflex trunk interfaces using the time-division multiplexing (TDM) connect function, you can use the **connect** command to cross-connect (1) two TDM groups from two controllers, or (2) an analog FXS port and a DS0 group on a T1. Cross-connecting is done differently for data and voice, as shown in the following procedures:

- Configuring TDM to TDM
- Configuring TDM to Analog Voice Port

Configuring TDM to TDM

Perform the following steps to configure TDM connect for data (also referred to as *pass-through*).

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **controller t1/e1** *slot/port*
4. **tdm-group** *tdm-group-no* **timeslot** *timeslot-list* **type**
5. **exit**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`controller t1/e1` *slot/port* **Example:** `Router(config)# controller t1 0/2`	Enters controller configuration mode for controller 1 (the trunk controller for the T1-PBX port). **Note** DS0-group number should be different from channel-group number and TDM-group number under the same controller.

Step 4	`tdm-group` *tdm-group-no* `timeslot` *timeslot-list* `type`
	
	Example:
	`Router(config-controller)# tdm-group 1 timeslots 13-20`
		Configures a TDM channel group for T1/E1. When configuring cross-connect for data traffic only, do not specify the **type** option. The **type** option applies only if the **mode cas** command is enabled.
		
		Note The TDM-group number should be different from the DS0-group number and the channel-group number under the same controller.

Step 5	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits to global configuration mode.

Configuring TDM to Analog Voice Port

Perform the following steps to configure TDM connect for voice between an onboard analog FXS port and a DS0 group on a T1.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ds0** *ds0-group-number* **timeslots** *timeslot-list* **type**
4. **exit**
5. **connect**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**ds0-group** *ds0-group-number* **timeslots** *timeslot-list* **type** {**e&m**|**fxs** [**loop-start**|**ground-start**]|**fxo** [**loop-start**|**ground-start**]} **Example:** Router(config-controller)# ds0-group 1 timeslots 1-10 type fxs-ground-start Router(config-controller)# ds0-group 2 timeslots 11-24 type fxo-loop-start	Configures a DS0 group for T1. Use only one time slot to map an analog port to a T1. Make sure that the signaling type is **fxo loop-start** or **fxo ground-start**, depending on the signaling type on the FXS port.
Step 4	**exit** **Example:** Router(config-if)# exit	Exits to global configuration mode.
Step 5	**connect** *id* **voice-port** *voice-port* **T1/E1** *ds0-group-id* **Example:** Router(config)# connect	Configures cross-connect between the analog FXS port and the DS0 group on the T1/E1.

Configuring TDM to Physical Serial Interface

Perform the following steps to configure TDM connect for serial interface.

✎

Note   The serial interface must be a DTE device.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **tdm-group** *tdm-group-no* **timeslot** *timeslot-list*
4. **exit**
5. **interface** *type number*
6. **no keepalive**
7. **exit**
8. **connect**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**tdm-group** *tdm-group-no* **timeslot** *timeslot-list* **Example:** Router(config-controller)# tdm-group 1 timeslot 13-20	Configures a list of time slots for creating clear channel groups (pass-through) for time-division multiplexing (TDM) cross-connect. When configuring cross-connect for data traffic only, do not specify the **type** option.
Step 4	**exit** **Example:** Router(config-controller)# exit	Exits to global controller mode.
Step 5	**interface** *type number* **Example:** Router(config-controller)# interface serial 1/0:0	Configures the serial interface.
Step 6	**no keepalive** **Example:** Router(config-if)# no keepalive	Sets the no keepalive function.

	Command or Action	Purpose

Step 7	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits serial interface mode.

Step 8	`connect` *id serial-1 controller-2 tdm-group-no-2* **Example:** `Router(config)# connect`	Configures cross-connect pass-through between physical serial interface and a controller.

Configuring a WIC-1DSU-T1/E1 Serial WAN Interface Card

You can manually configure the synchronous serial interfaces on a WIC-1DSU-T1/E1 serial interface card by entering Cisco IOS commands on the command line. This method, called *configuration mode*, provides the greatest power and flexibility.

> **Note** Before you begin, disconnect all WAN cables from the Cisco IAD to prevent it from running the AutoInstall process. Whenever you power on the Cisco IAD, if there is a WAN connection on both ends and the Cisco IAD does not have a valid configuration file stored in NVRAM (for instance, when you add a new interface), the Cisco IAD tries to run AutoInstall. It can take several minutes for the Cisco IAD to determine that AutoInstall is not connected to a remote TCP/IP host.

Before you begin configuring the synchronous serial interface, make sure to do the following:

- Connect a console to the Cisco IAD.
- Power on the Cisco IAD.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **ip routing**
4. **interface** *type number*
5. **ip address** *ip address subnet mask*
6. **half-duplex timer dcd-drop-delay** *value*
7. **clockrate** *value*
8. **dce-terminal-timing-enable**
9. **invert-txc**
10. **nrzi-encoding**
11. **exit**
12. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`ip routing`
	
	Example:
	`Router(config)# ip routing`
		Enables routing protocols as required for your global configuration. This example uses IP routing.

Step 4	`interface type number`
	
	Example:
	`Router(config-controller)# interface serial 0/0`
		Enters interface configuration mode. You have entered interface configuration mode when the prompt changes to `Router(config-if)#`.

Step 5	`ip address ip address subnet mask`
	
	Example:
	`Router(config-if)# ip address 172.16.74.1 255.255.255.0`
		Assigns an IP address and subnet mask to the interface.

Step 6	`half-duplex timer dcd-drop-delay value`
	
	Example:
	`Router(config-if)# half-duplex timer dcd-drop-delay 100`
		Specifies the time that the interface waits in controlled carrier mode. See Table 3-1 for a list of half-duplex timer commands.

Step 7	`clockrate value`
	
	Example:
	`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, Table 3-3, and Table 3-4 for lists of clock rate settings for specific interfaces. (For ports used in DTE mode, the Cisco IAD automatically uses the external timing signal.)

Step 8	`dce-terminal-timing-enable`
	
	Example:
	`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.

	Command or Action	Purpose
Step 9	**invert-txc** Example: Router(config-if)# invert-txc	Cisco IADs 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 bad packets, inverting the clock by means of this command can often correct the shift.
Step 10	**nrzi-encoding** Example: 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 11	**exit** Example: Router(config-if)# exit	Exits to global configuration mode. Repeat Step 4 through Step 12 if your Cisco IAD has more than one serial interface that you need to configure.
Step 12	**Ctrl-z** Example: Router#	Returns to enable mode when you finish configuring the interfaces.

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[2]	**half-duplex timer dcd-drop-delay**	100
DCD transmission start delay	**half-duplex timer dcd-txstart-delay**	100
RTS[3] 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. DCD = Data carrier detect
3. 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 2-Port 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 3-4   Clock Rate Settings for 4-Port Synchronous Serial Interface Card

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 a WIC-1T or WIC-2T Serial WAN Interface Card

The WIC-1T or WIC-2T serial interface cards include an integrated DSU/CSU and can be configured either for full T1/E1 service at 1.544 Mb/s or for fractional T1/E1 service. You can configure the interfaces on your T1/E1 WAN interface card manually by entering Cisco IOS commands on the command line. This method, called *configuration mode*, provides the greatest power and flexibility.

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

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

Before you begin configuring interfaces on a WIC-1T or WIC-2T serial WAN interface card, make sure to do the following:

- Connect a console to the Cisco IAD.
- Power on the Cisco IAD.

Configuring a VIC2-2FXO or VIC2-4FXO Voice Interface Card

in most situations, the default voice-port values are adequate for FXO voice ports.

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

If you need to change the default configuration for these voice ports, perform the following tasks. The first two tasks are required; the third task is optional.

Step 1 Identify the voice port and enter voice-port configuration mode.

Step 2 Configure the following mandatory voice-port parameters:

   a. Connection

   b. Dial type

   c. Signal type

   d. Call progress tone

Step 3 (Optional) Configure a description.

Perform the following steps to configure FXO voice ports.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **voice-port** *slot/port*

4. **connection**

5. **dial-type**

6. **signal**

7. **compand-type**

8. **cptone** *local*

9. **description** *string*

10. **exit**

11. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**voice-port** *slot/port* **Example:** Router(config)# voice-port 0/1	Enters voice-port configuration mode. See Port Numbering Conventions, page 1-5.
Step 4	**connection {trunk|plar|tie-line|plar-opx}** *string* **Example:** Router(config-voice-port)# connection tie-line 5550100	Configures the voice-port connection mode type and the destination telephone number. The **plar** value is used for private line automated ringdown (PLAR) connections. The **tie-line** value is used for a tie-line connection to a PBX. The **plar-opx** value, for PLAR off-premises extension, allows the local voice port to provide a local response before the remote voice port receives an answer.
Step 5	**dial-type {pulse|dtmf|mf}** **Example:** Router(config-voice-port)# dial-type pulse	Configures the voice-port dial-type. The default is **dtmf**.

	Command or Action	Purpose
Step 6	**signal {groundstart|loopstart|live-feed}** **Example:** Router(config-voice-port)# signal groundstart	Configures the signaling type for analog FXO voice ports. The default is loop-start.
Step 7	**compand-type {u-law|a-law}** **Example:** Router(config-voice-port)# compand-type a-law	Configures the companding standard used to convert between analog and digital signals in PCM systems.
Step 8	**cptone** *local* **Example:** Router(config-voice-port)# cptone ca	Configures the appropriate call progress tone for the local region. The default for this command is **northamerica**. For a list of supported countries, see the *Cisco Voice, Video, and Fax Command Reference, Release 12.3(4)T.*
Step 9	**description** *string* **Example:** Router(config-voice-port)# description purchasing_dept	(Optional) Enters a string description for the voice port. The string describes the voice port in displays. You can use the description command to note the voice port location or use.
Step 10	**exit** **Example:** Router(config-voice-port)# exit	Exits to voice-port mode.
Step 11	**Ctrl-z** **Example:** Router#	Returns to enable mode when you finish configuring the interfaces.

Configuring a VIC2-2FXS or VIC2-4FXS Voice Interface Card

In most situations, the default voice-port values are adequate for FXS voice ports.

> **Note**   The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

If you need to change the default configuration for the FXS voice ports, perform the following tasks. The first two tasks are required; the third task is optional.

Step 1   Identify the voice port and enter voice-port configuration mode.

Step 2   Configure the following mandatory voice-port parameters:

a.   Connection

b.   Dial type

    c. Signal type

    d. Call progress tone

Step 3   (Optional) Configure a description.

Perform the following steps to configure FXS voice ports.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **voice-port** *slot/port*
4. **signal**
5. **compand-type**
6. **cptone** *local*
7. **description** *string*
8. **exit**
9. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** `Router# enable`	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** `Router# configure terminal`	Enters global configuration mode.
Step 3	**voice-port** *slot/port* **Example:** `Router(config)# voice-port 0/1`	Enters voice-port configuration mode. See Port Numbering Conventions, page 1-5.
Step 4	**signal {groundstart|loopstart|live-feed}** **Example:** `Router(config-voice-port)# signal groundstart`	Configures the signaling type for analog FXS voice ports. The default is loop-start.
Step 5	**compand-type {u-law|a-law}** **Example:** `Router(config-voice-port)# compand-type a-law`	Configures the companding standard used to convert between analog and digital signals in PCM systems.

	Command or Action	Purpose
Step 6	**cptone** *local* **Example:** Router(config-voice-port)# cptone ca	Configures the appropriate call progress tone for the local region. The default for this command is **northamerica**. For a list of supported countries, see the *Cisco Voice, Video, and Fax Command Reference, Release 12.3(4)T.*
Step 7	**description** *string* **Example:** Router(config-voice-port)# description purchasing_dept	(Optional) Enters a string description for the voice port. The string describes the voice port in displays. You can use the description command to note the voice port location or use.
Step 8	**exit** **Example:** Router(config-voice-port)# exit	Exits to voice-port mode.
Step 9	**Ctrl-z** **Example:** Router#	Returns to enable mode when you finish configuring the interfaces.

Configuring ATM T1-WAN Ports

If your Cisco IAD has a T1-WAN port, a default ATM configuration is automatically enabled when you enter the **mode atm** controller command.

Note   The Cisco IAD2435 router does not support an ATM interface.

The default ATM configuration has the following operating parameters:

- Maximum virtual path identifiers (VPIs) per virtual channel identifier (VCI) (atm vc-per-vc)—1024.
- No IP address.
- ATM User to Network Interface (UNI) Version 3.0 is assigned.
- ATM Integrated Local Management Interface (ILMI) keepalive is disabled.
- No ATM PVCs are configured.

To configure the ATM interface parameters for your application, you need the following information:

- IP addresses and subnet masks
- VPI/VCI numbers
- Any other information related to the routing protocol

Perform the following steps to enter an ATM configuration.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **controller {t1|e1|j1}** *slot/port*

4. **mode {rpr|rpr-plus|sso}**

5. **exit**

6. **interface** *type number*

7. **ip address** *ip address subnet mask*

8. **atm uni-version** *version-number*

9. **atm ilmi-keepalive** *seconds*

10. **pvc** *name vpi/vci*

11. **protocol ipv6** *ipv6-address*

12. **vbr-rt** *peak-rate* **average-rate** *burst*

13. **encapsulation {aal5ciscoppp|aal5mux|aal5nlpid|aal5snap}**

14. **vbr-rt** *peak-rate* **average-rate** *burst*

15. **exit**

16. Repeat Step 8 through Step 12 for each additional ATM PVC to be configured.

17. **no shutdown**

18. **exit**

19. **exit**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`controller {t1|e1|j1} slot/port`
	
	Example:
	`Router(config)# controller t1 0`
		Enters controller configuration mode and specifies the controller number.

Step 4	`mode {rpr|rpr-plus|sso}`
	
	Example:
	`Router(config-ctrl)# mode atm`
		Enables ATM encapsulation and creates logical ATM interface 0. Controller framing is automatically set to Extended SuperFrame (ESF). The linecode is automatically set to binary 8-zero substitution (B8ZS).

	Command or Action	Purpose
Step 5	**exit** **Example:** Router(config-ctrl)# exit	Exits to controller mode.
Step 6	**interface** *type number* **Example:** Router(config)# interface atm 0	Enters ATM configuration mode for interface ATM 0.
Step 7	**ip address** *ip address subnet mask* **Example:** Router(config-if)# ip address 172.16.74.1 255.255.255.0	(Optional) Assigns an IP address to the asymmetric digital subscriber line (ADSL) or symmetric high bit-rate digital subscriber line (SHDSL) ATM interface.
Step 8	**atm uni-version** *version-number* **Example:** Router(config-if)# atm uni-version 3.1	(Optional) Specifies an ATM user network interface (UNI) version number.
Step 9	**atm ilmi-keepalive** *seconds* **Example:** Router(config-if)# atm ilmi-keepalive	(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 10	**pvc** *name vpi/vci* **Example:** Router(config-if)# pvc cisco 0/8	Enters atm-virtual-circuit (interface-atm-vc) configuration mode, and configure a new ATM PVC by assigning a name (optional) and VPI/VCI numbers. The default traffic shaping is unspecified bit rate (UBR); the default encapsulation is ATM adaption layer 5+ (AAL5+), Logical Link Control Protocol (LLC), Subnetwork Access Protocol (SNAP).
Step 11	**protocol ipv6** *ipv6-address* **Example:** Router(config-if-vc)# protocol ipv6 address 2001:0DB8:2222::72/32	(Optional) Enables IP connectivity and creates a point-to-point IP address for the VC.
Step 12	**vbr-rt** *peak-rate* **average-rate** *burst* **Example:** Router(config-if-vc)# vbr-rt 640 320 80	(Optional) Configures the PVC for real-time variable bit rate (VBR), VBR-nrt (non-real time), unspecified bit rate (UBR) UBR+, unspecified bit rate constant bit rate (CBR), available bit rate (ABR) traffic shaping. • Peak rate—peak information rate (PIR). 　For SHDSL ports, set the peak rate for the trained line rate minus 8 kb/s. • Average rate—average information rate (AIR). • Burst—burst size in cells.

	Command or Action	Purpose

Step 13	`encapsulation {aal5ciscoppp|aal5mux|aal5nlpid|aal5snap}`
	
	Example:
	`Router(config-if-vc)# encapsulation aal5autoppp virtual-template 1`
		(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type.
		
		• **aal5ciscoppp** for Cisco PPP over AAL5
		• **aal5mux** for AAL5+MUX (multiplexer)
		• **aal5nlpid** for AAL5+NLPID (Network Layer Protocol Identifier)
		• **aal5snap** for AAL5+LLC/SNAP (the default)

Step 14	`exit`
	
	Example:
	`Router(config-if-vc)# exit`
		Exits interface-atm-vc configuration mode.

Step 15	Repeat Step 8 through Step 12 for each additional ATM PVC to be configured.	Configures any additional ATM PVCs.

Step 16	`no shutdown`
	
	Example:
	`Router(config-if)# no shutdown`
		Activates the ATM interface.

Step 17	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits ATM interface configuration mode.

Step 18	`exit`
	
	Example:
	`Router(config)# exit`
		Exits global configuration mode.

Verifying Your ATM Interface Configuration

To verify the ATM interface configuration, enter the **show interface atm 0** privileged EXEC command. The following example shows typical output from the **show interface atm 0** command:

```
Router# show interface atm 0

ATM0 is up, line protocol is up
  Hardware is PQUICC Atom1
  MTU 1500 bytes, sub MTU 1500, BW 2304 Kbit, DLY 20000 usec,
    reliability 255/255, txload 1/255, rxload 1/255
  Encapsulation ATM, loopback not set
  Keepalive not supported
  Encapsulation(s):, PVC mode
  512 maximum active VCs, 4 current VCCs
  VC idle disconnect time:300 seconds
  Last input never, output never, output hang never
  Last clearing of "show interface" counters never
  Input queue:0/75/0/0 (size/max/drops/flushes); Total output drops:0
  Queueing strategy:None
  5 minute input rate 0 bits/sec, 0 packets/sec
  5 minute output rate 0 bits/sec, 0 packets/sec
    20486 packets input, 368419 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
        0 packets output, 0 bytes, 0 underruns
        0 output errors, 0 collisions, 0 interface resets
        0 output buffer failures, 0 output buffers swapped out
Router#
```

Configuring 1-Port ADSL/SHDSL WAN Interface Card

The ADSL/SHDSL WAN interface card is a 1-port WAN interface card (WIC) for the Cisco IAD2430 Series IADs. The card provides asymmetric digital subscriber line (ADSL) or symmetric high bit-rate digital subscriber line (SHDSL) high-speed digital data transfer between a single customer premises equipment (CPE) subscriber and the central office.

Note   The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

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

Note   A 1-port ADSL/SHDSL 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/SHDSL Port on the ADSL and SHDSL WAN Interface Card (required)
- Verifying ATM Configuration (optional)

Features used on the ADSL/SHDSL WAN interface card must also be configured on the digital subscriber line access multiplexer (DSLAM). See the documentation for the specific DSLAM for information about configuring features.

Configuring the ADSL/SHDSL Port on the ADSL and SHDSL WAN Interface Card

Perform the following steps to configure an ADSL/SHDSL port on the ADSL/SHDSL WAN interface card.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **interface atm** *slot/port*
4. **ip address** *ip address subnet mask*
5. **pvc** *name vpi/vci*

6. **protocol ipv6** *ipv6-address*

7. **vbr-rt** *peak-rate* **average-rate** *burst*

8. **encapsulation {aal5ciscoppp|aal5mux|aal5nlpid|aal5snap}**

9. **exit**

10. **dsl operating-mode**

11. **no shutdown**

12. **exit**

13. **exit**

14. **show interface atm** *slot/port*

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`configure terminal`
	
	Example:
	`Router# configure terminal`
		Enters global configuration mode.

Step 3	`interface atm` *slot/port* **Example:** `Router(config)# interface atm 1/0`	Enters ATM configuration mode for the ATM interface in the specified slot and port.

Step 4	`ip address` *ip address subnet mask*
	
	Example:
	`Router(config-if)# ip address 172.16.74.3`
	`255.255.255.0`
		Assigns an IP address to the ADSL/SHDSL ATM interface.

Step 5	`pvc` *name vpi/vci* **Example:** `Router(config-if)# pvc cisco 0/8`	Enters atm-virtual-circuit (interface-atm-vc) configuration mode, and configure a new ATM PVC by assigning a name (optional) and VPI/VCI numbers. The default traffic shaping is unspecified bit rate (UBR); the default encapsulation is ATM adaption layer 5+ (AAL5+), Logical Link Control Protocol (LLC), Subnetwork Access Protocol (SNAP).

Step 6	`protocol ipv6` *ipv6-address*
	
	Example:
	`Router(config-if-vc)# protocol ipv6 address`
	`2001:0DB8:2222::72/32`
		(Optional) Enables IP connectivity and creates a point-to-point IP address for the VC.

	Command or Action	Purpose
Step 7	**vbr-rt** *peak-rate* **average-rate** *burst* **Example:** Router(config-if-vc)# vbr-rt 640 320 80	(Optional) Configures the PVC for real-time variable bit rate (VBR), VBR-nrt (non-real time), unspecified bit rate (UBR) UBR+, unspecified bit rate constant bit rate (CBR), available bit rate (ABR) traffic shaping. • Peak rate—peak information rate (PIR). For SHDSL ports, set the peak rate for the trained line rate minus 8 kb/s. • Average rate—average information rate (AIR). • Burst—burst size in cells.
Step 8	**encapsulation** {**aal5ciscoppp**|**aal5mux**|**aal5nlpid**|**aal5snap**} **Example:** Router(config-if-vc)# encapsulation aal5autoppp virtual-template 1	(Optional) Configures the ATM adaptation layer (AAL) and encapsulation type. • **aal5ciscoppp**—Cisco PPP over AAL5 • **aal5mux**—AAL5+MUX • **aal5nlpid**—AAL5+NLPID • **aal5snap**—AAL5+LLC/SNAP (the default)
Step 9	**exit** **Example:** Router(config-if-vc)# exit	Exits interface-atm-vc configuration mode.
Step 10	**dsl operating-mode {adsl2[annex a|annex m]|adsl2+ [annex a|annex m]|ansi-dmt|auto|itu-dmt}** **Example:** Router(config-if)# dsl operating-mode adsl2+ annex m	Configure the ADSL/SHDSL 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/SHDSL line.
Step 11	**no shutdown** **Example:** Router(config-if)# no shutdown	Activates the ATM interface.
Step 12	**exit** **Example:** Router(config-if)# exit	Exits from ATM interface configuration mode.

	Command or Action	Purpose

Step 13	`exit`
	
	Example:
	`Router(config)# exit`
		Exits from global configuration mode.

Step 14	`show interface atm` *slot/port* **Example:** `Router> show interface atm 1/0`	Verifies the ATM interface configuration.

Verifying ATM Configuration

Use the following commands to verify the ATM 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 that 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 an ATM interface, use the **show interface atm** *slot/port* command. Make sure that the ATM slot/port and line protocol are 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 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
```

Configuring a VIC2-2BRI-NT/TE Card

ISDN BRI VICs provide digital connectivity for VoIP networks using the European Telecommunications Standards Institute (ETSI) Net3 switch type.

Note The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

BRI VICs present an ISDN S/T physical interface that connects to a network termination (NT) or terminal equipment (TE) device. With ISDN BRI VICs, you can connect a Cisco IAD2431 or IAD2432 series IAD to a private branch exchange (PBX) network in NT or TE mode or to a public switched telephone network (PSTN) in TE mode.

Each of the two BRI ports can operate in NT mode because the clock source can operate in TE mode as a clock slave.

Note When a VIC port operates in NT mode, it sources a clock to the BRI interface (a PBX trunk card, for example) which is operating in TE mode. When a VIC port operates in TE mode, it receives a clock from the BRI interface (a PBX line card, for example) which is operating in NT mode.

Perform the following steps to configure a VIC2-2BRI-NT/TE card.

SUMMARY STEPS

1. **enable**

2. **configure terminal**

3. **no isdn switch-type** *switch-type*

4. **tdm clock bri-auto**, **tdm clock bri** *slot/port* **export**, **tdm clock bri** *slot/port* **import**

5. **interface bri** *slot/port*

6. **no ip address**

7. **shutdown**, **isdn layer1-emulate {user|network}**, **no shutdown**

8. **line-power**

9. **isdn protocol-emulate {user|network}**

10. **exit**

DETAILED STEPS

	Command or Action	Purpose
Step 1	**enable** **Example:** Router# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** Router# configure terminal	Enters global configuration mode.
Step 3	**no isdn switch-type** *switch-type* **Example:** Router(config)# no isdn switch-type basic-net3	Removes the ISDN switch type.
Step 4	**tdm clock bri-auto** or **tdm clock bri** *slot/port* **export** and/or **tdm clock bri** *slot/port* **import** **{t1|e1|atm|bri|onboard}** **Example:** Router(config)# tdm clock bri-auto	Configures automatic TDM selection for the BRI VIC. • Configures the BRI port that exports the TDM clock. • Configures the BRI port(s) that import(s) the TDM clock.
Step 5	**interface bri** *slot/port* **Example:** Router(config)# interface bri 0/0	Changes to interface configuration mode for port 0 in slot 0.
Step 6	**no ip address** **Example:** Router(config-if)# no ip address	Specifies that there is no IP address for this interface.

	Command or Action	Purpose

Step 7	`shutdown`
	
	`isdn layer1-emulate {user|network}`
	
	`no shutdown`
	
	Example:
	`Router(config-if)# shutdown`
	`Router(config-if)# isdn layer1-emulate user`
	`Router(config-if)# no shutdown`
		Shuts down the interface.
		
		Configures the Layer 1 port mode and clock settings:
		
		• Enter **user** to configure the port as TE and to function as a clock slave. This is the default.
		
		• Enter **network** to configure the port as NT and to function as a clock master.
		
		Activates the interface after the port configuration.

Step 8	`line-power`
	
	Example:
	`Router(config-if)# line-power`
		(Optional only for NT-configured ports.) Turns on the power supplied from the port to a TE device.

Step 9	`isdn protocol-emulate {user|network}`
	
	Example:
	`Router(config-if)# isdn protocol-emulate user`
		Configures the Layer 2 port protocol emulation:
		
		• Enter **user** to configure the port as TE so that the PBX is the master. This is the default.
		
		• Enter **network** to configure the port as NT so that the PBX is the slave.

Step 10	`exit`
	
	Example:
	`Router(config-if)# exit`
		Exits global configuration mode.

Saving Configuration Changes

Perform the following steps to prevent loss of the Cisco IAD configuration.

SUMMARY STEPS

    1. **enable**

    2. **copy running-config startup-config**

    3. **Ctrl-z**

DETAILED STEPS

	Command or Action	Purpose

Step 1	`enable`
	
	Example:
	`Router# enable`
		Enters privileged EXEC mode.

Step 2	`copy running-config startup-config`
	
	Example:
	`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	`Ctrl-z`
	
	Example:
	`Router# Ctrl-z`
		Returns to enable mode when you finish configuring the interfaces.

C H A P T E R 4

Configuring Voice over IP

This chapter explains how to configure voice interfaces and ports, which convert telephone voice signals for transmission over an IP network.

This chapter presents the following major topics:

- Prerequisites, page 4-1
- Configuring the Voice Interface, page 4-2
- VoIP Configuration Examples, page 4-4

VoIP enables your Cisco IAD 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 and data trunking
- Plain old telephone service (POTS)–Internet telephony gateways

For more information on understanding and configuring VoIP, see the *Configuring Voice over IP* document.

Prerequisites

Before you can configure your Cisco integrated access device (IAD) to use VoIP, you must first do the following:

- Establish a working IP network.

Note For information applicable to the Cisco IAD2400 series, see "Voice over IP for the Cisco 3600 Series Overview," and references therein, at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios113ed/113t/113t_1/voip/voipover.htm

See also *Configuring Voice over IP for the Cisco 3600 Series* at the following URL:

http://www.cisco.com/univercd/cc/td/doc/product/software/ios120/12cgcr/voice_c/vcprt1/vcvoip.htm

- Implement a dial plan, including the following tasks:
  - 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.

> **Note** To support FXO signaling, you must install a VIC2-4FXO interface card. For information on connecting voice interface cards (VICs), see "Connecting Voice Network Modules" at the following URL:
>
> http://www.cisco.com/univercd/cc/td/doc/product/access/acs_mod/cis2600/hw_inst/nm_inst/nm-doc/conntvoi.htm

Configuring the Voice Interface

Whenever you install a new interface or want to change the configuration of an existing interface, you must configure the interface. If you replace a module that was already configured, the Cisco IAD recognizes it and brings up the interface in the existing configuration.

> **Note** The Cisco IAD2435 router is a fixed-configuration router and does not support interface cards.

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 configuring your Cisco IAD.

To configure a voice interface, you must use configuration mode (manual configuration). In this mode, you can enter Cisco IOS commands through the command-line interface (CLI).

Before you begin, disconnect all WAN cables from the Cisco IAD to prevent it from running the AutoInstall process. The Cisco IAD tries to run AutoInstall whenever you power it on if there is a WAN connection on both ends and the Cisco IAD 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 Cisco IAD to determine that AutoInstall is not connected to a remote TCP/IP host.

To configure the voice interface configuration mode, follow these steps:

Step 1 Connect a console to the Cisco IAD. If you need instructions for connecting a console, see the installation chapter of your Cisco IAD installation and configuration guide.

Step 2 Power on the Cisco IAD. 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 Cisco IAD.

> ✎
>
> **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>
```

The prompt changes to the privileged EXEC (enable) prompt (`Router#`):

```
Router#
```

Step 4   Enter the **configure terminal** command to enter global configuration mode:

```
Router# configure terminal
Router(config)#
```

The Cisco IAD enters global configuration mode, indicated by the `Router(config)#` prompt.

Step 5   If you have not configured the Cisco IAD before, or you 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, see 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 Cisco IAD hardware installation and software configuration guides 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 Cisco IAD for voice traffic, see the VoIP references in the "Prerequisites" section on page 4-1.

Step 9   To exit configuration mode and return to the enable prompt, when you finish configuring interfaces, press **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 if you have made changes to the configuration but have not yet written them to NVRAM. To write your changes to NVRAM and make 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 Cisco IAD is now configured to boot in the new configuration.

VoIP Configuration Examples

The actual VoIP configuration procedure you complete depends on the topology of your voice network. The following configuration examples give you a starting point. Of course, you need to customize these configuration examples for your own network topology.

Configuration procedures and examples are supplied for the following scenarios:

- FXS-to-FXS Connection
- Linking PBX Users with Digital E&M Trunk Lines over T1/E1 CAS
- PSTN Gateway Access Using an FXO Connection
- PSTN Gateway Access Using an FXO Connection in PLAR Mode

FXS-to-FXS Connection

The following example shows how to configure VoIP for simple FXS-to-FXS connections over channelized T1/E1s. 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 IAD-1; therefore, IAD-1 has been configured for one POTS peer and one VoIP peer. Routers RLB-w and R12-e establish the WAN connection between the two offices. Because one POTS telephony device is connected to IAD-2, that Cisco IAD has also been configured for only one POTS peer and one VoIP peer.

Figure 4-1 illustrates the topology of this FXS-to-FXS connection example.

Figure 4-1   Channelized T1/E1 FXS-to-FXS Connection
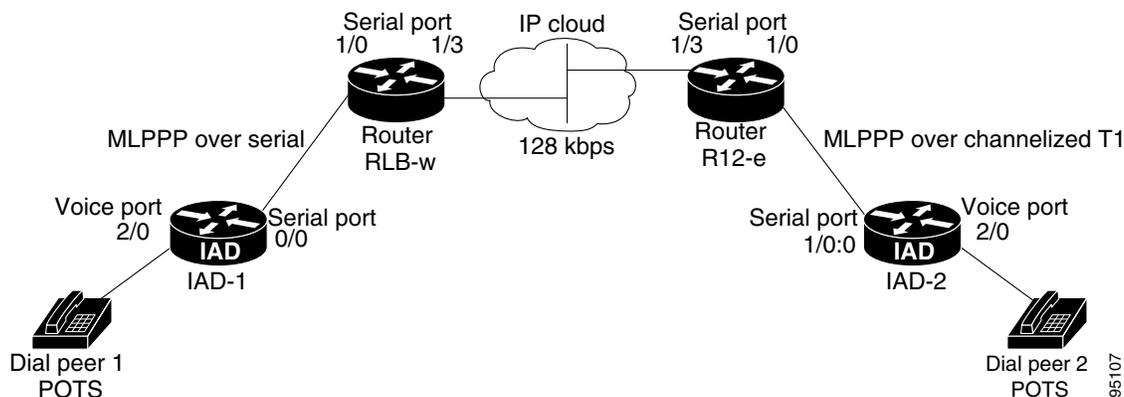
Configuration for IAD-1

```
hostname iad-1
! Create voip dial-peer 10
dial-peer voice 10 voip
! Define its associated telephone number and IP address
 destination-pattern +4152222222
 session target ipv4:10.0.0.1
! Create pots dial-peer 1
dial-peer voice 1 pots
! Define its associated telephone number and voice port
 destination-pattern +4081111111
 port 2/0
!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
 fair-queue 64 256 36
router igrp 888
network 10.0.0.0
```

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
 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
 fair-queue 64 256 3
! Configure IGRP
router igrp 888
network 10.0.0.0
network 20.0.0.0
```

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
 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
 fair-queue 64 256 3
 clockrate 128000
! Configure IGRP
router igrp 888
network 20.0.0.0
network 40.0.0.0
```

Configuration for IAD-2

```
hostname iad-2
! Create pots dial-peer 2
dial-peer voice 2 pots
! Define its associated telephone number and voice-port
 destination-pattern +4152222222
 port 2/0
! Create voip dial-peer 20
dial-peer voice 20 voip
!Define its associated telephone number and IP address
 destination-pattern +4081111111
 session target ipv4:40.0.0.1
! Configure channel group on T1/E1
controller T1 1/0
 channel-group 0 timeslots 1-24
! Configure serial interface 1/0:0
interface Serial1/0:0
 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
 fair-queue 64 256 3
 clockrate 64000
! Configure IGRP
router igrp 888
network 40.0.0.0
```

Linking PBX Users with Digital E&M Trunk Lines over T1/E1 CAS

The following example shows how to configure VoIP to link PBX users with digital E&M trunk lines over T1/E1 Channel-associated signalling (CAS). (See the "Configuring DS0 Groups for CAS" section on page 3-14.)

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 a PBX connected to the voice network by an E&M interface. Both offices are using E&M Port Type II, with four-wire operation and *ImmediateStart* signaling. Each E&M interface connects to the router by means of two voice interface connections. Users in San Jose dial "8-569" and then the extension number to reach a destination at the Salt Lake City office. Users in Salt Lake City dial "4-527" and then the extension number to reach a destination in the San Jose office.

Figure 4-2 shows the topology of this connection example.

Figure 4-2   Linking PBX Users with Digital E&M Trunk Lines over T1/E1 CAS
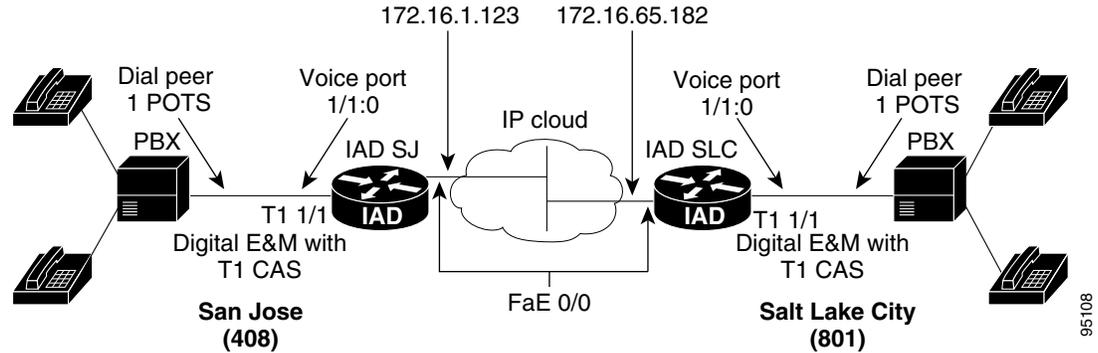
> **Note** This example assumes that the company already has established a working IP connection between its two remote offices.

IAD SJ Configuration

```
hostname sanjose
!Configure digital voice-ports
controller T1 1/0
 ds0-group 1 timeslots 1-24 type e&m-immediate-start
!Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +527....
 port 1/1:0
!Configure voip dial-peer 2
dial-peer voice 3 voip
 destination-pattern +569....
 session target ipv4:172.16.65.182
!Configure the fastethernet interface
interface fe 0/0
 ip address 172.16.1.123
 no shutdown
```

IAD SLC Configuration

```
hostname saltlake
!Configure digital voice-ports
controller T1 1/0
 ds0-group 1 timeslots 1-24 type e&m-immediate-start
!Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +569....
 port 1/1:0
!Configure voip dial-peer 2
dial-peer voice 3 voip
 destination-pattern +527....
 session target ipv4:172.16.65.123
!Configure the fastethernet interface
interface fe 0/0
 ip address 172.16.1.182
 no shutdown
```

> **Note**   PBXs should be configured to pass all dual tone multifrequency (DTMF) signals to the Cisco IAD. We recommend 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 an FXO Connection

The following example shows how to configure VoIP to link users with the PSTN gateway using a Foreign Exchange Office (FXO) connection.

In this example, users connected to Router SJ in San Jose, California, can reach PSTN users in Salt Lake City, Utah, using Router SLC. Router SLC in Salt Lake City is connected directly to the PSTN through an FXO interface.

Figure 4-3 shows 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.

IAD SJ Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +14081111111
 port 2/0
! 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
```

IAD SLC Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +9...........
 port 2/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +14081111111
 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 an FXO Connection in PLAR Mode

The following example shows how to configure VoIP to link users with the PSTN gateway using an Foreign Exchange Office (FXO) connection in private line, automated ringdown (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 (that is, a PSTN gateway using an FXO connection) Router SLC in Salt Lake City is connected directly to the PSTN through an FXO interface.

Figure 4-4 shows 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.

IAD SJ Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +14081111111
 port 2/0
! 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
```

IAD SLC Configuration

```
! Configure pots dial-peer 1
dial-peer voice 1 pots
 destination-pattern +9...........
 port 2/0
! Configure voip dial-peer 2
dial-peer voice 2 voip
 destination-pattern +14081111111
 session target ipv4:172.16.1.123
! Configure the voice port
voice port 2/0
connection plar 14081111111
! Configure the serial interface
interface serial 0/0
 ip address 172.16.65.182
 no shutdown
```

Cisco IAD2430 Series Configuration Examples

This appendix presents the following sample configurations for the Cisco 2430 series IADs:

Sample Configuration: Cisco IAD2435-8FXS

```
Current configuration : 1089 bytes
!
version 12.4(1)T
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname 2435-8FXS
!
logging queue-limit 100
!
ip subnet-zero
!
!
!
no voice hpi capture buffer
no voice hpi capture destination
!
!
mta receive maximum-recipients 0
!
!
controller T1 1/0
framing sf
 linecode ami
 channel-group 0 timeslots 1-24
!
!
!
interface FastEthernet0/0
 ip address 1.3.21.53 255.255.0.0
 no ip mroute-cache
 duplex auto
 speed auto
```

```
 fair-queue
!
interface Serial1/0:0
 ip address 10.1.1.1 255.255.0.0
 encapsulation ppp
!
ip http server
ip classless
!
!
!
call rsvp-sync
!
voice-port 2/0
!
voice-port 2/1
!
voice-port 2/2
!
voice-port 2/3
!
voice-port 2/4
!
voice-port 2/5
!
voice-port 2/6
!
voice-port 2/7
!
mgcp
mgcp call-agent 1.3.37.1 service-type mgcp version 1.0
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 1 pots
 application mgcpapp
 port 2/0
!
dial-peer voice 2 pots
 application mgcpapp
 port 2/1
!
!
line con 0
 exec-timeout 0 0
 speed 115200
line aux 0
line vty 0 4
 login
!
!
end
```

Sample Configuration: Cisco 2430-24FXS

```
Current configuration : 2612 bytes
!
version 12.4(1)T
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname swell-China
!
ip subnet-zero
!
!
no voice hpi capture buffer
no voice hpi capture destination
!
!
mta receive maximum-recipients 0
!
!
interface FastEthernet0/0
 ip address 1.3.21.55 255.255.0.0
 ip nat inside
 duplex auto
 speed auto
!
interface FastEthernet0/1
 ip address 1.2.111.1 255.255.0.0
 duplex auto
 speed auto
!
ip http server
no ip http secure-server
ip classless
ip route 0.0.0.0 0.0.0.0 1.2.0.1
!
!
call rsvp-sync
!
voice-port 2/0
 disc_pi_off
 input gain 10
 output attenuation 10
 playout-delay minimum low
 cptone HK
 timing digit 53
 description cflow1
 music-threshold -50
 bearer-cap Speech
 station-id name ashoowin
 station-id number 1000
 caller-id enable
 ren 3
 disconnect-ack
!
voice-port 2/1
 disc_pi_off
 input gain 10
 output attenuation 10
 playout-delay minimum low
 cptone HK
 timing digit 53
```

```
  description cflow1
  music-threshold -50
  bearer-cap Speech
  station-id name ashwin
  station-id number 1000
  caller-id enable
  ren 3
  disconnect-ack
!
voice-port 2/2
 cptone HK
!
voice-port 2/3
 cptone HK
!
voice-port 2/4
 cptone HK
!
voice-port 2/5
 cptone HK
!
voice-port 2/6
 cptone HK
!
voice-port 2/7
 cptone HK
!
voice-port 2/8
 cptone HK
!
voice-port 2/9
 cptone HK
!
voice-port 2/10
 cptone HK
!
voice-port 2/11
!
voice-port 2/12
!
voice-port 2/13
!
voice-port 2/14
!
voice-port 2/15
!
voice-port 2/16
!
voice-port 2/17
!
voice-port 2/18
!
voice-port 2/19
!
voice-port 2/20
!
voice-port 2/21
!
voice-port 2/22
!
voice-port 2/23
!
mgcp profile default
!
```

```
dial-peer cor custom
!
!
dial-peer voice 1 pots
 destination-pattern 1000
 port 2/0
!
dial-peer voice 2 pots
 destination-pattern 2000
 port 2/1
!
dial-peer voice 3 pots
 destination-pattern 1002
 port 2/2
!
dial-peer voice 4 pots
 destination-pattern 1003
 port 2/3
!
dial-peer voice 5 pots
 destination-pattern 1004
 port 2/4
!
dial-peer voice 6 pots
 destination-pattern 1005
 port 2/5
!
dial-peer voice 10 voip
 destination-pattern 2...
 session target ipv4:1.2.125.57
 codec g711ulaw
!
dial-peer voice 7 pots
 destination-pattern 1006
 port 2/6
!
dial-peer voice 8 pots
 destination-pattern 1007
 port 2/7
!
dial-peer voice 9 pots
 destination-pattern 1008
 port 2/8
!
dial-peer voice 11 pots
 destination-pattern 1009
 port 2/9
!
dial-peer voice 12 pots
 destination-pattern 1010
 port 2/10
!
line con 0
 exec-timeout 0 0
 speed 115200
line aux 0
line vty 0 4
 login
!
end
```

Sample Configuration: Cisco 2431-1T1/E1 with WIC-2T

```
Current configuration : 1755 bytes
!
version 12.4(1)T
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname 2431-2T1/E1-1
!
logging queue-limit 100
logging buffered 10000000 debugging
no logging console
!
network-clock-select 1 T1 1/0
ip subnet-zero
!
!
!
backhaul-session-manager
  set vsc1_set client nft
  group vsc1_grp set vsc1_set
isdn switch-type primary-ni
!
!
!
no voice hpi capture buffer
no voice hpi capture destination
!
!
mta receive maximum-recipients 0
!
!
controller T1 1/0
shutdown
 framing sf
 linecode ami
 channel-group 0 timeslots 1-24
!
controller T1 1/1
mode cas
 framing esf
 linecode b8zs
 ds0-group 1 timeslots 1-24 type e&m-wink-start
!
!
!
interface Multilink1
 ip address 10.1.1.1 255.255.0.0
 ppp multilink
 multilink-group 1
!
interface FastEthernet0/0
 ip address 1.3.21.56 255.255.0.0
 duplex auto
 speed auto
 ip rsvp bandwidth 1 1
!
interface Serial0/0
 no ip address
 encapsulation frame-relay
 clockrate 2000000
```

```
!
interface FastEthernet0/1
 no ip address
 shutdown
 duplex auto
 speed auto
!
interface Serial0/1
 no ip address
 encapsulation ppp
 shutdown
 clockrate 2000000
 ppp multilink
 multilink-group 1
!
interface Serial1/0:0
 no ip address
 encapsulation ppp
 no logging event link-status
 ppp multilink
 multilink-group 1
!
ip http server
ip classless
ip route 223.255.254.254 255.255.255.255 FastEthernet0/0
!
!
access-list 101 permit ip host 10.1.1.1 host 10.1.1.2
no cdp run
!
!
call rsvp-sync
!
voice-port 1/1:1
!
mgcp
mgcp call-agent 1.3.37.1 service-type sgcp version 1.5
mgcp quarantine mode process loop
mgcp timer receive-rtcp 2
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 1 voip
 destination-pattern 408....
 session target ipv4:1.3.21.54
!
dial-peer voice 2 pots
 application mgcpapp
 incoming called-number 408....
 port 1/1:1
!
!
line con 0
 exec-timeout 0 0
 speed 115200
line aux 0
line vty 0 4
 login
!
end
```

Sample Configuration: Cisco 2432-24FXS with VIC2-4FXO and QoS

```
Current configuration : 3807 bytes
!
version 12.4(1)T
service timestamps debug datetime msec
service timestamps log datetime msec
no service password-encryption
!
hostname 2432-24-2T1/E1-2
!
logging queue-limit 100
logging buffered 5000 debugging
no logging console
!
ip subnet-zero
!
!
ip cef
no ip domain lookup
!
!
!
no voice hpi capture buffer
no voice hpi capture destination
!
!
mta receive maximum-recipients 0
!
!
controller T1 1/0
shutdown
 framing sf
 clock source internal
 linecode ami
 channel-group 1 timeslots 1-12 speed 64
!
controller T1 1/1
framing esf
 clock source internal
 linecode b8zs
 channel-group 1 timeslots 1-12 speed 64
!
 class-map match-all control
  match ip dscp af31
 class-map match-all voice
  match ip dscp ef
!
!
 policy-map CORP-POLICY
  class voice
   priority percent 45
  class control
   bandwidth percent 10
  class class-default
   fair-queue
!
!
!
interface Multilink1
```

```
     ip address 12.12.0.1 255.255.0.0
     service-policy output CORP-POLICY
     ip tcp header-compression iphc-format
     load-interval 30
     no cdp enable
     ppp multilink
     ppp multilink fragment-delay 10
     ppp multilink interleave
     multilink-group 1
     ip rtp header-compression iphc-format
     ip rtp compression-connections 1000
    !
    interface FastEthernet0/0
     ip address 1.3.21.57 255.255.0.0
     load-interval 30
     duplex auto
     speed auto
    !
    interface FastEthernet0/1
     no ip address
     shutdown
     duplex auto
     speed auto
    !
    interface Serial1/0:1
     bandwidth 768
     no ip address
     encapsulation ppp
     load-interval 30
     ppp multilink
     multilink-group 1
    !
    interface Serial1/1:1
     bandwidth 768
     no ip address
     encapsulation ppp
     load-interval 30
     ppp multilink
     multilink-group 1
    !
    ip http server
    ip classless
    ip route 1.3.0.0 255.255.255.0 FastEthernet0/0
    ip route 10.2.0.0 255.255.0.0 Multilink1
    ip route 10.2.0.0 255.255.0.0 12.12.0.2
    !
    !
    !
    call threshold global cpu-5sec low 80 high 90 treatment
    call threshold global cpu-avg low 80 high 90 treatment
    call threshold global total-mem low 80 high 90 treatment
    call threshold global io-mem low 80 high 90 treatment
    call threshold global proc-mem low 80 high 90 treatment
    call threshold global total-calls low 10 high 12 treatment
    call rsvp-sync
    !
    voice-port 0/0
     battery-reversal answer
    !
    voice-port 0/1
     battery-reversal answer
    !
    voice-port 0/2
     battery-reversal answer
```

```
!
voice-port 0/3
 battery-reversal answer
!
voice-port 2/0
!
voice-port 2/1
!
voice-port 2/2
!
voice-port 2/3
!
voice-port 2/4
!
voice-port 2/5
!
voice-port 2/6
!
voice-port 2/7
!
voice-port 2/8
!
voice-port 2/9
!
voice-port 2/10
!
voice-port 2/11
!
voice-port 2/12
!
voice-port 2/13
!
voice-port 2/14
!
voice-port 2/15
!
voice-port 2/16
!
voice-port 2/17
!
voice-port 2/18
!
voice-port 2/19
!
voice-port 2/20
!
voice-port 2/21
!
voice-port 2/22
!
voice-port 2/23
!
mgcp
mgcp call-agent 1.3.37.1 service-type mgcp version 1.0
mgcp src-cac
no mgcp piggyback message
!
mgcp profile default
!
dial-peer cor custom
!
!
!
dial-peer voice 1 voip
```

```
                     incoming called-number 4088...
                     destination-pattern 4089...
                     session target ipv4:12.12.0.2
                     codec g711ulaw
                     no vad
                    !
                    dial-peer voice 2 pots
                     destination-pattern 4088001
                     port 2/0
                    !
                    dial-peer voice 3 pots
                     destination-pattern 4088002
                     port 2/1
                    !
                    dial-peer voice 4 pots
                     destination-pattern 4088003
                     port 2/2
                    !
                    dial-peer voice 5 pots
                     destination-pattern 4088004
                     port 2/3
                    !
                    dial-peer voice 6 pots
                     destination-pattern 4088005
                     port 2/4
                    !
                    dial-peer voice 7 pots
                     destination-pattern 4088006
                     port 2/5
                    !
                    dial-peer voice 8 pots
                     destination-pattern 4088007
                     port 2/6
                    !
                    dial-peer voice 9 pots
                     destination-pattern 4088008
                     port 2/7
                    !
                    dial-peer voice 10 pots
                     destination-pattern 4088009
                     port 2/8
                    !
                    dial-peer voice 11 pots
                     destination-pattern 4088010
                     port 2/9
                    !
                    !
                    line con 0
                     exec-timeout 0 0
                     logging synchronous
                     speed 115200
                    line aux 0
                    line vty 0 4
                     exec-timeout 0 0
                     login
                    !
                    !
                    end
```

Formatting the Flash Memory

This appendix describes how to format the 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 the standard DOS file system. It also describes how to perform file and directory operations in each file system.

> **Note** The IAD2435 IAD does not support LEFS, but supports Disk Operating System Filing System (DOSFS) and refers to internal compact flash as flash only.

This appendix presents the following major topics:

- Formatting Procedures for Flash Memory, page B-1
- File and Directory Operations, page B-5

For additional information on formatting flash memory, see the Maintaining System Memory section in the *Cisco IOS Configuration Fundamentals Configuration Guide, Release 12.2* document.

Formatting Procedures for Flash Memory

The following sections show formatting procedures for internal and external flash memory.

Formatting Procedures

We recommend that you erase (Class B) or format (Class C) new flash memory 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 memory.

> **Note** Flash memory that is formatted with the standard DOS file system does not support booting from the ROM monitor.

Determining the File System on Flash Memory

To determine the file system of external flash memory, enter the **show slot0: all** command.

> **Note** **slot0** is not supported on the IAD2435 IAD.

To determine the file system of internal flash memory, 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 sample 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 Flash directory:
File  Length    Name/status
        addr      fcksum  ccksum
  1   6658376   c2430-is-mz
        0x40      0xE0FF  0xE0FF
[6658440 bytes used, 25454200 available, 32112640 total]
31360K bytes of ATA Slot0 Flash (Read/Write)

 Chip information NOT available.
```

✎

Note   **slot0** is not supported on the IAD2435 IAD.

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 2008 04:27:46 c2430-is-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
```

Note   **slot0** is not supported on the IAD2435 IAD.

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 Flash directory:
File  Length    Name/status
         addr      fcksum  ccksum
  1   6658376   c2430-is-mz
         0x40      0xE0FF  0xE0FF
  2   14221136  c2430-telcoent-mz
         0x6599C8  0x5C3D  0x5C3D
[20879640 bytes used, 107308776 available, 128188416 total]
125184K bytes of ATA System Flash (Read/Write)

 Chip information NOT available.
```

Internal Card with Class C Flash File System

The geometry and format information is displayed in this format:

```
11# show flash: all

-#- --length-- -----date/time------ path
1      6658376 Mar 01 2008 04:27:46 c2430-is-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 Flash Memory as a Class B Flash File System

Use these formatting commands to:

- Format flash memory with a Class B flash file system (LEFS)

- Remove the files from flash memory previously formatted with a Class B flash file system

For external flash memory, enter the **erase slot0:** command.

Note **slot0** is not supported on the IAD2435 IAD.

Note The IAD2435 IAD supports the class C file system.

For internal flash memory, enter the **erase flash:** command.

The following example shows sample output for formatting an external flash memory 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...
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
eeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
...erased
Erase of slot0: complete
```

Formatting Flash Memory as a Class C File System

Use these formatting commands to do the following:

- Format flash memory with a Class C flash file system
- Remove the files from flash memory previously formatted with a Class C flash file system

Note The IAD2435 IAD supports the class C file system.

For external flash memory, enter the **format slot0:** command.

Note **slot0** is not supported on the IAD2435 IAD.

For internal flash memory, enter the **format flash:** command.

Note The IAD2435 IAD does not support LEFS, but supports Disk Operating System Filing System (DOSFS) and refers to internal compact flash as flash only.

The following example shows sample output for formatting an internal flash memory 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 show file and directory operations for internal and external Cisco flash memory. 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 flash memory formatted with a Class B flash file system.

Copying Files

To copy files to another location, enter the **copy** {**flash:** | **slot0:**} command.

Note   **slot0** is not supported on the IAD2435 IAD.

The following example shows sample output for copying a Cisco IOS file from an internal flash memory (**flash:**) to an external flash memory (**slot0:**):

```
Router# copy flash:c2430-is-mz.tmp slot0:

Destination filename [c2430-is-mz.tmp]?
Erase slot0:before copying?
[confirm]nCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
Verifying checksum...  OK (0xC68E)
6458584 bytes copied in 67.788 secs (96396 bytes/sec)
```

The following example shows sample output for copying a configuration file to the startup configuration in an internal flash memory (**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 sample output for copying a configuration file to the running configuration in an internal flash memory (**flash:**):

```
Router# copy flash:my-config2 running-config

Destination filename [running-config]?
```

```
709 bytes copied in 0.72 secs
```

Displaying the Contents of Flash Memory

To display the contents (directories and files) of flash memory formatted with a Class B flash file system, enter the **dir** {**flash:** | **slot0:**} command or the **show** {**flash:** | **slot0:**} command.

The following example shows sample output for displaying the contents of an internal flash memory using the **dir flash:** command:

```
Router# dir flash:

Directory of flash:/

    1  -rw-    5190020                <no date>  c2430-is-mz
    2  -rw-    6458584                <no date>  c2430-is-mz
    3  -rw-   16535740                <no date>  c2430-telcoent-mz

128450560 bytes total (100266024 bytes free)
```

The following example shows sample output for displaying the contents of external flash memory using the **show slot0:** command:

```
Router# show slot0:

System Flash directory:
File  Length   Name/status
   1   5190020  c2430-is-mz
   2   6458584  c2430-is-mz
   3   16535740  c2430-telcoent-mz
[28184536 bytes used, 100266024 available, 128450560 total]
125440K bytes of ATA System Flash (Read/Write)
```

Delete Files from Flash Memory

To delete a file from flash memory, enter the **delete** {**flash:** | **slot0:**} command, followed by the **squeeze** {**flash:** | **slot0:**} command.

Note   **slot0** is not supported on the IAD2435 IAD.

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 sample output for deleting a Cisco IOS file from external flash memory, and then releasing the memory space originally occupied by the file:

```
Router# dir slot0:

Directory of slot0:/

    1  -rw-    6458208                <no date>  c2430-is-mz.tmp
    2  -rw-    6458208                <no date>  c2430-is-mz

16056320 bytes total (3139776 bytes free)
```

```
Router# delete slot0:c2430-is-mz.tmp

Delete filename [c2430-is-mz.tmp]?
Delete slot0:c2430-is-mz.tmp? [confirm]

Router# dir slot0:

Directory of slot0:/

    2  -rw-    6458208              <no date>  c2430-is-mz

16056320 bytes total (3139776 bytes free)

Router# show slot0:

Slot0 Flash directory:
File  Length   Name/status
   1  6458208  c2430-is-mz.tmp [deleted]
   2  6458208  c2430-is-mz
[12916544 bytes used, 3139776 available, 16056320 total]
15680K bytes of ATA Slot0 Flash (Read/Write)

Router# squeeze slot0:

Squeeze operation may take a while. Continue? [confirm]
squeeze in progress...
sssssssssssssssssssssssseeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeeee
Rebuild file system directory...
Squeeze of slot0 complete
```

Note **slot0** is not supported on the IAD2435 IAD.

Displaying File Content

To display the content of a file in flash memory, use the **more** {**flash:** | **slot0:**} command.

The following example shows sample output from the **more** {**flash:** | **slot0:**} command on external Cisco flash memory:

```
Router# more slot0:c2430-is-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 flash memory formatted with a Class C flash file system.

File Operations for Class C Flash File System

Copying Files

To copy files to another location, enter the **copy** {**flash:** | **slot0:**} command.

> **Note**   **slot0** is not supported on the IAD2435 IAD.

The following example shows sample output for copying a Cisco IOS file from an external flash memory to internal flash memory:

```
Router# copy slot0:c2430-is-mz.tmp flash:

Destination filename [c2430-is-mz.tmp]?
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
6458584 bytes copied in 202.940 secs (31973 bytes/sec)
```

The following example shows sample output for copying a configuration file to the startup configuration in internal flash memory (`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 sample output for copying a configuration file to the running configuration in internal flash memory (`flash:`):

```
Router# copy flash:my-config2 running-config

Destination filename [running-config]?
709 bytes copied in 0.72 secs
```

Displaying the Contents of Flash Memory

To display the contents (directories and files) of flash memory formatted with a Class C flash file system, use the **dir**{**flash:** | **slot0:**} or **show** {**flash:** | **slot0:**} command.

The following examples show sample outputs for displaying the contents of an external flash memory with a Class C flash file system:

```
Router# dir slot0:

Directory of slot0:/
```

```
    3  -rw-     6455048   Mar 01 2001 00:04:06  c2430-is-mz
1579  -rw-     6458584   Mar 01 2001 00:24:38  c2430-is-mz.new

15912960 bytes total (2998272 bytes free)


Router# show slot0:

-#- --length-- -----date/time------ path
1      6658376 Mar 01 1993 00:29:52 c2430-is-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)
```

Displaying Geometry and Format Information

To display the geometry and format information of flash memory formatted with a Class C flash file system, use the **show** {**flash:** | **slot0:**} **filesys** command.

The following example shows sample output for displaying the geometry and format information of external Cisco flash memory:

```
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 Flash Memory

To delete a file from flash memory, use the **delete** {**flash:** | **slot0:**} command.

The following example shows sample output for deleting a Cisco IOS file from internal flash memory:

```
Router# delete flash:c2430-is-mz.tmp

Delete filename [c2430-is-mz.tmp]?
Delete flash:c2430-is-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 flash memory, use the **rename** {**flash:** | **slot0:**} command.

The following example shows sample output for renaming a Cisco IOS file in internal flash memory:

```
Router# dir flash:

Directory of flash:/

    3  -rw-     6458388   Mar 01 1993 00:00:58  c2430-is-mz.tmp
 1580  -rw-     6462268   Mar 06 1993 06:14:02  c2430-is-mz.3600ata

63930368 bytes total (51007488 bytes free)

Router# rename flash:c2430-is-mz.tmp flash:c2430-is-mz

Destination filename [c2430-is-mz]?

Router# dir flash:

Directory of flash:/

 1580  -rw-     6462268   Mar 06 1993 06:14:02  c2430-is-mz.3600ata
    3  -rw-     6458388   Mar 01 1993 00:01:24  c2430-is-mz

63930368 bytes total (51007488 bytes free)
```

Displaying File Content

To display the content of a file in flash memory, use the **more** {**flash:** | **slot0:**} command.

The following example shows sample output from using the **more** {**flash:** | **slot0:**} command to display the contents of an internal flash card:

```
Router# more flash:c2430-is-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 flash memory, use the **mkdir** {**flash:** | **slot0:**} command.

The following example shows sample output for first displaying the contents of an internal 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 2008 00:04:08  c2430-is-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 2008 00:04:08  c2430-is-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 2008 23:50:08  test-config

128094208 bytes total (121626624 bytes free)
```

Remove a Directory

To remove a directory from 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 sample output for displaying the contents of an internal flash card, and then removing the subdirectory named **test-config**:

```
Router# dir flash:

Directory of flash:/config/

 1581  drw-        0   Mar 01 2008 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 flash memory, use the **cd** command.

To determine which directory you are in, use the **pwd** command.

If you enter only **cd**, you will go to the default home directory, which is **flash:/**.

The following example shows sample output, respectively, for the following actions:

- Entering the home directory (**flash:/**) of flash memory in an internal slot
- 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 flash memory 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 2008 00:04:08  c2430-is-mz.tmp
 1580  drw-           0   Mar 01 2008 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 IAD2430 series integrated access device (IAD). 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 that you encounter while installing your router.

This appendix contains the following sections:

Entering the ROM Monitor Mode

To use the ROM monitor, you must be using a terminal or PC that is connected to the router over the console port.

Perform these steps to configure the router to boot up in ROM monitor mode the next time it is rebooted.

SUMMARY STEPS

1. **enable**
2. **configure terminal**
3. **config-register** *value*
4. **exit**
5. **reload**

DETAILED STEPS

	Command or Action	**Purpose**
Step 1	**enable** **Example:** VG# enable	Enters privileged EXEC mode.
Step 2	**configure terminal** **Example:** VG# configure terminal	Enters global configuration mode.
Step 3	**config-register** *value* **Example:** VG(config)# config-register 0x2102	Resets the configuration register settings.
Step 4	**exit** **Example:** VG(config)# exit	Exits to global configuration mode.
Step 5	**reload** **Example:** VG# reload	Reboots the voice gateway with the new configuration register value. The voice gateway remains in ROM monitor and does not boot the Cisco IOS software. As long as the configuration value is 0x0, you must manually boot the operating system from the console. See the **boot** command in the "Command Descriptions" section in this appendix. After the voice gateway reboots, it is in ROM monitor mode. The number in the prompt increments with each new line.

Timesaver   Break (system interrupt) is always enabled for 60 seconds after the router reboots, regardless of whether it is set to on or off in the configuration register. During this 60-second window, you can break to the ROM monitor prompt by pressing the Break key.

ROM Monitor Commands

Enter **?** or **help** at the ROM monitor prompt to display a list of available commands and options, as follows:

```
rommon 1 > ?
alias             set and display aliases command
boot              boot up an external process
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 directories-dir <directory>
dis              display instruction stream
frame            print out a selected stack frame
help             monitor builtin command help
history          monitor command history
iomemset         Set IO memory percent
meminfo          main memory information
repeat           repeat a monitor command
reset            system reset
rommon-pref      Select ROMMON
set              display the monitor variables
showmon          Display currently selected ROM monitor
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 1 >
```

Commands are case sensitive. You can halt any command by pressing the Break key on a terminal. If you are using a PC, most terminal emulation programs halt a command when you press the Ctrl and the Break keys at the same time. If you are using another type of terminal emulator or terminal emulation software, see the documentation for that product for information on how to send a Break command.

Command Descriptions

Table C-1 describes the most commonly used ROM monitor commands.

Table C-1   Commonly Used ROM Monitor Commands

Command	Description
help or **?**	Displays a summary of all available ROM monitor commands.

-?	Displays information about command syntax; for example:
	
	```rommon 16 > dis -?```
	```usage : dis [addr] [length]```
	
	The output for this command is slightly different for the **xmodem** download command:
	
	```rommon 11 > xmodem -?```
	```xmodem: illegal option -- ?```
	```usage: xmodem [-cyrxu] <destination filename>```
	```-c CRC-16```
	```-y ymodem-batch protocol```
	```-r copy image to dram for launch```
	```-x do not launch on download completion```
	```-u upgrade ROMMON, System will reboot after upgrade```

reset or **i**	Resets and initializes the router, similar to a power up.

Table C-1   Commonly Used ROM Monitor Commands (continued)

Command	Description

dir *device***:**	Lists the files on the named device; for example:
	
	`rommon 5 > `**`dir flash`**`:`
	`Directory of flash:`
	
	`2 1343152 -rw- c2430-advipservices-k9.mz`
	`rommon 6 >`

meminfo	Lists the main memory information; for example:
	
	`rommon 6 > `**`meminfo`**`:`
	
	`Main memory size: 256 MB.`
	`Available main memory starts at 0x80018000, size 262048 KB`
	`IO (packet) memory size: 5 percent of main memory`
	`NVRAM size: 256 KB`

boot commands	For more information about the ROM monitor boot commands, see the *Cisco IOS Configuration Fundamentals and Network Management Guide*.
b	Boots the first image in flash memory.
b flash: [*filename*]	Attempts to boot the image directly from the first partition of flash memory. If you do not enter a filename, this command will boot this first image in flash memory.

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 -r**—Use this if you have a TFTP server directly connected to a Fast Ethernet port.

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 argument *filename* specifies the source file containing the Cisco IOS image.

Other options include the following:

- **-c**—Use cyclic redundancy check (CRC-16).
- **-y**—Use Ymodem transfer protocol.
- **-r**—Copy the image to DRAM for launch.
- **-x**—Do not launch image on completion of download.

Note   The IAD2435 IAD ROMMON supports only **-c** and **-y**.

Using the tftpdnld -r Command

The **tftpdnld -r** command downloads a Cisco IOS software image from a remote server into flash memory using TFTP.

tftpdnld -r—Begins the TFTP copy command.

The following variables are required:

- IP_ADDRESS—The IP address for the router you are using.
- IP_SUBNET_MASK—The subnet mask for the router you are using.
- DEFAULT_GATEWAY—The default gateway for the router you are using.
- TFTP_SERVER—The IP address of the server from which you want to download the image file.
- TFTP_FILE—The 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.
- FE_PORT—Selects the FE Port for **tftpdnld** download. 0=FE 0,1=FE 1. If FE_PORT variable is not mentioned then FE 0 will be used as default.

The syntax for specifying the variables is:

```
VARIABLE_NAME=value
```

After you specify the variables, you must reenter the **tftpdnld -r** command. For example:

```
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/c2430-i-mz
rommon 7 > TFTP_VERBOSE=1
rommon 8 > tftpdnld -r

    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/2430-i-mz
    TFTP_VERBOSE=1

Invoke this command for disaster recovery only.
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.

Configuration Register

The virtual configuration register is in nonvolatile RAM (NVRAM) and has the same functionality as other Cisco routers. You can view or modify the virtual configuration register from either the ROM monitor or the operating system software. Within the ROM monitor, you can change the configuration register by entering the register value in hexadecimal format, or by allowing the ROM monitor to prompt you for the setting of each bit.

Changing the Configuration Register Manually

To change the virtual configuration register from the ROM monitor manually, enter the **confreg** command followed by the new value of the register in hexadecimal format, as shown in the following example:

```
rommon 1 > confreg 0x2101


You must reset or power cycle for new config to take effect
rommon 2 >
```

The value is always interpreted as hexadecimal. The new virtual configuration register value is written into NVRAM but does not take effect until you reset or reboot the router.

Changing the Configuration Register Using Prompts

Entering the **confreg** command without an argument displays the contents of the virtual configuration register and a prompt 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 does not take effect until you reset or reboot the router.

The following display shows an example of entering the **confreg** command:

```
rommon 7> confreg

    Configuration Summary
enabled are:
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]:
enable  "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  [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
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
```

Console Download

You can use console download, which is a ROM monitor function, to download either a software image or a configuration file over the router console port. After download, the file is either saved to the mini-flash memory module or to main memory for execution (image files only).

Use console download when you do not have access to a TFTP server.

> **Note**   If you want to download a software image or a configuration file to the router over the console port, you must use the ROM monitor **dnld** command.

> **Note**   If you are using a PC to download a Cisco IOS image over the router console port at 115,200 bps, ensure that the PC serial port is using a 16550 universal asynchronous transmitter/receiver (UART). If the PC serial port is not using a 16550 UART, we recommend using a speed of 38,400 bps or less when downloading a Cisco IOS image over the console port.

Command Description

The following are the syntax and descriptions for the **xmodem** console download command:

xmodem [-cyrx] *destination_file_name*

c	Optional. Performs the download using 16-bit cyclic redundancy check (CRC-16) error checking to validate packets. Default is 8-bit CRC. **Note** The IAD2435 IAD only supports **c** and **y**.
y	Optional. Sets the router to perform the download using Ymodem protocol. The default is Xmodem protocol. The protocols differ as follows: • Xmodem supports a 128-block transfer size. Ymodem supports a 1024-block transfer size. • Ymodem uses CRC-16 error checking to validate each packet. Depending on the device that the software is being downloaded from, this function might not be supported by Xmodem. **Note** The IAD2435 IAD only supports **c** and **y**.
r	Optional. Image is loaded into DRAM for execution. The default is to load the image into flash memory.

x	Optional. Image is loaded into DRAM without being executed.
destination_file_name	Name of the system image file or the system configuration file. In order for the router to recognize it, the name of the configuration file must be *router_confg*.

Follow these steps to run Xmodem:

Step 1   Move the image file to the local drive where Xmodem will execute.

Step 2   Enter the **xmodem** command.

Error Reporting

Because the ROM monitor console download uses the console to perform the data transfer, when an error occurs during a data transfer, error messages are only displayed on the console once the data transfer is terminated.

If you have changed the baud rate from the default rate, the error message is followed by a message telling you to restore the terminal to the baud rate specified in the configuration register.

Debug Commands

Most ROM monitor debugging commands are functional only when Cisco IOS software has crashed or is halted. If you enter a debugging command and Cisco IOS crash information is not available, you see the following error message:

```
"xxx: kernel context state is invalid, can not proceed."
```

The following are ROM monitor debugging commands:

- **stack** or **k**—Produces a stack trace; for example:

```
rommon 6> stack
Stack trace:
PC = 0x801111b0
Frame 00: FP = 0x80005ea8    PC = 0x801111b0
Frame 01: FP = 0x80005eb4    PC = 0x80113694
Frame 02: FP = 0x80005f74    PC = 0x8010eb44
Frame 03: FP = 0x80005f9c    PC = 0x80008118
Frame 04: FP = 0x80005fac    PC = 0x80008064
Frame 05: FP = 0x80005fc4    PC = 0xfff03d70
```

- **context**—Displays processor context; for example:

```
rommon 7> context
CPU context of the most recent exception:
PC  = 0x801111b0  MSR = 0x00009032  CR  = 0x53000035  LR    = 0x80113694
CTR = 0x801065e4  XER = 0xa0006d36  DAR = 0xffffffff  DSISR = 0xffffffff
DEC = 0xffffffff  TBU = 0xffffffff  TBL = 0xffffffff  IMMR  = 0xffffffff
R0  = 0x00000000  R1  = 0x80005ea8  R2  = 0xffffffff  R3    = 0x00000000
R4  = 0x8fab0d76  R5  = 0x80657d00  R6  = 0x80570000  R7    = 0x80570000
R8  = 0x00000000  R9  = 0x80570000  R10 = 0x0000954c  R11   = 0x00000000
R12 = 0x00000080  R13 = 0xffffffff  R14 = 0xffffffff  R15   = 0xffffffff
R16 = 0xffffffff  R17 = 0xffffffff  R18 = 0xffffffff  R19   = 0xffffffff
R20 = 0xffffffff  R21 = 0xffffffff  R22 = 0xffffffff  R23   = 0xffffffff
```

```
R24 = 0xffffffff  R25 = 0xffffffff  R26 = 0xffffffff  R27  = 0xffffffff
R28 = 0xffffffff  R29 = 0xffffffff  R30 = 0xffffffff  R31  = 0xffffffff
```

- **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: user break
pc:0x801111b0,  error address: 0x801111b0
Stack Trace:
FP: 0x80005ea8, PC: 0x801111b0
FP: 0x80005eb4, PC: 0x80113694
FP: 0x80005f74, PC: 0x8010eb44
FP: 0x80005f9c, PC: 0x80008118
FP: 0x80005fac, PC: 0x80008064
FP: 0x80005fc4, PC: 0xfff03d70
FP: 0x80005ffc, PC: 0x00000000
FP: 0x00000000, PC: 0x00000000
```

- **meminfo**—Displays size in bytes, starting address, available range of main memory, the starting point and size of packet memory, and size of NVRAM; for example:

```
rommon 9> meminfo
Main memory size: 40 MB.
Available main memory starts at 0x10000, size 40896KB
IO (packet) memory size: 5 percent of main memory.
NVRAM size: 32KB
```

Exiting the ROM Monitor

You must set the configuration register to a value from 0x2 to 0xF for the router to boot a Cisco IOS image from flash memory upon startup or reloading.

The following example shows how to reset the configuration register and cause the router to boot a Cisco IOS image stored in flash memory:

```
rommon 1 > confreg 0x2101
```

You must reset or power cycle for new config to take effect:

```
rommon 2 > boot
```

The router will boot the Cisco IOS image in flash memory. The configuration register will change to 0x2101 the next time the router is reset or power cycled.

I N D E X

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